

# The 19th International Conference on Industrial Engineering and Engineering Management

Ershi Qi · Jiang Shen · Runliang Dou  
Editors

# The 19th International Conference on Industrial Engineering and Engineering Management

Engineering Economics Management

*Editors*

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# Chapter 1

## A Study of Research and Application of Credit Scoring Model Based on Probit Model

Da Ren, Maodong Hou and Huan Li

**Abstract** As the main content of the credit risk management, Credit rating has significant research value. China's current use of credit scoring method is too subjective and unable to adapt to the fierce competition in the banking sector. In connection with the weak ability of risk identification of Chinese commercial banks, paper use the Probit regression to build credit scoring models, calculate the probability of default of each customer, divide the customers into two categories, and then test the classification results with ROC curve. The conclusion of the paper shows that the Probit—based credit scoring models can be effective to identify the risk of a manufacturing enterprise, and it is suitable for China's commercial banks to assess corporate lending credit risk.

**Keywords** The management of credit risks · Probit regression · Credit rating · Risk identification

### 1.1 Introduction

As the basis of market economy, credit system impacts on the development of market economy seriously. The financial crises of 2008 make credit risk an urgent problem to the market economy countries. As the most main type, credit risk is being the greatest issue of current financial community. With the development of the economic environment, commercial banks are forced by the fierce market competition to find a fast and accurate credit mechanism to take place of artificial credit. And the credit scoring has been developed in the internal needs of such credit institutions. The CBRC released the China Banking Regulatory Committee Issuing the Guidelines on the Implementation of New Capital Accord provides that

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large domestic commercial banks should finish the model of credit risk and market risk to measure the credit risk, market risk and the operational risk. Since differences in the business and data of different banks limits the general applicability of the model of credit rating, the banks should build the credit scoring models suited to the development of their business needs based on their own business characters and the data their got. The credit decision is mainly depend on artificial subjective judgments which are complicated, low efficiency, and high cost, and this influences the accuracy and objectivity of credit decisions. Accordingly, the study of the credit scoring model has great theoretical and practical significance.

## 1.2 The Current Research Status

The foreign scholars expanded credit scoring models to the evaluation of small sample and individual consumers, and not only limited to the improvement of the model, but also dedicated to the examination of the perfect combination of technology and model (Thomas and Edelman 2002; Good 2005; Rosenberg and Gleit 1994) Summarized the common credit scoring models and introduced the applications. Marshall and Milne (2010), Potter (2005), Fitzmaurice et al. (2007) builded the the corresponding non-linear regression model and verified the results by permutation test base on the Unbalanced sample data. Vladimir et al. (2002) created the credit evaluation model based on the quadratic utility function. Musto and Souleles (2005) built a portfolio model; Gross and Souleles (2000) built a nonlinear regression method. They also tried to explain that how does the psychology and behavior of consumers influence the results of credit scoring, and the study found that liabilities affect the application of credits greatly. Deyoung et al. (2008) built the scoring models based on the Differences between the loaner and loanee in SME Loan Financial Information and the behavior of loaners, and this model has a higher ability to identify the risk of default of the SME.

The study of the credit scoring system in china is relatively late, and it is at the stage of study and research; some scholars make effort to SME credit scoring models. Hui (2001) and some others studied the new research and development of key technologies of personal credit scoring; Lin (2006), Du (2008), Chen (2005) and so on studied the mature credit scoring system in the U.S., and summed up the development process of credit scoring model; Li (2009) built the a credit scoring system which suit to China based on the summery of credit evaluation index system and method; Dong (2007) proposed small business credit scoring can improve the availability of small-scale loans greatly by reducing information asymmetry effectively. Wu (2005) analyzed the application and impact of credit scoring in the field of SME loans, and provided the advices to solve the difficulty of SME loans and development. Cheng (2003) explored the method to measure the SME credit and set up the evaluation index system preliminary by analyzing the characteristics of High-tech SMEs. Ziyi and Zhao (2005) built the SME credit scoring model based on financial position, and quantification of information of

enterprises and their head, and this provided reference to measure credit risk accurately and low-cost for banks. Guan and Zongxian (2004) built and explored the Default prediction model as sub-scale and sub-regional sample specially for manufacturing industry enterprises based on a massive database of loans to businesses across financial institutions on national. Sun (2007) compared the accuracies of many kinds of default prediction of credit risk models by constructing accuracy ratio and conditional information entropy, and found that Nonlinear models have higher default prediction accuracy at the end. Cheng and Lian (2007) modeled credit scoring system with the ROC curve and the Transformation of Variable array that different with the method used in China before.

With the development of computer technology, artificial intelligence methods began to be used on the commercial banks' credit ratings, but the statistical method is still the core of the credit scoring model. The two main reasons are robustness and transparency. A part of the artificial intelligence methods get bad results when the characteristics of data change totally. What's more, the regulatory agencies require customers to give reasons for refusing customers credit application. But the "black case work" made by artificial intelligence can provide this information. In China, commercial banks started to use statistical methods such as logistic regression, linear regression, linear programming and classification tree. The logistic regression is used the most widely due to many advantages, but its accuracy is relatively low. As a generalized linear model like logistic regression, Probit-regression model has not been used widely until now, so there is no corresponding literature reference about discussion and comparison of this model. Accordingly, this paper introduces probit-regression into credit scoring, and tests its accuracy of prediction.

### 1.3 Index Selection and Data Collection

The Credit Risk Assessing Targets recognized internationally contain "5C", "5P", "LAPP" Pinson (1989), and the targets include the financial credit information such as credit history record, individual accounting recording, and debt intention. All these are developed on long-time accumulation of historical data, and have strong reliability. Whereas commercial banks in China have been built for a short time and the credit system is not perfect and lacks long-time accumulation of historical data, so the choice of credit targets depends on basic personal information more, such as age, gender, occupation, income and other factors. Specific indicators and the number depends on the data collected by banks.

The financial market seems to provide model vast amounts of data, but in fact, it is still hard to get many parts of data, and even the data got are maybe unable to get application. For the credit scoring model studied in this paper, commercial banks may focus more on the data of customers got the loan rather than the data of customers who have not got the loan, and defaulting customers of banks are only a small part on customers. This leads to customer type distribution is extremely

uneven. And serious imbalance of data will affect the accuracy of credit scoring model, which has become a common problem facing by all credit scoring models already. Chinese scholars believe that the ratio of good and bad sample have obvious effect on the estimation and efficiency of Logistic default probability model, and the ratio of 3:1 is more suit to the situation of china. Therefore, the ratio of 3:1 is the focus of this paper.

## 1.4 The Foundation of Model

### 1.4.1 Identification of Bad Sample

The attributes of the customers is the internal secret, and they are affected by a variety of outside factors such as the types of financial products. But it is important to define good and bad customers clearly and to keep accord with banks' credit policy and goal of risk management. Generally, quality customer, good sample, refers to the ones without default or with low risk of default during the observation window period; and the high-risk customer, bad sample, refers to the ones with default or delay and the ones refused by banks when propose a loan; the customers unable to be defined don't be included.

### 1.4.2 Probit Model

Probit-regression is mainly used to process the case that the dependent variable is Binary Choice, that is to say the dependent variable is 0 or 1. In the example of paper, the bad sample with default is defined as  $Y = 1$ , and the good sample without default is defined as  $Y = 0$ . Set  $P_i = p(y_i = 1|x_i)$ , it refers that the probability of  $y_i = 1$  under certain condition  $x_i$ . And  $1 - p_i$  is the probability of  $y_i = 0$  under certain condition  $x_i$ .

To define a continuous explanatory variable  $Y^*$ , set  $y_i^* = \alpha + x_i \beta + \varepsilon_i$ ,  $\varepsilon_i \sim N(0, 1)$  and when  $y_i^* > 0$ ,  $y_i = 1$ . Then  $p(y_i = 1|x_i) = p(y_i^* > 0) = p(\alpha + x_i \beta + \varepsilon_i > 0) = p(-\varepsilon_i > \alpha + x_i \beta) = \Phi(\alpha + x_i \beta) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\alpha+x_i\beta} e^{-\frac{t^2}{2}} dt = p_i$  where  $\Phi$  in the cumulative distribution function of the standard normal distribution, and this transformation is called the probit transformation.

Probit regression model uses maximum likelihood estimation method to calculate the coefficients. Set independent observations as samples, denoted as

$y_1 \dots y_n$ . Then the likelihood function is  $L = \prod_{i=1}^n p_i^{y_i} (1 - p_i)^{1-y_i}$ .

Take logarithm on both sides:

$$\begin{aligned}\ln L &= \ln \left[ \prod_{i=1}^n p_i^{y_i} (1 - p_i)^{1-y_i} \right] \\ &= \sum_{i=1}^n [y_i \ln(p_i) + (1-y_i) \ln(1 - p_i)]\end{aligned}$$

Take  $y_i^* = \alpha + x_i \beta + \varepsilon_i$  into above, then

$$\ln L = \sum_{i=1}^n \left[ y_i \ln \phi \left( \alpha + \sum_{j=1}^m \beta_j x_{ij} \right) + (1 - y_i) \ln \left( 1 - \phi \left( \alpha + \sum_{j=1}^m \beta_j x_{ij} \right) \right) \right].$$

For the log-likelihood function, work out the partial derivatives of  $\alpha$  and  $\beta_j$ , set them to 0, and then calculate the estimated values of the Simultaneous equations by iteration method. We can verify the result of modeling with data external samples.

### 1.4.3 Model Checking

To judge the merits of credit scoring models is the key of modeling. The testing of stability and accuracy of model is based on the performance of the credit scoring model to distinguish good customers and bad customers. In the paper, the ROC curve is used to measure the accuracy of the model.

The ROC, receiver operating characteristic curve, is also named feelings shaped curve.

For a classification problem, each sample two categories and there are Positive and Negative. To credit scoring, P means bad customers and N means good customers. Specificity = True Negative/N, this means the ratio that a good customer is correctly predict as a good customer; Sensitivity = True Positive/P, this means that a bad customer is correctly predict as a bad customer and Sensitivity is marked as TP rate. 1-specificity, marked as FP rate, which means a good customer is predict as a bad customer.

FP rate as X axis, and TP as Y axis, then we can get a ROC curve. On the ROC curve, The origin (0, 0) means that the correct rate of classifying P is 0, and also the rate of classifying N; (1,1) means that the correct rate of classifying P is 1, and also the rate of classifying N. The points on the diagonal means that these point represents right and wrong equal probability, which is random. The point should keep as far as possible from the diagonal. If points are close to the diagonal, it means that the result is better without random assortment, and this makes no sense. To rank the scores of sample as descending order, then set the classification criteria as the scoring after ranking. Then to mobile classification criteria, calculate the classification of samples, update TP and FP continuously until to get several

discrete classification points, and those points are connected together to be an approximate continuous ROC curve. The values of AUC are values represented on the ROC curve, and we can convert the classification result of the ROC curve into a specific value by calculating the size of the area under the ROC curve. The value of AUC is between 0 to 1, and when it is closer to 1, the larger the area under the ROC curve, which indicates that the classification result is better.

## 1.5 Numerical Experiments

### 1.5.1 Data Sources

The purpose of the paper is to verify the application of probit model in credit scoring model. Data sources come from the financial data of a certain manufacturing enterprise collected by a large state-owned commercial bank. After clearing missing data and abnormal data, there are 11922 remaining data. Among these, there are 11855 good samples, 67 bad samples, including 130 variables, marked as  $X_1, \dots, X_{130}$ .

The initial index system is exceptionally complicated, and there is a serious collinearity. Therefore, before modeling we must consider the 130 variables and remove significant correlational variables at first, and then filter the remaining variables. We often use cross tabulation to analyze, and determine the characteristic variables and feature items into the model by Weight of Evidence, WOE and Information Value, IV.

There are two purpose of the experiment in the paper. Firstly, to verify the better judgment ability of model with the ratio of good and bad samples that is 3:1. Secondly, to verify that the WOE value got from Weight of Evidence is better than the value got from the model with original indexes.

### 1.5.2 Full Sample Model

There are 67 “bad” samples in the data, and we selected 201 “good” samples and 67 “bad” randomly to model. The “good” samples remaining are used to verify.

To build the regression model with the 15 variables selected, the non-dominant of some indexes (Table 1.1) need to a further selected. In the paper, a step-by step screening method is used, and removed variables  $X_{105}$ ,  $X_{73}$ ,  $X_{108}$ ,  $X_{16}$ ,  $X_{122}$ ,  $X_{118}$ ,  $X_{62}$ , Sequentially, and the get a better regression model (Table 1.2).

After choosing 201 good samples and 67 bad samples to build the model, we get a model with 8 independent variables (Table 1.3).

The ROC curve of modeling samples is shown in Fig. 1.1 and the area under the ROC curve, AUC value, is 0.9058.

**Table 1.1** The coefficients of a full variable regression model

Parameters	Estimate	Standard error	Z	Sig.	95 % Confidence interval	
					Upper limit	Lower limit
X16	-0.1	0.213	-0.471	0.637	-0.517	0.317
X18	-0.127	0.076	1.687	0.092	-0.276	0.021
X28	-0.531	0.731	-0.727	0.467	1.965	0.902
X54	-3.603	0.363	2.643	0.008	6.274	-0.931
X62	0.08	0.624	0.128	0.898	1.143	1.302
X72	0.016	0.007	0.211	0.027	0.002	0.03
X73	0	0	1.801	0.072	0.001	0
X97	-0.415	0.076	5.437	0	0.565	-0.266
X104	0	0	2.277	0.023	0	0
X105	-0.207	0.581	0.356	0.722	1.345	0.931
X108	-0.009	0.597	0.015	0.988	1.178	1.16
X114	1.216	0.518	0.347	0.019	0.2	2.231
X118	0	0	0.498	0.619	0	0
X122	-0.682	0.788	0.865	0.387	2.226	0.863
X124	-1.344	0.843	1.594	0.111	2.997	0.309
Intercept	4.313	0.821	5.256	0	0.492	5.133

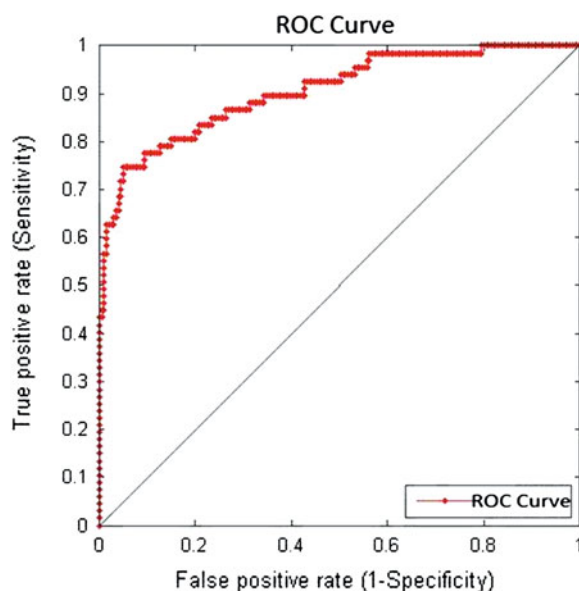
**Table 1.2** The coefficients of stepwise regression model

Parameters	Estimate	Standard error	Z	Sig.	95 % Confidence interval	
					Upper limit	Lower limit
X18	-0.145	0.066	-2.178	0.029	-0.275	-0.015
X28	-1.275	0.496	-2.572	0.01	2.247	-0.303
X54	-3.448	0.237	-2.787	0.005	5.872	-1.024
X72	0.02	0.008	2.574	0.01	0.005	0.036
X97	-0.423	0.073	-5.778	0	-0.566	-0.279
X104	0	0	-2.356	0.018	0	0
X114	1.359	0.524	2.594	0.009	0.332	2.387
X124	-1.618	0.645	-2.508	0.012	2.883	-0.354
Intercept	4.543	0.874	5.197	0	3.669	0.417

Analysis of modeling results can be informed that the cut-off point is 0.343, that is to say there are 201 data with calculation results less than 0.343. To verify the results of modeling with 11654 good samples and also taking the 0.343 as the cut-off point, there are 1206 samples are judged as bad samples. The ratio of correct judgment is 89.65 %, and the ratio of fail judgment is 10/35 %. This is an acceptable result. Since the 67 bad samples are all used to model, there is no bad sample used to verify the model.

**Table 1.3** Full sample model

Index	Estimate
The ratio of the net assets of fixed assets	-0.145
The growth rate of tangible assets	-1.275
FFO to total assets	-3.448
Asset turnover number of months	0.02
Logarithm of total assets	-0.423
Three-year average sales growth rate	0.0001
Net profit ratio of fixed assets and inventories	1.359
Long-term return on capital	-1.618
Intercept	4.543

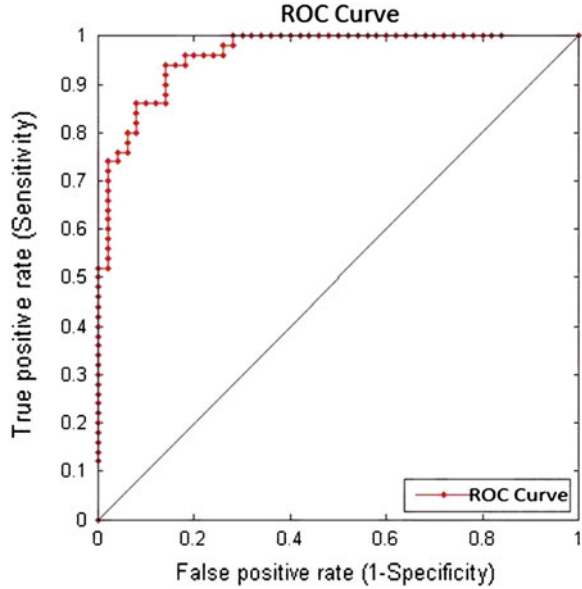
**Fig. 1.1** The ROC curve of full sample model

### 1.5.3 Random Sample Model

In the model above, since all the samples used to verify is good and all the bad samples are used to build the model, the performance of the model on the rate of correct judgment is no convincing. Now to model with samples obtained randomly.

At present, the domestic scholars build credit scoring model at the ratio of good or bad samples generally 1:1; 1:2; 1:3. To design three experiments to verify that Probit model can get application efficiently into the credit scoring, and draw a conclusion that it is a better ability of evaluation capacity when the model is built at the ratio of good or bad samples is 3:1.

**Fig. 1.2** The ROC of experiment 1



Experiment 1: To build the model with 50 good samples and 50 bad samples, and to verify the model with the remaining samples. There are 11822 samples, which contain 11805 good samples and 17 bad samples.

Experiment 2: To build the model with 90 good samples and 45 bad samples, and to verify the model with the 11765 good remaining samples and 22 bad remaining samples.

Experiment 3: To build the model with 144 good samples and 49 bad samples, and to verify the model with the remaining 11711 good remaining samples and 19 bad remaining samples Figs. 1.2, 1.3, 1.4, Table 1.4.

Considering the sentenced positive rate, the model is best when the ratio of good or bad is 3:1. However, these data need to be selected by SPSS before modeling.

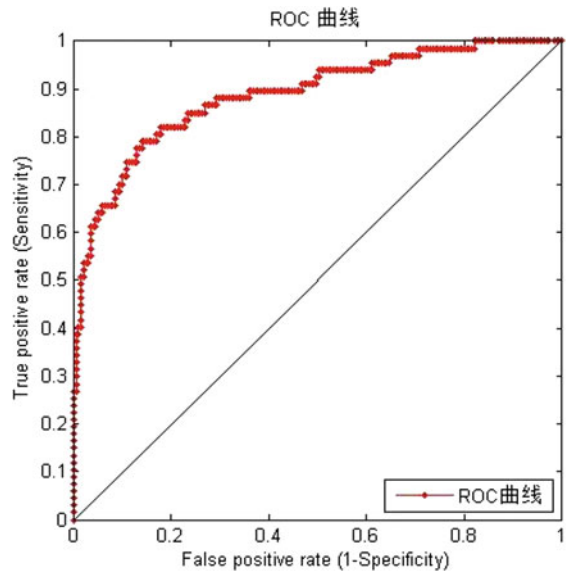
When there is a great imbalance of bad and good samples, the three experiments above may not be able to carry out. Although the model with ratio 3:1 is superior to the models with ratios 2:1 and 1:1, we can't say it superior to all the models. So we build the model at the ratios of 4:1, 5:1, and 10:1.

Experiment 4: To build the model with 168 good samples and 45 bad samples, and to verify the model with the 11687 good remaining samples and 22 bad remaining samples.

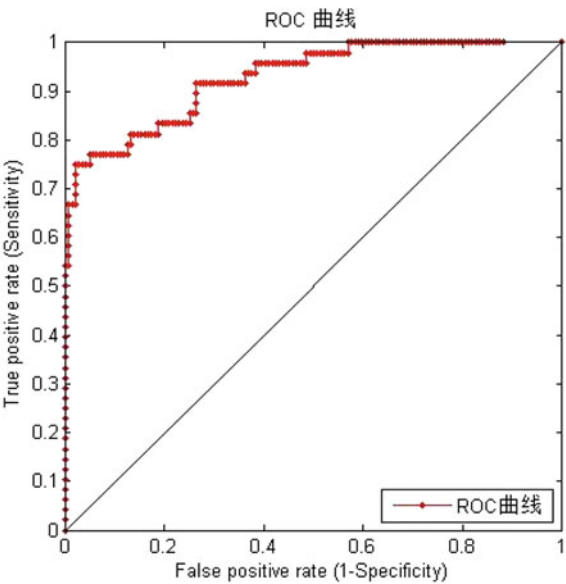
Experiment 5: To build the model with 200 good samples and 40 bad samples, and to verify the model with the 11655 good remaining samples and 27 bad remaining samples.

Experiment 6: To build the model with 300 good samples and 30 bad samples, and to verify the model with the 11555 good remaining samples and 37 bad remaining samples.

**Fig. 1.3** The ROC of experiment 2



**Fig. 1.4** The ROC of experiment 3



**Table 1.4** Testing values of multi-experiments model

	AUC	Found positive rate	
		Predicated good (%)	Predicated bad (%)
Experiment 1	0.962	77.88	64.71
Experiment 2	0.9568	85.23	59.09
Experiment 3	0.928	88.66	73.68

**Table 1.5** Testing values of the experiments

	AUC	Found positive rate	
		Predicated good (%)	Predicated bad (%)
Experiment 1	0.962	77.88	64.71
Experiment 2	0.9568	85.23	59.09
Experiment 3	0.928	88.66	73.68
Experiment 4	0.9012	89.12	65.98
Experiment 5	0.8776	90.01	60.65
Experiment 6	0.8025	92.17	49.04

The values from Table 1.5 show that with the ration increases gradually, AUC value decreases gradually, and this illustrates that the overall sentenced positive rate is getting lower and lower. In the fact, since the amount of good samples increases, the correct judgment of judging good increases and the correct judgment of judging bad decreases at the same time, but the degree of reducing is significantly greater than the degree of the increase of correct judgment of judging good. This demonstrates that at the ratio of 3:1 can get the optimal regression estimation model when the ratio is in a certain range.

**1.5.4 The WOE Value Model**

To calculate with new variable indicators and WOE value. When the ratio of good and bad samples was 1:1, we selected 23 indicators with WOE, and calculated and compared the results got from 23 original value and WOE value separately (Table 1.6).

The analysis shows that the model built with WOE value get the best results when the ratio of good and bad samples is 3:1. And the correct-judgment rate of good samples is 91.66 %, and the correct-judgment rate of bad samples is 73.68 %. The AUC value of validation sample is 0.8711. This result is acceptable.

**Table 1.6** Comparison of testing values of original value model and WOE value model

Matching type	AUC	Found positive rate	
		Predicated good (%)	Predicated bad (%)
1:1	Original value	72.08	64.71
	WOE value	84.06	64.71
2:1	Original value	88.81	63.64
	WOE value	87.71	68.18
3:1	Original value	88.28	63.16
	WOE value	91.66	73.68

Among the samples judged as good the really good samples account for 99.98 %. But compared with good samples, the amount of bad samples is too small, so the data may not mean much.

## 1.6 Conclusion

This paper introduced Probit model into credit scoring model, and designed experiments with the data provided by commercial banks to verify that the credit scoring system based on Probit model can distinguish good samples and bad samples efficiently and has a good application. In the credit scoring model based on Probit, the correct-judgment rate of good samples is 91.66 %, but the correct-judgment rate of bad is week. This may be related to the datasets imbalance of modeling and verification. In practice, we can rely mainly on credit scoring and make expert evaluation method subsidiary, and combine the Qualitative Analysis and the result of credit scoring to maximize the accuracy and reduce the bank credit risk exposure. This paper built scoring models with original value and WOE vale separately under the different ratios of good and bad samples. Having compared the results, we get the conclusion that the result calculated with WOE value is better than the result calculated with original value, the result is the best when the ratio of good samples is 3:1 and it can satisfy the requirement of establishing the credit scoring models.

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# Chapter 2

## A Study on the Impact of Cash Dividend Distribution on Earnings Persistence of Listed Company

Zhi-jian Zeng, Wei-yi Yang and Chang-qing Luo

**Abstract** Cash dividend distribution transmits some information of earnings persistence of listed company, but the analysis on the influence of cash dividend distribution on earnings persistence is still not enough. Based on the data of Chinese listed companies from 2003 to 2009, this article tests the impact of cash dividend distribution on earnings persistence of companies. The empirical results are as follows: in general, cash dividend distribution has a negative effect on earnings persistence of company, so cash dividend distribution of listed company is more a tool for tunneling by controlling shareholders; but among companies which allocate cash dividend at the current term, the impact on earnings persistence varies with cash dividend payout ratio levels; relative to moderate levels of cash dividend payments, low levels of cash dividend payments have significant negative impact on earnings persistence, but high levels of cash dividend payments have no obvious effect on earnings persistence.

**Keywords** Cash dividend · Dividend payout ratio · Earnings persistence · Listed company

### 2.1 Introduction

There are some closed connections between cash dividend distribution and earnings of listed company. Since Lintner (1956) concludes that earnings are the primary determinants of dividend policies. Fama and Babiak (1968) document

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strong support for the Lintner dividend model and found there are strong time-series relation between realized earnings and cash dividends. Fama and French's (2001) study shows that the earnings ability of listed companies is an important factor which influencing whether or not a company allocate cash dividends. Usually, companies which have higher earnings level tend to distribute cash dividends and the level of payout is higher. Von Eije and Megginson (2008) studied on the evolution of dividend policy in 15 EU countries listed companies from 1989 to 2003 and found that earnings ability is an important factor which affects the cash dividend distribution decisions. Huang et al. (2011) take Chinese listed companies from 1994 to 2006 for the research sample and found that cash dividends of listed companies is mainly influenced by conventional factors, especially the company's earnings ability. All the above concerned mainly on earnings level, some recent studies begin to concern about the information reflecting the company earnings quality—Earnings Persistence signaled by the company's cash dividend.

Koch and Sun (2004) found that cash dividend changes reflect changes in earnings persistence and investors can assess the earnings persistence of the company through cash dividend changes. Brav et al. (2005) surveyed listed companies in the USA. and found that the future earnings of companies, which distribute cash dividend in current term, is more sustainable and steady. Skinner and Soltes (2011) found that cash dividend distribution reflects information of earnings persistence of companies; it is a signal of company's earnings private information.

So, what is earnings persistence? Contradict with "random walk hypothesis" of earnings, Freeman et al. (1982) suggested that ROR has predictive content with respect to earnings changes. Miller and Rock (1985) relate that current-period earnings innovation on the present value of the revisions in expected future earnings to the "persistence" of earnings. Sloan (Sloan 1996) found that the earnings persistence is shown to depend on the relative magnitude of the cash and accrual components of earnings. Li (2008), Dichev and Tang (2009) studied separately some factors influencing persistence of earnings, such as annual report readability, earnings volatility.

However, some researches on cash dividend distribution of Listed Companies in China found that cash dividend distribution is more connected with tunneling of largest shareholders. Lee and Xiao (1994), Chen et al. (2009) found that largest shareholders tend to expropriate the interests of minority shareholders through cash dividend distribution, especially in double agent mechanism under ownership concentration and ownership segregation. So, is there any different correlation between cash dividend and earnings persistence of companies?

Earnings persistence can reflect future operation performance of companies very well. It is very important to study the impact of cash dividend distribution on earnings persistence whether for investors choosing stocks to invest in a long term or to help managers formulating rational cash dividend policies. This article studies the impacts of cash dividend payout tendency and cash dividend payout

level on earnings persistence. We try to supply some more empirical evidence to understand cash dividend distribution of listed companies.

This article proceeds as follows: [Sect. 2.2](#) is theoretical analysis and hypothesis. [Section 2.3](#) is empirical methodology research. [Section 2.4](#) is analyses of empirical results. [Section 2.5](#) concludes.

## 2.2 Theoretical Analysis and Hypothesis

According to dividend agent theory, there are agency relationship between shareholders and managers in a company. Managers have motives of self-interest; they usually behave on their own interest, lower the operation efficiency of the company. On the one hand, cash dividend distribution can reduce capital on managers' own, lower the internal cash flow level and avoid some risks of over-invest of the company. On the other hand, it reduces investment funds, make the company refinancing in capital market, by which companies are supervised by investors. Lower free cash flow level and supervising stress from investors alleviate agency problems, and promote the operation efficiency of the company. As promotion of operation efficiency of the company, earnings growth will be more steady, earnings will be more persistent. So, we put forward the hypothesis:

H1: Choosing allocating cash dividend has a positive impact on earnings persistence of companies.

There are some special characteristics on cash dividend payout level of listed companies in China. Since the successive introductions of regulatory policies of cash dividend distribution, some listed companies pay very few cash dividends to satisfy the demands of the regulatory policies. Minority shareholders gain little from this kind of cash dividend after taxes. Listed companies allocate such kind of cash dividend in order to achieve demands of regulatory for refinancing rather than reward the investors. On condition that future cash flow is not so optimistic in which companies pay for refinancing. Outflow of funds deteriorates their earnings condition since the companies' earnings quality is not so stable. So, low level cash dividend distribution has a negative impact on earnings persistence.

On the other hand, some companies tend to pay too much cash dividends disregarding their earnings at the current term. The main objectives of operating companies are maximizing shareholders' value and sustainable earnings. Though excessive cash dividends distribution gives shareholders some current income, they will lead to financial strain of operating funds and harm financial conservatism which are detrimental to corporations' long term development. In such way, we put forward the hypothesis:

H2: Relative to median cash dividends distribution, allocating cash dividends too little or too excessive both have negative effects on earnings persistence of companies.

## 2.3 Empirical Methodology Research

### 2.3.1 Data Sources and Sample Selection

The sample in this paper is based on A-share listed companies from 2002 to 2010. Relatively, compared to B-shares and H-shares of listed companies, A-share listed companies have a more stable market environment and uniform accounting standards, so we exclude A-share listed companies that also issue B-shares or H-shares. We must use the total assets of the previous year and the earnings data of the next year to measure the earnings persistence, so 2002 and 2010 annual report of listed companies is not involved in the sample. Meanwhile, due to the particularity of financial industry and ST companies operating conditions, we remove the listed companies of the financial industry and ST companies. In addition, according to the company law in China, dividend distribution can be conducted after earnings making up for the losses this year, as well as surplus reserves. So only companies that have positive earning are eligible to distribute cash dividend, we remove the loss-making companies, and get 6026 companies in our sample. The data in this paper could be required from CSMAR database.

### 2.3.2 Variable Selection and Model Specification

To test H1, we divide cash dividend distribution into two groups: pure cash dividend distribution and mixed dividend distribution (companies both pay cash dividend and stock dividend) and set dummy variables. According to most of researches on earnings, we decompose total earnings in operating earnings and non-operating earnings, net operating cash flow and accrual earnings. Regression model are as follows:

$$E_{it+1} = \alpha_0 + \alpha_1 E_{it} + \alpha_2 CA_{it} + \alpha_3 SC_{it} + \alpha_4 CA_{it} * E_{it} + \alpha_5 SC * E_{it} + \sum \beta_i YEAR_i + \varepsilon_{it} \quad (2.1)$$

$$E_{it+1} = \alpha_0 + \alpha_1 OI_{it} + \alpha_2 NOI_{it} + \alpha_3 CA_{it} + \alpha_5 SC_{it} + \alpha_6 CA * OI_{it} + \alpha_8 SC * OI_{it} + \alpha_9 CA_{it} * NOI_{it} + \alpha_{11} SC_{it} * NOI_{it} + \sum \beta_i YEAR_i + \varepsilon_{it} \quad (2.2)$$

$$E_{it+1} = \alpha_0 + \alpha_1 CFO_{it} + \alpha_2 ACC_{it} + \alpha_3 CA_{it} + \alpha_5 SC_{it} + \alpha_6 CA_{it} * CFO_{it} + \alpha_8 SC_{it} * CFO_{it} + \alpha_9 CA_{it} * ACC_{it} + \alpha_{11} SC_{it} * ACC_{it} + \sum \beta_i YEAR_i + \varepsilon_{it} \quad (2.3)$$

$$E_{it+1} = \alpha_0 + \alpha_1 E_{it} + \alpha_2 HIGH_{it} + \alpha_3 LOW_{it} + \alpha_4 HIGH_{it} * E_{it} + \alpha_5 LOW_{it} * E_{it} + \sum \beta_i YEAR_i + \varepsilon_{it} \quad (2.4)$$

$$E_{it+1} = \alpha_0 + \alpha_1 OI_{it} + \alpha_2 NOI_{it} + \alpha_3 LOW_{it} + \alpha_4 HIGH_{it} + \alpha_5 LOW_{it} * OI_{it} + \alpha_6 HIGH_{it} * OI_{it} + \alpha_7 LOW_{it} * NOI_{it} + \alpha_8 HIGH_{it} * NOI_{it} + \sum \beta_i YEAR_i + \varepsilon_{it} \quad (2.5)$$

$$E_{it+1} = \alpha_0 + \alpha_1 CFO_{it} + \alpha_2 ACC_{it} + \alpha_3 LOW_{it} + \alpha_4 HIGH_{it} + \alpha_5 LOW_{it} * CFO_{it} + \alpha_6 HIGH_{it} * CFO_{it} + \alpha_7 LOW_{it} * ACC_{it} + \alpha_8 HIGH_{it} * ACC_{it} + \sum \beta_i YEAR_i + \varepsilon_{it} \quad (2.6)$$

If the coefficients of interaction between dummy variables and earnings and components of earnings are significant positive, one kind of dividend distribution has a positive impact on total earnings. In model (2.1), if  $\alpha_4$  is significant positive, then pure cash dividend distribution influences positively on earnings persistence; if  $\alpha_5$  is significant positive, then mixed cash dividend distribution influences positively on earnings persistence. Model (2.2) and model (2.3) test the impacts of propensity of cash dividend distribution on the persistence of counterparts of earnings. Explanations of parameters are similar with model (2.1). Where model (2.4), model (2.5) and model (2.6) can refer to model (2.1), model (2.2) and model (2.3). Specifications of all variables are listed on Table 2.1.

## 2.4 Analyses of Empirical Results

To test H1, we choose the sample of all companies by pool data regression in model (2.2), model (2.3) and model (2.4). The regression results are shown in Table 2.2, the regression coefficient of the interaction between pure cash dividend and net earnings is significantly negative. That is to say pure cash dividend distribution, which compared to the other companies, has negative effects on the persistent of the company overall earnings. The interaction coefficient between mixed dividend and net earnings is significantly negative too, which means that mixed dividend distribution, comparing to the other, has significant negative effect on the persistent of the company's overall earnings.

According to the regression results of the net earnings components, pure cash dividend distribution negatively affects the persistent of the operating earnings but not the non-operating earnings. Mixed dividend distribution affects the persistent of the operating earnings negatively; however, it has positive effects on the persistent of the non-operating earnings. For net cash flows from operating and total

**Table 2.1** Variables definition and description

Variable	Variable name	Describe and calculation
$E_{it+1}$	$t + 1$ period net earnings	$t + 1$ period net earnings/ $t - 1$ period total assets
$E_{it}$	$t$ period net earnings	$t$ period net earnings/ $t - 1$ period total assets
$OI_{it}$	$t$ period operating earnings	$t$ period operating earnings/ $t - 1$ period total assets
$NOI_{it}$	$t$ period non-operating earnings	$t$ period total earnings-operating earnings/ $t - 1$ period total assets
$CFO_{it}$	$t$ period net cash flow from operating	$t$ period net cash flow from operating activities/ $t - 1$ period total assets
$ACC_{it}$	$t$ period total accrual earnings	$t$ period total accrued earnings/ $t - 1$ period total assets
$CA_{it}$	Pure cash dividend distribution dummy variable	Only cash dividend distribution of the current period is 1, otherwise 0
$SC_{it}$	Mixed dividend distribution dummy variable	Both cash dividend distribution and stock dividend distribution is 1, otherwise 0
$LOW_{it}$	low level cash dividend dummy variable	the current distribution of cash dividend payout ratio in 10 % of the lowest part is 1, otherwise 0
$HIGH_{it}$	high level cash dividend dummy variable	the current distribution of cash dividend payout ratio in 10 % of the highest part is 1, otherwise 0
$YEAR_i$	Year dummy variable	Where $i = 1, 2, 3, 4, 5, 6$ and $i = 1$ which respectively represent period, 2004, 2005, 2006, 2007, 2008 and 2009

**Table 2.2** Impacts of propensity of cash dividend distributions on earnings persistence**Persistence of earnings and components**

Model (1)		Model (2)		Model (3)	
<i>Cons</i>	-0.003	<i>Cons</i>	-0.003	<i>Cons</i>	-0.004 <sup>a</sup>
$E_{it}$	1.118 <sup>c</sup>	$CA_{it}$	0.011 <sup>c</sup>	$CA_{it}$	0.010 <sup>c</sup>
$CA_{it}$	0.010 <sup>c</sup>	$SC_{it}$	0.012 <sup>c</sup>	$SC_{it}$	0.012 <sup>c</sup>
$SC_{it}$	0.011 <sup>c</sup>	$OI_{it}$	0.954 <sup>c</sup>	$CFO_{it}$	1.139 <sup>c</sup>
$CA_{it}^a E_{it}$	-0.055 <sup>a</sup>	$NOI_{it}$	0.856 <sup>c</sup>	$ACC_{it}$	1.108 <sup>c</sup>
$SC_{it}^a E_{it}$	-0.105 <sup>c</sup>	$CA_{it}^a OI_{it}$	-0.092 <sup>c</sup>	$CA_{it}^a CFO_{it}$	-0.067 <sup>b</sup>
		$SC_{it}^a OI_{it}$	-0.138 <sup>c</sup>	$SC_{it}^a CFO_{it}$	-0.114 <sup>c</sup>
		$CA_{it}^a NOI_{it}$	-0.139	$CA_{it}^a ACC_{it}$	-0.084 <sup>b</sup>
		$SC_{it}^a NOI_{it}$	0.306 <sup>a</sup>	$SC_{it}^a ACC_{it}$	-0.142 <sup>c</sup>
year		controlled			
Adj.R <sup>2</sup>					
0.513		0.512		0.516	
F statistics					
578.494 <sup>c</sup>		452.047 <sup>c</sup>		458.897 <sup>c</sup>	
Number of observations					
6,025		6,025		6,025	

Note <sup>a</sup>, <sup>b</sup>, <sup>c</sup> denotes statistical significance at the 10, 5, 1 % level

**Tables 2.3** Impacts of cash dividend level on earnings persistence

<b>Persistence of earnings and components</b>					
<b>Model (4)</b>		<b>Model (5)</b>		<b>Model (4)</b>	
<i>Cons</i>	0.009 <sup>b</sup>	<i>Cons</i>	0.002	<i>Cons</i>	0.000
<i>E<sub>it</sub></i>	1.149 <sup>c</sup>	<i>LOW<sub>it</sub></i>	0.027 <sup>c</sup>	<i>LOW<sub>it</sub></i>	0.028 <sup>c</sup>
<i>LOW<sub>it</sub></i>	0.027 <sup>c</sup>	<i>HIGH<sub>it</sub></i>	0.003	<i>HIGH<sub>it</sub></i>	0.002
<i>HIGH<sub>it</sub></i>	0.003	<i>OI<sub>it</sub></i>	0.880 <sup>c</sup>	<i>CFO<sub>it</sub></i>	1.148 <sup>c</sup>
<i>LOW<sub>it</sub>*E<sub>it</sub></i>	-0.354 <sup>c</sup>	<i>NOI<sub>it</sub></i>	0.958 <sup>c</sup>	<i>ACC<sub>it</sub></i>	1.098 <sup>c</sup>
<i>HIGH<sub>it</sub>*E<sub>it</sub></i>	-0.068	<i>LOW<sub>it</sub><sup>a</sup>OI<sub>it</sub></i>	-0.258 <sup>c</sup>	<i>LOW<sub>it</sub><sup>a</sup>CFO<sub>it</sub></i>	-0.352 <sup>c</sup>
		<i>HIGH<sub>it</sub><sup>a</sup>OI<sub>it</sub></i>	-0.115	<i>HIGH<sub>it</sub><sup>a</sup>CFO<sub>it</sub></i>	-0.128
		<i>LOW<sub>it</sub><sup>a</sup>NOI<sub>it</sub></i>	-0.264	<i>LOW<sub>it</sub><sup>a</sup>ACC<sub>it</sub></i>	-0.337 <sup>c</sup>
		<i>HIGH<sub>it</sub><sup>a</sup>NOI<sub>it</sub></i>	-0.210 <sup>b</sup>	<i>HIGH<sub>it</sub><sup>a</sup>ACC<sub>it</sub></i>	-0.135
year		controlled			
Adj.R <sup>2</sup>					
0.499		0.503		0.501	
F statistics					
363.552 <sup>c</sup>		271.059 <sup>c</sup>		289.131 <sup>c</sup>	
Number of observations					
4,011		4,011		4,011	

Note <sup>a, b, c</sup> denotes statistical significance at the 10, 5, 1 % level

accrual earnings, pure cash dividend distribution and mixed dividend distribution both have significant negative effects.

To test H2, we choose sample which involve companies distribute cash dividends. The regression results are shown in Table 2.3, the regression coefficients of the interaction between low level cash dividend and net earnings are significantly negative, that is to say low level cash dividend distribution, which compared to the moderate cash dividend distribution, has negative effects on the persistent of the company overall earnings. The interaction coefficient between high level cash dividend and net earnings are negative, but the coefficients are not significant, which means that high distributing cash dividend, comparing to the moderate distributing cash dividend, has no significant effect on the persistent of the company's overall earnings.

According to the regression results of the net earnings components, low distributing cash dividend negatively affects the persistent of the operating earnings and the non-operating earnings; high level cash dividend does not significantly affects the persistent of the operating earnings, however, it significantly and negatively affects the persistent of the non-operating earnings. Comparing to the insignificant influence of high level cash dividend distribution, low level cash dividend distribution significantly and negatively effects the persistent of surplus cash flow and the total cash paying. To sum up, low distributing cash dividend significantly and negatively affects the persistent of the total net earnings and the

components of net earnings, instead, high level cash dividend distribution only negatively influence the persistent of the non-operating earnings, significantly.

To ensure the stabilization of the regression results, we re-divide the high and low level cash dividend by the standard of the top 5 % and the bottom 15 %. The results show that no matter how group are divided, low level cash dividend distribution has significant negative effect on the persistent of total net earnings and the components of net earnings. Insignificant interaction coefficients between high level cash dividend distribution and net earnings means that there is no significant influence of high level cash dividend distribution on net earnings or earnings components, compared to moderate level cash dividend distribution. The idea that high level cash dividend distribution damages the future earnings quality supporting by big stockholders is not supported by empirical results and the hypothesis H2 is only partly supported.

## 2.5 Conclusion

In conclusion, it is still a bad news if companies allocate cash dividends for investors when they select the stocks for the long-term investment at current stage. The cash dividend will have negative affects on the company's future earnings quality. The companies which implement cash dividend distribution will be difficult to sustain its future earnings quality because of its low amount of cash dividends. On the one hand, the relevant policies and regulatory authorities should strengthen the supervision of cash dividends of listed companies and improve the current "one size fits all" regulatory system of distribution of cash dividends. They should also develop an appropriate regulatory standard and implement classified supervision in accordance with the industry. On the other hand, they should build up the system of legal protection on minority investors, standardize and urged listed companies to increase the intensity and information disclosure quality for investors.

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# Chapter 3

## A Study on the Stock Price Effect of Convertible Bonds Redemption

Chi Xie, Liang-jing Guo and Chang-qing Luo

**Abstract** Redemption clause is an important part of convertible bonds clauses, and studying convertible bond redemption price effect is beneficial to the issuers and investors to understand the redemption clause of convertible bond. In view of this, the paper selects listed companies which called convertible bonds from 2004 to 2010 in Shanghai and Shenzhen stock exchange markets as research samples and the empirical results show that listed companies' stock yield is significantly weaker than that of the market average level. Meanwhile, convertible bond redemption' stock price is affected by the redemption notice period, company size, growth, financial leverage. The empirical results support the judgment of signal theory leading to convertible bond redemption price effect.

**Keywords** Convertible bond redemption · Event study · Signaling hypothesis · Stock price effect

### 3.1 Introduction

Convertible bond is a kind of special financing tool, which has the characteristics of the stock and the bond. Therefore, it has different meanings to investors and issuers from that of direct equity financing and debt financing. In recent years,

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convertible bond market is developing rapidly and has increasingly become a mainstream in capital market. Convertible bond is helpful for listed companies' solving the problems such as high proportion of equity financing, the rareness of security products and the lack of financial innovation in their process of external financing. Therefore, a lot of domestic listed companies gradually tend to issue convertible bonds.

Redemption clause is an important part of convertible bonds clauses. Once the company releases redemption announcement, investors need to make choose between converting bonds into stock and obtaining bond interest. Because equity financing preference in Chinese market is strong, the redemption clause plays an important role in convertible bond market. Many domestic and foreign scholars have studied on the stock price effect of the convertible bond redemption announcement.

Ingersoll (1977), Brennan and Schwartz (1977) thought that in-the-money bonds would lead to all of issuers to call bonds, and redemption announcement was not good news or bad news (Ingersoll 1977; Brennan and Schwanz 1977). However, as scholars have studied the stock price effect of convertible bond in depth, they found that convertible bond redemption announcement was always associated with an average abnormal stock price decline such as Alexander and Stover (1980), Mikkelson (1981), Kim and Kallberg (1998) and so on (Alexander and Stover 1980; Mikkelson 1981; Kim and Kallberg 1998). Scholars explain this phenomenon mainly using signaling hypothesis, price pressure hypothesis and so on. Harris and Raviv (1985) applied signaling hypothesis into studying stock pressure effect of convertible bond, and they thought that convertible bond redemption announcement was a bad news which caused stock price to decline (Harris and Raviv 1985). Nayar, Cowan and Singh (2000), Scruggs (2007) thought underwritten transferred bad news to market, so underwritten redemption announcement's stock price effect was more significant than that of naked redemption announcement's stock price effect (Nyborg 1995; Scruggs 2007). However, Mazzeo and Moore (1992) believed that the increase of price pressure around the redemption announcement day caused by investors' converting bonds into stock was the main reason for price decline. The price pressure disappeared in the following 30 days and the decline in stock price recovered to the original level (Mazzeo and Moore 1992). Mazzeo and Moore (1992) thought that the recovery process could not be explained by signal theory (Mazzeo and Moore 1992). Ederington and Goh (2001), Zhang and Sheng (2010) also support price pressure hypothesis (Ederington and Goh 2001; Zhang and Sheng 2010). Bechmann (2004) thought that short-sell the underlying stock but not the converting bond into stock led to price pressure (Bechmann 2004). However, Brick et al. (2007) thought stock price effect of convertible bond redemption could not be explained by price pressure hypothesis (Brick et al. 2007). There are still scholars who explain it from other views. For example, Beyer et al. (2010) thought the increase of risk is the main reason, and Wang and Yu studied it from the view of cash flow (Beyer et al. 2010; Wang and Yu 2010).

From the analysis above, we can see that domestic relevant researches have just started and there is not a common conclusion, so we need further discussion. Therefore, this paper studies the listed companies' price effect of convertible bond redemption, and explores the possible influential factors and analyzes the theory foundation of it.

## **3.2 Theoretical Analysis and Hypothesis**

### ***3.2.1 The Exist Analysis of Stock Price Effect of Convertible Bond Redemption***

Signaling hypothesis assumes that managers make redemption policy to maximum stockholders' benefits. If they think companies' future prospects are good, they do not choose to call bonds. Thus, they can protect the existing stockholders' benefits and avoid new stockholders' sharing companies' future profit. In contrary, if they think companies' future prospects are not good, they choose to call bond. Thus, it can accelerated investors conversion process in order to achieve the purpose of making new shareholders share loss. Therefore, convertible bond redemption conveys bad news about companies' future prospect or overvalued stock price. Investors reevaluate stock value according to the received information, and stock price is downward corrected.

Price pressure hypothesis is established based on the downward sloping demand curves. As special goods, stock price drops as its supply increases. Redemption announcement causes investors to accelerate convert bonds into stock. Stock supply pressure increases along with investors converting bonds into stock around the convertible bond redemption announcement day. Based on the above analysis, we put forward hypothesis 1:

Hypothesis 1: Listed companies' convertible bond redemption exists negative stock price effect.

### ***3.2.2 The Effective Factors Analysis of Convertible Bond Redemption's Stock Price Effect***

The effective factors of convertible bond redemption mainly include the conversion size after redemption, redemption notice period, the period from the day which redemption condition is satisfied to redemption announcement day, firm size, growth, profitability and financial leverage.

According to price pressure hypothesis, as special goods, stock price is restricted to demand and supply equilibrium. Therefore, the bigger the investor's conversion size resulted from convertible bond redemption announcement is, the

smaller negative effect the convertible bond redemption can exert on the underlying stocks yield rate. Therefore, we put forward the hypothesis 2.1

**Hypothesis 2.1** The accumulative abnormal return after listed companies' calling convertible bond is inversely related to conversion size after redemption.

Redemption notice period refers to the period from redemption announcement day to the redemption day. The longer it is, the more time investors own to make choose between converting bonds into stock and get principal and interest. Therefore, the possibility of investors converting bond into stock is relatively small, and thus redemption announcement has fewer negative effect on underlying stock yield rate. Therefore, we put forward hypothesis 2.2

**Hypothesis 2.2** The accumulative abnormal return after listed companies' calling convertible bond is positively related to redemption notice period.

The period is from the day which redemption condition is satisfied to redemption announcement day. The longer it is, the more fully investors can digest the information conveyed by redemption announcement and the less significant the stock price effect is. Therefore, we put forward hypothesis 2.3

**Hypothesis 2.3** The accumulative abnormal return after listed companies' calling convertible bond is positively related to the period from the day which redemption condition is satisfied to redemption announcement day.

Firm size is mainly used to measure information asymmetry: (3.1) investors pay more attention to large companies; (3.2) the information disclosure system of large companies is more effective than that of the small company. Therefore, large companies' redemption announcements contain much information than that of small companies, and then the stock price effect of small companies' convertible bond redemption is more significant. Therefore, we put forward hypothesis 2.4

**Hypothesis 2.4** The accumulative abnormal return after listed companies' calling convertible bond is positively related to firm size.

Investors tend to have confidence in companies which have huge growth potential. It is helpful for stock price stability. Therefore, we put forward hypothesis 2.5

**Hypothesis 2.5** The accumulative abnormal return after listed companies' calling convertible bond is positively related to firm growth.

Firm profitability is an important factors influencing stock price. The stronger the firm profitability is, the more confidence investors have in the stock. Therefore, investors tend to buy the firm's stock and improve stock price. Therefore, we put forward hypothesis 2.6

**Hypothesis 2.6** The accumulative abnormal return after listed companies' calling convertible bond is positively related to profitability.

According to the pecking order hypothesis, financial leverage is an important index to measure companies' quality. The higher the financial leverage is, the higher the company's quality is. Investors are more confident in companies with high financial leverage. Therefore, we put out hypothesis 2.7

**Hypothesis 2.7** The accumulative abnormal return after listed companies' calling convertible bond is positively related to financial leverage.

### 3.3 Empirical Methodology Research

#### 3.3.1 Sample Selection and Data Sources

Because the first convertible bond redemption appeared in 2004, the paper begins by identifying a sample of convertible bond redemption made between 2004 and 2011 and uses the following criteria to select the sample: (3.1) financial companies and public companies are excluded. (3.2) Any sample existing stock dividend, stock split, merger or acquisition within 20 days around redemption announcement day is excluded. (3.4) Samples lack of relevant data is excluded. The final sample is 48, and the sample numbers of 2004, 2005, 2006, 2007, 2008, 2009, 2010 and 2011 are respectively 3, 1, 7, 18, 3, 9, 7 and 1. The data can obtain from CSMAR database.

#### 3.3.2 Variable Selection and Model Specification

To test hypothesis 1, event study method is used. Announcement day is defined as  $t = 0$  and model's parameters are estimated by the period  $[-210, 2]$ . The paper exams the abnormal return in the period  $[-1, 20]$ . To test whether an event can produce effect on the underlying stock, abnormal return ( $AR$ ) and cumulative abnormal return ( $CAR$ ) must be calculated.  $AR$  refers to the difference between actual return and the expected return.  $CAR$  is calculated over a variety of windows. The paper chooses market model to compute  $AR$  and  $CAR$ . They are calculated as follows:

$$R_{i,t} = \ln(P_{i,t}/P_{i,t-1}) \quad (3.1)$$

$$E[R_{i,t}] = \alpha_i + \beta_i \times R_{m,t} \quad (3.2)$$

$$AR_{i,t} = R_{i,t} - E[R_{i,t}] \quad (3.3)$$

$$CAR_i = \sum_{t=2}^{t=1} AR_{i,t} \quad (3.4)$$

Where  $n$  is sample number,  $P_{i,t}$ ,  $E[R_{i,t}]$ ,  $AR_{i,t}$  are respectively indicate actual stock price, expected return, abnormal return of sample  $i$  on trading day  $t$ .  $CAR_i$  is the cumulative abnormal return of sample  $i$  in period  $[t_1, t_2]$ .

To test hypothesis 2.1–2.7, we construct model 1 as follows.

$$\begin{aligned} CAR_0 = & \alpha_0 + \beta_1 \text{Resize} + \beta_2 \text{Period}_1 + \beta_3 \text{Period}_2 \\ & + \beta_4 \text{Size} + \beta_5 \text{SG} + \beta_6 \text{EPS} + \beta_7 \text{Lev} + \beta_8 \text{AR}_0 \\ & + \beta_9 \text{Inst} + \beta_{10} \text{Pr ereturn} \end{aligned} \quad (3.5)$$

**Table 3.1** Variables definition and describe

Variable	Describe and calculation
$CAR_0$	$CAR$ on the redemption announcement day; the smaller it is, the significant the negative stock price effect is
Resize	Conversion size measured by the proportion of stock number converted on the announcement day to the liquid stock number
Period <sub>1</sub>	Redemption notice period
Period <sub>2</sub>	The period from the day which redemption condition is satisfied to redemption announcement day
Size	Firm size measured by the natural logarithm of total assets
SG	Firm growth measured by sales growth rate
EPS	Profitability measured by earnings per share
Lev	Financial leverage measured by the debt assets ratio
$AR_0$	The average abnormal return on the redemption announcement day
Inst	The proportion of institutions holding stock
Prereturn	The actual return five days before the announcement day

Where  $CAR_0$  is the dependent variable which refers to the cumulative abnormal return in the period  $[-1,0]$ ; *Resize*, *period<sub>1</sub>*, *period<sub>2</sub>*, *Size*, *SG*, *EPS*, *Lev* are the independent variables;  $AR_0$ , *Inst* and *Prereturn* are the control variables. Variables' definition and descriptions is in the Table 3.1.

## 3.4 Analyses of Empirical Results

### 3.4.1 The Significance Test of Stock Price of Convertible Bond Redemption

Tables 3.2 and 3.3 are significance test results of  $ARs$  and  $CARs$ . From the Table 3.2, we can conclude that there are 13 trading days when the  $AR$  means are negative while 9 days when the  $AR$  means are positive in the period  $[-1, 20]$ . The average of  $AR$  means in the period  $[-1, 20]$  are significantly negative. Therefore, convertible bond redemption exerts negative effect on the underlying stock daily return, and it exists from the day before the redemption announcement day. In addition, we can also see that samples'  $ARs$  means are significantly negative on the day before the announcement day, the announcement day, the day after the announcement day, which indicate that the stock price effect is most significant in the period  $[-1, 1]$ . From Table 3.3, we can conclude all of the  $CARs$  means are significantly negative in the period  $[-1, 20]$ . It shows that the effect of convertible bond redemption on underlying stock price can maintain for a while, and it also indicates that Chinese market is weak efficient market or semi-strong efficient market which responses to new information slowly.

**Table 3.2** The significance test results of *ARs*

T	AR (%)	T	AR (%)	T	AR (%)	T	AAR (%)
-1	-0.009*	5	0.001	11	-0.007*	17	0.003
0	-0.007*	6	0.001	12	-0.002	18	0.002
1	-0.007*	7	0.002	13	0.002	19	-0.004
2	-0.004	8	-0.002	14	-0.004	20	0.001
3	0.001	9	-0.003	15	-0.004		
4	-0.005	10	-0.002	16	0.002		
Average <i>AR</i> < 0(number)				13			
Average <i>AR</i> > 0(number)				9			
Average <i>AR</i> in period [-1, 20]				-0.002**			

Note \*, \*\*, \*\*\* denotes statistical significance at the 10 %, 5 % and 1 % level

**Table 3.3** The significance test results of *CARs*

Period	Mean	Period	Mean
<i>CAR</i> [-1, 0]	-0.016***	<i>CAR</i> [-1, 11]	-0.041***
<i>CAR</i> [-1, 1]	-0.023***	<i>CAR</i> [-1, 12]	-0.044***
<i>CAR</i> [-1, 2]	-0.027***	<i>CAR</i> [-1, 13]	-0.042***
<i>CAR</i> [-1, 3]	-0.026***	<i>CAR</i> [-1, 14]	-0.046***
<i>CAR</i> [-1, 4]	-0.031***	<i>CAR</i> [-1, 15]	-0.050***
<i>CAR</i> [-1, 5]	-0.030***	<i>CAR</i> [-1, 16]	-0.048***
<i>CAR</i> [-1, 6]	-0.029***	<i>CAR</i> [-1, 17]	-0.045***
<i>CAR</i> [-1, 7]	-0.027***	<i>CAR</i> [-1, 18]	-0.042***
<i>CAR</i> [-1, 8]	-0.027***	<i>CAR</i> [-1, 19]	-0.047***
<i>CAR</i> [-1, 9]	-0.032***	<i>CAR</i> [-1, 20]	-0.046***
<i>CAR</i> [-1, 10]	-0.034***		

Note \*, \*\*, \*\*\* denotes statistical significance at the 10 %, 5 % and 1 % level

### 3.4.2 The Empirical Analysis of Effective Factors of Convertible Bond Redemption

Because only the data of conversion size of Shanghai market samples can be obtained, we use Shanghai market samples to study the effective factors of convertible bond redemption. Table 3.4 displays the regression analysis results. From the Table 3.4, we can conclude R square is 89.6 % which indicates the model-fitting degree is high.

According to the regression results, we can see that  $CAR_0$  is positively related to conversion size after redemption but it is not significant, which does not support price pressure hypothesis. Therefore, hypothesis 2.1 is not supported. It shows that price pressure hypothesis cannot explain convertible bond redemption stock price effect in Chinese market. Redemption notice period is negatively related to  $CAR_0$  and it is significant, therefore, hypothesis 2.2 is supported.  $CAR_0$  is negatively related to the period from the day which redemption condition is satisfied to redemption announcement day ( $Period_2$ ), but it is not significant. Therefore, the

**Table 3.4** The multi-regression results of convertible bond redemption' stock price

Variables	B	Sig.	Variables	B	Sig.
Constant	-0.149**	0.016	<i>EPS</i>	0.011	0.455
Resize	0.377	0.532	<i>Lev</i>	-0.060**	0.020
Period <sub>1</sub>	0.001*	0.070	<i>Inst</i>	0.056***	0.003
Period <sub>2</sub>	-0.002	0.241	<i>ARO</i>	1.221***	0.000
Size	0.044**	0.049	<i>Prereturn</i>	0.751***	0.000
SG	0.103**	0.038			
F	24.258(0.000)				
R square	89.6 %				

Note \*, \*\*, \*\*\* denotes statistical significance at the 10, 5, 1 % level

hypothesis 2.3 is not supported. It may be that a longer *Period<sub>2</sub>* cannot make investors digest more information contained in the redemption announcement but make investors are puzzled by the issuers, so the *Period<sub>2</sub>* has an uncertain effect on the stock price effect of convertible bonds. The *Size* and *SG* are positive and significant at 0.05 levels, thus firm size and growth are positively related to *CAR<sub>0</sub>*. Therefore, hypothesis 2.4 and hypothesis 2.5 are supported. The *EPS* is positive but not significant, thus hypothesis 2.6 is not supported. *Lev* is negative and significant at the 0.05 level, thus financial level is significantly related with *CAR<sub>0</sub>*. It does not support hypothesis 2.7. The reason for it may be that high financial leverage produces high bankruptcy cost and results into the firm's value decrease.

### 3.5 Conclusion

The paper uses listed companies which called convertible bonds from 2004 to 2010 in Shanghai and Shenzhen stock exchange market as research samples and draws some conclusions as follows:

Firstly, convertible bond redemption of listed companies exist stock price effect. The underlying stock return declines significantly in the period  $[-1, 20]$ . Meanwhile, convertible bond redemption' stock price is affected by the redemption notice period, company size, growth, financial leverage. Secondly, the empirical results of effective factors of convertible bond redemption' stock price effect supports the signaling hypothesis, while does not support price pressure hypothesis.

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# Chapter 4

## Auditor Industry Specialization, Analysts Following and Financing Constrains

Heng-gao Tang and Tao-ying Peng

**Abstract** Using a sample of Chinese listed firms from 2007 to 2009, this paper examines the effect of auditor industry specialization and analysts following on financing constrains. We find that, as two types of information conduct mechanism, after controlling for other variables, both auditor industry specialization and analysts following can relieve firm's financing constrains. Furthermore, Compared to firms with more analysts following, the effect of auditor industry specialization on the mitigation of financing constrains is much more significant in firms with less analysts following. This indicates that developing securities analyst industry with great efforts and actively cultivating the industry specialization of auditors contribute to improve the transparency of capital market information, which is beneficial to capital market's development toward a more healthier way.

**Keywords** Analysts following · Auditor industry specialization · Financing constrains · Information Asymmetry

### 4.1 Introduction

Financing constrains refers to the fact that enterprises can not obtain the funds needed for production and operation from external capital market following the normal cost. The existence of financing constrains influences enterprises' production and operation as well as competition in product markets severely, resulting in insufficient investment and ultimately deterring to firms' growth. Financing

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constrains root in the presence of information asymmetry and agency problems, therefore increasing the level of information disclosure and reducing agency problems are important means to ease financing constrains.

Compared with Western countries, China's capital market is less developed. As two types of crucial intermediaries and external governance forces, it is an important research topic whether Securities analysts and external auditors are able to reduce information asymmetry among management and outside investors as well as creditors in order to ease financing constrains through their own professional knowledge mining and spreading company-specific information.

From the perspective of two external governances, that is securities analysts and external auditors, this article discusses two mitigation mechanisms for financing constrains plus their relationship in easing financing constrains. Existing empirical literatures concerning auditor industry specialization and securities analysts are still very scarce, this paper enriches the research in the relevant areas.

## 4.2 Theory Analysis and Hypothesis

The separation of ownership and management rights of modern enterprises leads managers to have natural advantages in the process of information production and captive. On the one hand, investors may face adverse selection before they carry out project investment, due to the existence of information asymmetry and lemon problems. On the other hand, after they have invested to the firms, agency problems arise from inter-persons' interests appropriation. The existence of information asymmetry and agency problem exacerbates perceived risks of rational investors, which results in a higher rate of return required by investors to compensate for the risks they take on as a price protection mechanism. Meanwhile, information asymmetry can also exacerbate the risk of unfair trade between common investors and informed traders, which will ultimately increase enterprises' external financing cost and restrict financing from capital market.

Improving the level of information disclosure is an important way to reduce information asymmetry. Information disclosure includes three aspects which is the quality of information disclosure, the quantity of information disclosure and the characteristics of information disclosure. The former two are negatively correlated with information asymmetry. What is more, information disclosure's characteristics can be further divided into three parts: (1) The proportion of public information and private information in the information disclosure. The higher the proportion of private information is, the higher the degree of information asymmetry is. (2) The proportion of informed investors. The higher the proportion of informed investors is, the higher the degree of information asymmetry is. (3) Ways of information disclosure. In more ways information is disclosed, the easier information could be accessed by investors and the lower the degree of information asymmetry is. Therefore, it is useful to reduce information asymmetry from the above mentioned three aspects.

As one of external governance mechanisms, the impact of external audit on firm value is realized by reducing the information asymmetry and supervising the internal person. Moreover, In accordance with the deep pockets theory, as a kind of insurance mechanism, when audit failure occurs, investors can earn more compensation from high quality auditors (Menon and Williams 1994; Baber et al. 1995), the last is to maintain reputation. According to reputation theory, it takes a long time to foster good reputation while a moment to lost, so facing pressure from the customers, high-quality auditors need to consider the issue of independence.

The existing literatures suggest that auditor industry specialization can improve audit quality (Liu et al. 2010), increase the robustness of earnings (Long et al. 2011) and reduce information asymmetry (Almutairi et al. 2009). According to signaling hypothesis, to hire high quality auditors needs to pay high costs. Moreover, the behavior of hiring high quality auditors can be used as a credible commitment to signal to external information users that the accounting information is credible. Auditor industry expertise is seen as a synonym for high quality audit, only enterprises with good financial condition employ auditors with industry expertise. It pays for corporations with poor performance to hire auditors with industry expertise imitating companies with good performance. On the one hand, considering the fact that industry expertise can be transferred among companies, auditors with industry expertise may leak business secrets and competition strategies with no intention, especially two competing firms (Kwon 1996). For example, when Ernst and Whinney and Young merged into a new audit firm- Ernst and Young in 1998, two competing firms, Coca-Cola and Pepsi, should be audited by Ernst and Young, however, one of them turned to another auditor. On the other hand, auditor with industry expertise may disclose some bad information (Dunn et al. 2004). According to above analysis, we develop the first hypothesis:

H1: *Ceteris paribus*, auditor industry specialization and financing constrains are negatively correlated.

Securities analysts are professional persons who intervene in all ranges of information production, transmission and absorption in modern capital market and bridge between companies and investors to make companies be better supervised from investors. As information intermediaries, analysts involve in the process of the market to reduce information asymmetry mainly through the following channels: first of all, in the most important information production process, compared with the majority of dispersed investors, securities analysts have more superiority in obtaining information and excavating useful information from financial reports by using proficient expertise and industry knowledge. Secondly, after acquiring relevant information, securities analysts will spread it via different channels, such as providing earnings forecasts and investment recommendation to ordinary investors, providing customers with research reports and transmitting by mass media like internet and newspapers etc. last but not the least, securities analysts possess the capability to extract useful information from complex financial reports and process it into the one which is easy to understand for investors. Zhu et al. (2007) found that analysts following helped to decrease the stock price synchronicity, reflect more firm-specific characteristics and improve the operating

efficiency of capital markets. Pan et al. (2011) indicated that analysts contributed to enhance information transparency. Yu (2008) and Yu et al. (2011) showed that analysts following can be used as an external governance mechanism, influencing managements' earnings management behavior. Based on the above analysis, we put forward the second hypothesis as follows:

H2: *Ceteris paribus*, analysts following and financing constrains are negatively correlated.

Compared with nonindustrial expertise auditors, industry expertise auditors become more familiar with specific-industry and specific-firm's transaction process and accounting principals, therefore can make effective professional judgments and be more likely to detect accounting fraud. Securities analysts and industry expertise auditors both have industry-specific expertise, however, enterprises can choose to hire industry expertise auditors but can not hire analysts. So in companies where there are more analysts following, their information is mined and disseminated with high extensive, investors and creditors can easy obtain the required information with relatively low cost, in this case, the motivation to hire industry expertise auditors as a signaling mechanism easing financing constrains will be reduced. Dyck et al. (2010) showed that as a type of external oversight mechanism, 16 point 9 % of the corporate fraud cases could be founded out by securities analysts, in contrast, the proportion is only 11 point 3 % for industry expertise auditors, which to some extent revealed that financial analysts and industry expertise auditors have a competitive relationship in the supervision of management behavior. Jerry et al. studied the relationship among independent directors, securities analysts and industry expertise auditors. The result showed that in enterprises with more analysts following, independent directors are less inclined to employ industry expertise auditors (Jerry and Liu 2011). Moreover, empirical evidence told that industry expertise auditors charge higher audit fee premium compared with non-industry expertise auditors (Li et al. 2011), based on the above analysis, the third hypothesis is put forward as follows:

H3: *Ceteris paribus*, compared with firms with more analysts following, auditor industry expertise in firms with less analysts following relieve the financing constrains with greater extent.

## 4.3 Data and Methodology

### 4.3.1 *Model and Variable Definition*

Concerning the measurement of financing constrains, the sensitivity of investment-internal cash flow was first used by Fazzari et al. (1988) to measure financing constrains. However, opposite conclusion was reached by Kaplan and Zingales (1997) and Cleary (1999). Since then, Almeida et al. (2004) employed cash-cash flow sensitivity to measure the level of enterprises financing constrains. The greater

the financing constrains is, the higher the sensitivity of cash–cash flow would be. Almeida et al. (2004) used closely mathematical reasoning testing the rational of the model so as to avoid inherent defects brought by investment-cash flow sensitivity as financing constrains agent variable. The basic ideal of the model is that for firms which are suffered from financing constrains, they have to accumulate part of cash for future use when their cash flow can not pay for all the investment projects, the consequence of the behavior is that they must sacrifice current investment opportunity for cost if they have valuable future investment opportunities. In other words, enterprises must arrange cash flow reasonably between present and future to maximize firm value. However, the above mentioned question do not exist for firms without financing constrains, because they can always raise money for investment projects which have positive net present value from external.

This paper refers to expansion model used by Almeida et al. (2004) to test the above hypotheses. The description of the models is as follows:

$$\begin{aligned}\Delta CH = & \beta_0 + \beta_1 CF + \beta_2 MS + \beta_3 MS * CF + \beta_4 Size \\ & + \beta_5 Tobin's Q + \beta_6 \Delta NWC + \beta_7 \Delta STD + \beta_8 EXP + \beta_9 TOP \\ & + \beta_{10} YEAR + \beta_{11} INDUSTRY + \varepsilon\end{aligned}\quad (4.1)$$

$$\begin{aligned}\Delta CH = & \beta_0 + \beta_1 CF + \beta_2 Analyst + \beta_3 Analyst * CF + \\ & \beta_4 Size + \beta_5 Tobin's Q + \beta_6 \Delta NWC + \beta_7 \Delta STD + \beta_8 EXP + \\ & \beta_9 TOP + \beta_{10} YEAR + \beta_{11} INDUSTRY + \varepsilon\end{aligned}\quad (4.2)$$

Model 1 is used to test hypothesis 1, model 2 is used to test hypothesis 2, finally, we use model 1 by grouping analysts following to test hypothesis 3.

$\Delta CH$  represents cash and cash equivalent net revaluation divided by the end of last year total assets,  $CF$  refers to cash flow coming from operating activities, which is a main source of cash, the coefficient of the variable represents the degree of financing constrains, the bigger the sensitivity of cash–cash flow is, the greater financing constrains that enterprises are faced with.

$Analyst$  represents the attention of analysts, in this paper, it is measured on the basis of the number of analysts who release investment rating opinion and earnings forecast report toward firm  $i$  in year  $t$ , that is  $Analyst = \text{LN}(n_{i,t} + 1)$ .

$MS$  represents auditor industry specialization, we use industry market share based on total assets with reference to Liu et al. (2010) and Xie (2011) to measure it. According to industry classification standard made by China securities regulatory commission (CSRC) in 2001, the industries other than manufacturing industry are classified with one code, manufacturing industry is classified with two codes, for the reason that the manufacturing industry includes many industries and every industry differ from each other vastly, the concrete expression is as follows:

$$MS_{ik} = \frac{\sum_{j=1}^J \sqrt{ASSET_{ikj}}}{\sum_{i=1}^I \sum_{j=1}^J \sqrt{ASSET_{ikj}}}$$

Among them,  $MS_{ik}$  refers to market share that auditor  $i$  possesses in industry  $k$ ,  $j$  refers to clients that auditor  $i$  have in industry  $k$ ,  $\sum_{j=1}^J \sqrt{ASSET_{ikj}}$  refers to the sum of asset square roots of all clients that auditor  $i$  possesses in industry  $k$ ,  $\sum_{i=1}^I \sum_{j=1}^J \sqrt{ASSET_{ikj}}$  refers to the sum of asset square roots of all clients in industry  $k$ .

Control variables include *Size*, *Tobin's Q*,  $\Delta NWC$ ,  $\Delta STD$ , *EXP*, *TOP*, *Year* and *Industry*. *Size* represents the natural logarithm of total asset. *Tobin's Q* represents the corporate growth opportunities, with total market value divided by asset replacement cost.  $\Delta NWC$  is measured by non-cash working capital revaluation divided by total assets of last year.  $\Delta STD$  refers to the revaluation of short term current liabilities divided by total assets of last year. *EXP* refers to cash paid on the purchase of fixed assets, intangible assets and other long term asset divided by total assets of last year. *TOP* is a dummy variable, it equal to 1 when the auditor is TOP 4, and 0 otherwise.

### 4.3.2 Sample and Data

The initial sample for our study consists of all A-share listed firms in China from 2007 to 2009, then we exclude the following companies: (1) Financial firms. Because the accounting standards they follow and the regulatory environment they are faced with are different from other listed companies. (2) The companies which also issue B share or H share for their different information disclosure requirements. (3) The industries with less than five listed companies, which is C2 and C9. (4) Firms listed in the securities exchange less than one year. Such firms financed from the capital market not long ago and were less likely to be confronted with financing constrains. (5) Integrated listed companies as a result of their unapparent industry characteristics. (6) Firms with missing data and negative net assets. (7) ST or PT listed companies for their special financial characteristics. Finally, eliminate continuing variables' extreme value to avoid the results being affected. Finally, we obtain a total of 2736 firm-year observations, comprising 930 for year 2007, 907 for year 2008 and 899 for year 2009. What is more, all financial data of this paper are extracted from the China Stock Market and Accounting Research (CSMAR) databases and the data process software is SPSS 17.0 and Excel 2003.

## 4.4 Empirical Results and Analysis

### 4.4.1 Description Statistics

Table 4.1 is description statistics for main variables, we can see from it that the mean of auditor industry specialization is 5.1 %, the maximum of it is 48.7 %,

**Table 4.1** Description statistics of main variables

Variables	Mean	Median	Std.dev	Min	Max
$\Delta CH$	0.033	0.014	0.149	-0.62	4.322
CF	0.074	0.068	0.121	-0.97	1.814
MS	0.051	0.039	0.044	0.002	0.487
Analyst	1.508	1.386	1.182	0	4.094
Size	21.87	21.71	1.162	19.05	27.49
Tobin's Q	1.886	1.570	1.107	0.584	11.32
$\Delta STD$	0.083	0.044	0.343	-0.87	13.21
$\Delta NWC$	-0.07	-0.072	0.264	-4.72	1.860
TOP	0.07	0	0.261	0	1
EXP	0.081	0.052	0.095	0	1.287

however, the minimum of it is only 0.2 %, which indicates that China's accounting firm industry expertise vary widely and the average is significantly lower compared to western countries. The average of the attention of analysts is 7.65, while the largest number of analysts who follow a company is 59, there are also companies with no analysts following. On average, there are only 7 % companies employing top 4 audit firm. Moreover, the growth of listed companies also varies greatly, ranging from 0.584 to 11.32.

#### 4.4.2 Empirical Results

We use OLS method to test the assumptions. Table 4.2 show that the coefficients of *CF* in all models are significantly positive in the level of 1 per cent, suggesting that there is a serious problem of financing constrains in Chinese enterprises.

In model 1, the coefficient of interaction variable *MS\*CF* is significantly negative, indicating that auditor industry specialization could ease enterprises' financing constrains no matter by signaling mechanism or governance mechanism. Hypothesis 1 is supported by model 1.

In model 2, the coefficient of interaction variable *Analyst\*CF* is also significantly negative in the level of 5 per cent, suggesting that analysts following could relieve financing constrains that enterprises are faced with. The results support hypothesis 2, as we expected, analysts following plays information intermediary and external governance role in capital market.

Finally, according to the median of analysts, we divided the sample into two group to test hypothesis 3, group 1 with more analysts following and group 2 with less analysts following. From Table 4.2, we can see that the coefficients of interaction variables *MS\*CF* in both groups are negative, but in group 1, the coefficient is no longer significant, in group 2, the coefficient is still significant which indicate that auditor industry specialization and analyst following both could reduce financing constrains, whereas in firms with more analysts following,

**Table 4.2** The results of multiple regression

Variables	Model 1		Model 2	
	<i>Coefficient</i>	<i>T value</i>	<i>Coefficient</i>	<i>T value</i>
CF	0.343***	12.098	0.330***	11.125
MS	0.039	0.553		
MS*CF	−1.338***	−2.977		
Analyst			0.001	0.368
Analyst*CF			−0.030**	−2.107
Adj. <i>R</i> <sup>2</sup>	0.460		0.458	
F value	84.089***		83.687***	
Variables	Group 1		Group 2	
	<i>Coefficient</i>	<i>T value</i>	<i>Coefficient</i>	<i>T value</i>
CF	0.353***	8.400	0.378***	9.939
MS	−0.064	−0.633	0.105	1.086
MS*CF	−0.582	−0.985	−2.204***	−2.995
Adj. <i>R</i> <sup>2</sup>	0.213		0.671	
F value	15.795***		88.831***	

*Note:* \*\*\*, \*\* and \* represent statistical significance at the 1 %, 5 % and 10 % levels, respectively, two-tailed

the internal information is excavated by multiple coverage of interwoven network channel and negative messages accumulated by accrual-based and real activities could easily be found out. In this case, the companies’ agency problems are not relatively serious, the empirical evidences showed that the more serious the company’s agency problem was, the more likely the company employ auditor with industry expertise, therefore compared with firms with more analysts following, auditor industry expertise relieve financing constrains more significant in firms with lee analysts following. So hypothesis 3 is supported as expected.

In addition, though not being displayed as a result of the restriction of length, seen from the perspective of control variables, the coefficients of  $\Delta STD$  are significantly positive in all circumstances, according to Almeida (2004),  $\Delta STD$  and  $\Delta CH$  have two relationship, on the one hand, short-term debt may be used in place of cash, on the other hand, enterprises borrow short-term debt as cash holdings. In the first case, the short-term debt and cash are interchangeable. In this paper, the coefficient is significantly positive, indicating that short-term debt is used as cash holding. The coefficient of *EXP* is significantly negative, which verifies the theory put forward by Almeida (2004) that the increase in capital expenditure reduces firm’s cash holding, the coefficient of *Tobin’s Q* is positive but not significant, indicating that for firms subject to financing constrains, the higher the growth is, the more investment opportunities they have and they must increase cash holdings for future investment.

## 4.5 Conclusion and Implications

In this paper, we use the method of multiple linear regression analysis to study the impact of auditor industry expertise and analysts following on corporate financing constrains. The results show that both auditor industry expertise and analysts following can ease financing constrains, moreover, there exists a substitute relationship in relieving financing constrains. In other words, in firms with more analysts following, the capable of auditor industry expertise mitigate financing constrains weaken. This shows that securities analysts and external auditors play an important role in information intermediary, more importantly, they compete with each other to a certain extent.

The above results show that although securities analysts industry in China is still not mature enough and there are conflicts of interests as well as herding among investors, investors are not confident with the investment recommendations and earnings forecasts made by analysts, but securities analysts played a certain role indeed. In addition, this study also provides evidence for a series of related policies launched by the Ministry of Finance to make audit firms bigger and stronger. The merger of audit firms contributes to scale development, only when they reach a certain size can they have the ability to carry out specialized investment and foster industry-specific experience. China's policy makers should encourage audit firms to expand within industries, meanwhile, when they decide to merge, industry factors should be considered.

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# Chapter 5

## Bank Debt, Growth Opportunities and Corporate Investment Behavior

### Empirical Evidence from Chinese Listed Companies

Gong-rong Chen, Cong-min Ding and Cheng-yin Zheng

**Abstract** As one of the two major creditors of corporate debt in China, the bank has great advantages in monitoring corporate's behavior than commercial credit creditors. So, this paper proposes that the "control effect" of the liabilities mainly comes from bank debt. To verify the above assumption, we use the data of listed firms during 2008–2010 to examine the bank debt-investment relationship. The result shows that bank debt has a negative effect on corporate investment behavior. In addition, we find the growth opportunities do have an impact to the relationship between bank debt and investment: The debt-investment relationship is significantly negative in high-growth firms, but not significant in low-growth firms.

**Keywords** Bank debt · Corporate governance · Growth opportunity · Investment behavior

## 5.1 Introduction

Modigliani and Miller propose that a firm's investment policy is irrelevant with capital structure. With transaction costs and asymmetric information was introduced, a large number of literatures have challenged the MM proposition. Jensen and Meckling (1976) and Myers (1977) analyze that agency problems between shareholders and debt holders can give rise to asset substitution or underinvestment incentives (Jensen and Meckling 1976; Myers 1977). Jensen (1986) and Stulz (1990) propose that conflicts of interest between shareholders and managers will lead to overinvestment, while debt can be able to reduce this agency cost (Jensen 1986; Stulz 1990).

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The development of empirical research has validated these new theories. Lang et al. (1996) examine the impact of financial leverage on the firms' investment decisions using information on American large industrial firms (Lang et al. 1996). They find there is a negative relation between leverage and future investment growth, and this negative leverage-investment relationship only holds for firms with low growth opportunities. After then, Aivazian et al. (2005) also show similar result in Canadian publicly traded companies (Aivazian et al. 2005). These studies provide support to the theory that leverage has a disciplining role for overinvestment.

In recent years, according to characteristics of China's capital market and listed companies, domestic scholars have studied the relationship of financial leverage and corporate investment from several aspects. Based on project risk, Tong and Lu (2005) find that the higher debt ratio, the less investment size, and investment declines more quickly as debt ratio rises in firms with lower project risk (Tong and Lu 2005). From the point of centralized shares, the result of Yao and Kong (2008) shows leverage has a significant negative impact on firms' investment and this effect is weaken with the controlling shareholders' proportion increasing (Yao and Kong 2008). From the view of firms' growth opportunity, Liu and Yang (2006) and Wang and Mao (2010) find that the negative relationship between financial leverage and corporate investment becomes significantly stronger for firms with high growth opportunities than those with low growth opportunities (Liu and Yang 2006; Wang and Mao 2010). Based on the ownership characteristics of the listed companies, Dou and Liu (2011) gives a result that the debt-leverage-induced effect of alleviating the over-investment would be stronger in non-state-owned listed companies compare with state-owned listed companies (Dou and Liu 2011).

From the above content we can find that most researchers did not distinguish the sources of debt, and the possibly different impacts on investment from different debt are ignored. In fact, different from the Western corporates liabilities mainly rely on issuing long-term bonds, liabilities of enterprises in China are almost made up of commercial credit and bank loans. Due to commercial credit tend to be scattered and small in amount; it is difficult for commercial credit creditors bind the debtor's behavior. On the contrary, bank as professional financial institution, can obtain and deal with the borrower information with lower cost. That make bank more effectively in monitoring the problems under asymmetric information (Diamond 1984). And bank can add restrictive terms in the loan contracts to binding behaviors of enterprises. So, bank creditors are easier to supervise corporate investment behavior than commercial credit.

But there are few literatures to study how bank debt impacts firms' investment. And this paper will fill in this blank. We hope it will provide the new perspective on studying the relation between debt and corporate investment in Chinese market.

## 5.2 Hypothesis Development

Based on decentralized share, Jensen (1986) points out managers have the incentives to cause their firms to grow beyond the optimal size, because it will not only increase their control of resources, but also reward more promotion chances to middle managers (Jensen 1986). Therefore, managers will tend to invest non-profit projects to expand enterprise size with free cash flow, and produce the overinvestment.

As is known to all, centralized shares which will greatly weaken the conflict of shareholders and managers is the characteristic of China's capital market. But Yao and Kong find that controlling shareholder in order to maximize their interests also advocate building so-called "empire-building", so companies with centralized shares may have over-investment too.

While the control function of debt may alleviate firms' overinvestment behavior for the following reasons. First, managers are bonding their promise to pay out future cash flows. Second, if the companies can't repay the debt, the enterprise will be controlled by the creditors, and managers or controlling shareholders will lose the benefits obtained from the enterprise. Debt will make enterprises face more monitoring and the risk of bankruptcy.

The above theoretical analysis shows that the control effect of liabilities will make the debt negatively correlated with the scale of corporate investment. And companies' liabilities for investment are mainly from bank loans in China. In generally, it's considered there is a soft budget constraint between China's state-owned commercial banks and enterprises, especially state-owned enterprises. That makes the control effect of liabilities become weak. However, we believe that with the market-oriented and demutualization reforms of China's state-owned banking system are completed, the soft budget constraint has got a lot of harden. So we have the following hypothesis:

*Hypothesis 1:* Bank debt rate is negatively related with corporate investment, and bank debt shows control effect for overinvestment in general.

McConnell and Servaes (1995) go on to discuss the impact of financial leverage on investment (McConnell and Servaes 1995). They point out that the debt financing have both positive effect and negative effect to all enterprises, which can ease the overinvestment or result in underinvestment. They conjecture the negative effects of liabilities will be dominant in the firms with plentiful growth opportunities because at least in some cases, the liabilities force managers to give up positive net present value projects. Similarly, another reasonable conjecture is that the positive effect will predominate in firms with few growth opportunities because in at least some cases, debt keeps managers from taking on negative net present value projects.

Bank as a professional lending institutions, is considered to be the most important creditor to participate in corporate management, and bank has the ability to protect creditor's assets by interfering the behavior of enterprises. And bank has a lot of credit professionals. In order to maximize its interest, bank may provide

financial support for the identified high-growth corporates through long-term loans or short-term borrowing “extension”. So following hypothesizes are set up:

*Hypothesis 2:* The relationship between bank debt and corporate investment is significantly negative in low growth corporate; and bank debt shows control effect for overinvestment.

*Hypothesis 3a:* The relationship between bank debt and corporate investment is significantly negative in high growth corporate, and bank debt causes underinvestment.

*Hypothesis 3b:* The relationship between bank debt and corporate investment is not significant or significantly positive in high growth corporate; and bank debt performs a support to corporates’ growth.

## 5.3 Data and Methodology

### 5.3.1 Sample Construction

Our sample comes from listed companies issuing A-shares on Shanghai and Shenzhen Stock Exchanges within the period from 2008 to 2010. We restrict our sample to firms listed before the end of 2008 in order to calculate variables needed. We exclude firms without bank debt for we only care how the loans affect investment. We also exclude financial firms, firms which are special treated by CSRC and firms not given an unqualified opinion by auditor. Finally, we exclude firms with missing values. Then we get a sample including 3,625 observations in the 3 years. And our data comes from CSMAR database.

### 5.3.2 Description of Variables

This paper makes a study of how bank debt influence corporates’ investment, so the dependent variable is investment scale and bank debt is chosen to be independent variable. Whited Toni (1992), Hubbard (1997) and others, provide evidence that investment is related to Tobin’s q ratio, cash flow, sales, amount of financing and growth (Whited Toni 1992; Hubbard 1997). So we add the variable to control their effect on corporate investment. We also control the possible effect on corporate investment of the state-owned shares, shares concentration, industry and year. The computation of variables is presented in Table 5.1.

### 5.3.3 Regression Model

According to the “investment equation” developed by Aivazian et al. (2005) we construct the following model:

**Table 5.1** Variables

Variable	Symbol	Computation
Investment	Invest	The annual added value of fixed assets and construction in progress/ending total assets of last year
Bank debt	Debt	The sum of short-term loans, long-term liabilities and long-term liabilities due within one year/ending total assets
Corporate value	Q	(Total liabilities + Market value of the stocks)/total assets
Cash flow	CF	Net cash provided by operating activities/ending total assets
Growth rate	G	The growth of sale income in this year/sale income of last year
Amount of financing	$\Delta F$	Net cash provided by financing activities/ending total assets
Sales income	Sale	Sales income/ending total assets
State-owned shares	PSE	State-owned shares/total shares at the end of the year
Shares		concentration
Share	The	company's share ratio of the largest shareholder
Industry dummy	Ind	20 dummies for 21 industries (the manufacturing is according to small partitioning) coded by CRSC excepting financial
Year dummy	Year	2 dummies for 3 years

$$\begin{aligned}
Invest_{i,t} = & \beta_0 + \beta_1 Debt_{i,t-1} + \beta_2 Q_{i,t-1} + \beta_3 CF_{i,t} \\
& + \beta_4 \Delta F_{i,t} + \beta_5 Sales_{i,t-1} + \beta_6 PSE_{i,t} + \beta_7 Share_{i,t} \\
& + \sum_{j=8}^{27} \beta_j Ind_i + \sum_{j=28}^{29} \beta_j Year_i + \varepsilon_{i,t}
\end{aligned}$$

First, we make the regression for the whole samples to verify hypotheses 1. Then, sample will be divided into low-growth group and high-growth group by the mean of growth rate (the mean after excluding both ends of the extreme value of 5 %). And we will estimate the coefficient of equation model by sub-sample to test hypotheses 2 and 3.

## 5.4 Empirical Results

### 5.4.1 Debt-Investment Relationship

As panel data is used in this paper, so referencing to Aivazian's research, we estimate the investment equation using the random effect and fixed effect model as well as the pooling regression method. In this way, we can control the individual firm heterogeneity. In addition, we statistically test which methodology is most suitable for estimating corporate investment behavior. Table 5.2 shows the regressions result of whole sample.

Table 5.2 reports the regression results for the investment equation using the three different methodologies. The results show the debt-investment relationship is not robust for different empirical models. When using the fixed effect model, the relationship is negative at the 10 % significance level. But the relationship becomes positive at the 1 % significance level when the pooling regression method and random effect model are used. Except lagged sales, the impacts of the other variables on investment have the expected signs and do not change in the three models.

To identify which empirical methodology of the three is most suitable, we perform two statistical tests: the first is the F test of the fixed effect model. The null hypothesis is that there is no individual firm effect. The F statistics is reported in Row 13 of Table 5.2, and is equal to 1.19. Thus, the null hypothesis is rejected at the 1 % significance level suggesting that the pooling regression is not suitable in this case. Second, we conduct the Hausman test to select the fixed effect or the random effect models. If individual effects are uncorrelated with the independent variables, the fixed effect and random effect estimators should not be statistically different. The Chi square statistics is reported in Row 14 of Table 5.2, and the null hypothesis is rejected at the 1 % significance level suggesting that the fixed model is better.

**Table 5.2** Regression analysis of investment equation

Variable	Alternative methodologies		
	Pooling	Fixed effect	Random effect
Debt	0.139*** (4.66)	−0.126* (−1.66)	0.135*** (4.38)
Q	0.0250*** (5.55)	0.0535*** (7.30)	0.0260*** (5.68)
CF	0.655*** (30.79)	0.712*** (26.07)	0.657*** (30.80)
Sales	−0.0120 (−1.59)	−0.0528** (−2.02)	−0.0126 (−1.61)
ΔF	0.505*** (28.45)	0.514*** (22.79)	0.504*** (28.30)
PSE	0.0668*** (2.96)	0.00597 (0.15)	0.0644*** (2.79)
Share	0.136*** (4.60)	1.163*** (9.54)	0.145*** (4.72)
_cons	−0.143*** (−3.97)	0.105 (0.56)	−0.146*** (−3.89)
Ind	Control	Control	Control
Year	Control	Control	Control
F test	F(1,269, 2,326) = 1.19***		
Hausman test	chi <sup>2</sup> (29) = 165.54***		
Adj.R <sup>2</sup>	0.2867	0.3230	0.2828
Observations	3,625	3,625	3,625

Notes 1 The coefficients of Industry Dummies and Year Dummies are not listed in order to save space

2 \*Significant at the 10 % level, \*\*Significant at the 5 % level, \*\*\*Significant at the 1 % level. T-statistics are in parentheses

The results above show that the fixed effect model is most appropriate in estimating the investment equation. Thus, the corporate investment is negatively related with bank debt at the 10 % significance level. And the coefficient suggests that the investment to capital ratio decreases by about 1.26 % when the bank debt level increases by 10 %. Visibly, bank debt can bind the corporate overinvestment, and hypothesis 1 passes the test.

### 5.4.2 Impact of Growth Opportunities

Table 5.3 reports the regression results of sub-sample for high-growth and low-growth. We can find that growth opportunity has a large impact to the debt-investment relationship. In low-growth subsample, the estimated coefficient of bank debt level is negative, but it is not significant. This result shows that bank debt doesn't have the control effect for overinvestment in the low growth firms,

**Table 5.3** Impact of growth opportunities

Variable	Sub-sample	
	Low-growth	High-growth
Debt	-0.0851 (-1.60)	-0.562*** (-3.37)
Q	-0.00216 (-0.52)	0.0654*** (3.27)
CF	0.211*** (5.18)	0.651*** (6.04)
Sales	0.00769 (0.43)	0.0530 (0.83)
$\Delta F$	0.215*** (7.63)	0.402*** (6.87)
PSE	-0.0603** (-2.45)	0.111 (1.24)
Share	0.122 (1.47)	0.816*** (2.89)
_cons	0.143 (1.51)	-0.439 (-1.38)
Ind	Control	Control
Year	Control	Control
F test	$F(1,122, 823) = 1.50^{***}$	$F(1,042, 590) = 1.50^{***}$
Hausman test	$\chi^2(27) = 170.79^{***}$	$\chi^2(19) = 54.43^{***}$
Adj. $R^2$	0.2913	0.1752
Observations	1,973	1,652

*Notes* 1 The statistical tests (F-test and Hausman test) also show a result that the fixed-effect model appears most suitable. Thus, in order to save space, we only listed the regression results of fixed effects model

2 \*Significant at the 10 % level, \*\*Significant at the 5 % level, \*\*\*Significant at the 1 % level. T-statistics are in parentheses

and hypothesis 2 does not pass the test. But in the high-growth group, the relationship of bank debt level and investment is negative at the 10 % significance level. And the coefficient of debt is  $-0.562$ , much larger than the coefficient under the whole sample. Thus, we believe that bank debt make strong binding effects for corporate investment in the firms with high growth opportunities, and may be lead to underinvestment. This result provided the evidence for our hypothesis 3a instead of hypothesis 3b.

Why we have the result that different from foreign research in the low-growth firm? A reasonable explanation is that the debt management mechanism is still not effective enough in China's capital market, and result in the control effect for overinvestment of bank debt becomes weaken and even disappeared in low growth firms. Another possible explanation is that the government's easy monetary policy after the world financial crisis which in order to stimulate the economy has led to a result of monetary supply excess. And in order to pursuit profit, the bank reduced their professional skepticism when they loan debt to the low-growth firms. But this need more evidences.

## 5.5 Conclusions

In this paper, we use an unbalanced panel data of listed firms during 2008–2010 to examine the relationship between the bank debt level and the corporate investment scale. The result shows that bank debt has a significant negative effect on corporate investment behavior. In addition, this paper divides the sample into high-growth sub-sample and low-growth sub-sample. And we find that the growth opportunities do have a large impact to the relationship between bank debt and investment. In high growth firms, the debt-investment relationship is significantly negative, and high bank debt level may lead to corporate underinvestment. But in low growth firms, the impact of bank debt on corporate investment is not significant, suggesting that bank debt doesn't have the control effect for overinvestment.

In sum, we can conclude that the bank debt does not play a very good management function in corporate investment behavior. The commercial banks can strengthen the ability to forecast and distinguish firm's growth opportunities, and provide moderate financial support for high-growth firms to avoid underinvestment, implement more severe monitoring for the low-growth firms.

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# Chapter 6

## Comparative Study of Our Commercial Banks' Efficiency

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**Abstract** This article based on DEA correction model studies the efficiency of 13 commercial banks in China from 1997 to 2008. The result indicated that the efficiency of this 13 commercial banks as a whole was rising, but in which the joint stock commercial banks' efficiency value better than the state owned commercial banks'. From the perspective of efficiency improvement, there were big differences among 13 commercial banks, but in short that 4 state owned commercial banks' efficiency improvement better than 9 joint stock commercial banks'.

**Keywords** Commercial banks • Data enveloping analysis (DEA) • Efficiency

The evaluation "Finance is the core of modern economy" deeply reveals the important role of finance in modern economic development. Commercial bank as the main body of the financial industry holds an important position in a country's financial and economic system. In the financial system, commercial bank is the primary transmitter of the central bank's monetary policy. From the economic system, commercial bank is important hinge in modern social economy development. In case of indirect financing is the main form in China's finance system, commercial bank guides value stream to logistics, and monetary capital movement to material resources. The efficiency of commercial bank sector not only direct relates to social resource allocation but also produces an effect on a country's financial and economic development. As special enterprise the primary goal of commercial bank is maximize profits which closely related to efficiency. As financial intermediaries, the main task of commercial bank is to contribute to the formation of monetary flow. So the commercial bank has to making and selling, which in fact is the cost benefit issues, equal to efficiency issues. Therefore, the issue of efficiency has always been taken serious by government and scholars.

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Domestic bank efficiency started relatively late than foreign, the initial studies tended to use single factor indicators to analyze, and most of them are static analysis. In recent years, using of cutting edge efficiency analysis methods to measure bank efficiency became the mainstream approach of commercial efficiency research. Some scholars made some theoretical and empirical research on the efficiency of China's commercial banks from our actual situation.

## 6.1 DEA Model Introduced

The DEA model which was originally proposed by Charnes and Cooper, Rhodes in 1978 is a nonparametric forefront efficiency analysis method, using input oriented method to measure technical efficiency under the assumed conditions of constant returns to scale. Subsequently, Banker, Charnes and Cooper proposed a variable returns to scale DEA model in 1984 to measure pure technical efficiency and scale efficiency (Alhadeff 1954; Schweiger and McGee 1961; Beston 1972; Banker and Morey 1986).

### 6.1.1 Constant Returns to Scale Model (CRS) and Technical Efficiency (TE)

Assumes that there are  $n$  banks, each bank has  $k$  inputs and  $m$  outputs,  $x_i$  and  $y_i$  shows the vectors of  $i$  bank.  $x_{k \times n}$  indicates  $k$ -dimensional input matrix,  $Y_{m \times n}$  indicates  $m$ -dimensional output matrix. We need to measure the proportion of all outputs and all inputs of each bank, that is  $u' y_i / v' x_i$ ,  $u$  is  $m \times 1$ -dimensional output weight vector,  $v$  is  $k \times 1$ -dimensional input weight vector. Assumed constant returns to scale, optimal weights can be obtained by solving the mathematical programming problem.

$$\begin{aligned} & \max_{u,v} (u' y_i / v' x_i) \\ & s.t. \ u' y_j / v' x_j \leq 1 \quad j = 1, 2, \dots, n \\ & \quad u, v \geq 0 \end{aligned}$$

The above function is the weighted proportion of outputs and inputs of the  $i$ -bank. Increasing constrain  $v' x_i = 1$  in order to avoid more than a poor solution. So the above mentioned mathematical programming problem becomes:

$$\begin{aligned} & \max_{\mu,v} (\mu' y_i) \\ & s.t. \ v' x_i = 1 \\ & \quad \mu' y_j - v' x_j \leq 0 \quad j = 1, 2, \dots, n \\ & \quad \mu, v \geq 0 \end{aligned}$$

where  $\mu$  is  $m \times 1$ -dimensional vector, which are multiple linear programming problems. Using linear programming duality principle, we can figure out this problem's equivalent form:

$$\begin{aligned} & \max_{\theta, \lambda} \theta \\ & s.t. -y_i + Y\lambda \geq 0 \\ & \theta x_i - X\lambda \geq 0 \quad i = 1, 2, \dots, n \\ & \lambda \geq 0 \end{aligned}$$

$\theta$  is a scalar, and  $\lambda$  is the  $n \times 1$ -dimensional constant vector. According to the definition of Farrell in 1957,  $\theta$  is the efficiency value of  $i$ -bank, to meet the  $0 \leq \theta \leq 1$ . When  $\theta = 1$ , the efficiency value of the bank in the efficiency cutting edge surface, which is technically valid,  $1 - \theta$  is the unnecessary input ratio of  $i$  decision making unit. We can get each bank's efficiency after  $n$  times solving of above equation. The efficiency values which were figured out by scale invariant models are technical efficiency.

### 6.1.2 Variable Returns to Scale Model (VRS) and Scale Efficiency (SE)

Banker, Charnes and Cooper in 1984 proposed the variable returns to scale model which removes the influence of scale efficiency when calculates the technical efficiency, so the outcome of this model is pure technical efficiency value. If we increase one constrain condition  $N1'\lambda = 1$  on CRS model, which will transforms to VRS model, the procedure is:

$$\begin{aligned} & \max_{\theta, \lambda} \theta \\ & s.t. -y_i + Y\lambda \geq 0 \\ & \theta x_i - X\lambda \geq 0 \\ & N1'\lambda = 1 \\ & \lambda \geq 0 \end{aligned}$$

In this procedure  $N1'$  is  $n \times 1$ -dimensional vector. Because of  $TE = PTE \cdot SE$ , the VRS model's measured efficiency values are larger than CRS', which indicates that the observation point of VRS model is closer to efficiency frontier.

The values measured by DEA model are between 0 and 1, if the sample bank's efficiency value is closer to 1, indicates that the efficiency of sample bank is better (Lang and Welzel 1996; Molyneux 1997; Clark and Speaker 1994; Farrell 1957; Berger and Humphrey 1998)

## 6.2 The DEA Model Amendments: Cross Evaluation Mechanism (DMU)

The efficiency value of DMU can be taken to 1 in practical problems, so we can not distinguish that which decision-making unit is better only by the value of  $E_{ii}$ .

In models each  $DMU_i$  calculates the values of  $E_{ii}$  using the best conducive weight. The  $DMU_i$  will give more weight to the input and output indicators which is good for  $DMU_i$  calculate the value of  $E_{ii}$ , and the contrary situation is that the  $DMU_i$  will give less weight or zero to the input and output indicators which not well for  $DMU_i$  calculates the value of  $E_{ii}$ . These models only concerned about a small number of favorable inputs and outputs indicators and without attention to other indicators calculates the efficiency value of  $E_{ii}$  that can not fully reflect the pros and cons of  $DMU_i$ .

One way to solve this problem is to introduce the cross evaluation mechanism. The basic idea of the cross evaluation mechanism (the cross evaluation) is: To calculate the efficiency value of other  $DMU_k$  through the best weights  $w_i^* = \left[ \frac{v_i^*}{u_i^*} \right]$  of each  $DMU_i$ , the cross evaluation values is  $E_{ik} = \frac{y_k^T u_i^-}{x_k^T v_i^+}$ .

The greater of value  $E_{ik}$  the more favorable for  $DMU_k$ , and the greater of value  $E_{ik}$  the more unfavorable for  $DMU_i$ .

But linear programming optimal solution  $u_i^*$  and  $v_i^*$  is not unique, cross cutting evaluations value  $E_{ik}$  obtained by the equation uncertainty, Aggressive cross evaluation can be used to solve this problem. The calculating steps of aggressive cross evaluation are: (1) obtained self evaluation value  $E_{ii}$  of each  $DMU_i$  firstly; (2)  $DMU_k$  gets the smallest possible cross evaluation value on the condition that ensures  $DMU_i$  gets the maximum value of  $E_{ii}$  (Sathye 2003; Leibenstein 1966; Berger and Master 1997; Coelli 1996; Doy and Green 1993, 1994)

## 6.3 Variables, Sample, Selection and Data Description

About choice of input indicators and output indicators, a combination of production and intermediary wears was be taken. Just like Labor, fixed assets and loadable funds and so on as input indicators, Interest income and non interest income as output indicators.

The sample data choose 4 state owned commercial banks including Bank of China, Agricultural Bank of China, Industrial and Commercial Bank of China, China Construction Bank, and 9 joint stock commercial banks including Bank of Communications, CITIC Industrial Bank, Huaxia Bank, China Minsheng Bank, Guangdong Development Bank, Shenzhen Development Bank, China Merchants Bank, Industrial Bank, Pudong Development Bank. These 13 commercial banks which accounted for more than 90 % of the total assets of commercial banks in China can fully reflect the level of overall efficiency of China's commercial

banking industry. Sample data time span of 10 years, from 1998 the ending year of Asia financial crisis to 2007 the China joint stock reform of state owned commercial banks.

## **6.4 The Empirical Analysis of China's Commercial Banks Based on DEA Cross Evaluation Mechanism Model**

DEA cross evaluation mechanism model which refers to a large number of linear programming involves a very large amount of calculation. We use mathematical software MATLAB7.0 to write the procedures for calculating, and this 13 commercial banks efficiency value table on the following.

According to the results of empirical analysis on Table 6.1, we can see:

### ***6.4.1 China's Commercial Banks Efficiency Level on Upward Trend***

These 13 commercial banks efficiency values overall on upward trend from 1998 to 2007. This outcome also indicated china's commercial banks efficiency level on upward trend at same time.

It can be seen from Table 6.2 and Fig. 6.1, the average efficiency value of commercial banks of China showed a rising trend during the period 1998–2007, which from 0.5456 in 1998 up to 0.7289 in 2006, and the increasing rate was 33.59 %. From the chart I we can see that there were fluctuations of average efficiency in the periods 1998–2001 and 2005–2007 of china commercial banks. But in period 2001–2004 the average efficiency showed a rising trend with increasing rate about 2.8 %. There were two reasons bring about this situation: First, due to the impact of accession to the WTO, the domestic commercial banks have adopted a strategy to reduce costs in order to improve efficiency and win in the competition. Second, thanks to the support of the government policy, especially the four state owned banks get more policy support. In words, the efficiency of China's banking industry in recent years, especially after 2001, showed a trend of overall improvement. But the efficiency which is 0.5907 in 2007 down warded, compared with the decline 0.14 of 2006. The main reason is probably that this time is the end period of protection of accession to the WTO, foreign banks which began to take advantage of policy seized a number of quality clients with quality service and excellent human resources strategy, and thus our small and medium commercial banks suffered from this phenomenon. The overall efficiency of china banking industry also declined.

**Table 6.1** 1998–2007 annually efficiency values of 13 commercial banks based on DMU

Years	1998	1999	2000	2001	2002
ICBC	0.3699	0.4354	0.4745	0.5758	0.5519
ABC	0.373	0.3938	0.421	0.43	0.4271
BOC	0.4452	0.5703	0.6904	0.8008	0.6408
CCB	0.4111	0.4444	0.4692	0.4957	0.5031
BC	0.5822	0.631	0.6407	0.8028	0.7239
CITIC	0.5624	0.5196	0.4399	0.6873	0.7309
HXB	0.5172	0.7347	0.8374	0.8422	0.837
MS	0.4666	0.6705	0.8118	0.8331	0.7512
GDB	0.4489	0.6753	0.4775	0.7693	0.8187
SZDB	0.7713	0.6516	0.7431	0.6749	0.7419
CMB	0.8505	0.8893	0.7591	0.5411	0.5539
IB	0.5055	0.5627	0.3972	0.6605	0.8509
PDDB	0.7888	0.696	0.5169	0.635	0.6984
<i>Year</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>
ICBC	0.6156	0.6155	0.534	0.5899	0.4745
ABC	0.4547	0.4241	0.4466	0.5866	0.421
BOC	0.7011	0.6641	0.6364	0.7323	0.6904
CCB	0.5791	0.5748	0.5287	0.6298	0.4692
BC	0.5989	0.6021	0.5363	0.5928	0.6407
CITIC	0.5526	0.5989	0.6256	0.7251	0.4399
HXB	0.8293	0.7427	0.8174	0.8944	0.8374
MS	0.7977	0.8637	0.6684	0.7702	0.8118
GDB	0.8343	0.9021	0.7642	0.6526	0.4775
SZDB	0.7857	0.7406	0.6567	0.8182	0.7431
CMB	0.6039	0.7131	0.7927	0.8531	0.7591
IB	0.7906	0.7589	0.6867	0.8316	0.3972

*Data sources* from “Chinese finance Yearbook” and “statistical yearbook”

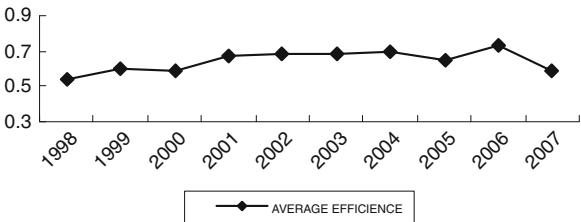
**Table 6.2** Commercial bank average efficiency values

Years	1998	1999	2000	2001	2002
YearsAverage	0.5456	0.6057	0.5907	0.673	0.6792
<i>Years</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>
Average	0.6861	0.6918	0.6476	0.7289	0.5907

### 6.4.2 State Owned Commercial Banks and Joint Stock Commercial Banks

From Fig. 6.2 we can see that the average efficiency values of 4 state owned commercial banks on raise from 1998 to 2001, the increasing rate was 32.74 %, and the average efficiency values fluctuated after 2001. Average efficiency values

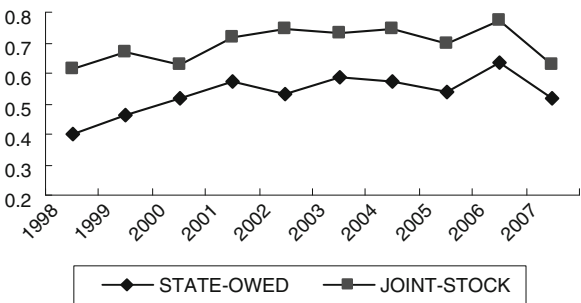
**Fig. 6.1** Commercial bank average efficiency



of the joint stock commercial banks in the sample period on overall upward trend. In addition, the average annual efficiency of the joint stock banks were higher than the average efficiency of the four state owned commercial banks, the biggest difference value was 0.2145 showed in 2002. Generally speaking, the operational efficiency of the joint stock commercial banks was higher than that of state owned commercial banks during the sample period (Table 6.3).

Government policy has a certain tendency to state owed commercial banks, which decide that the four state owned banks efficiency improvement rates were significantly higher than that of other joint stock banks from 1998 to 2006, in this period the average efficiency values of the 4 major state owned commercial banks increased 58.75 %, the average efficiency values of the 9 joint stock commercial banks increased 26.26 %. In 1998, the central government issued 270 billion yuan special treasury bonds to supplement the capital of the state owned commercial banks, the State Council set up four asset management companies responsible for bad debts of state owned banks, after short time the major state owned commercial banks had been achieved joint stock restructuring in support of government policy. The state owned banks had a greater improvement in resource utilization after these series reforms. In that time other joint stock banks have to kept high cost because of short time founding, low market share rate and business strategy of expansion, inevitably led to low efficiency.

**Fig. 6.2** The average efficiency value of state owned and joint stock commercial bank



**Table 6.3** The average efficiency value of state owned and joint stock commercial banks

Years	1998	1999	2000	2001	2002
YearsState owed	0.3998	0.461	0.5138	0.5756	0.5307
Jointstock	0.6104	0.6701	0.6248	0.7162	0.7452
Difference	0.2106	0.2091	0.1111	0.1407	0.2145
Years	2003	2004	2005	2006	2007
State owed	0.5876	0.5696	0.5364	0.6347	0.5138
Jointstock	0.7299	0.7461	0.6971	0.7707	0.6248
Difference	0.1423	0.1765	0.1606	0.1361	0.111

### 6.4.3 Commercial Banks Efficiency Improvements Differences

It can be seen from Table 6.1, Bank of China each year efficiency values are greater than the other three state owed banks, and improved as much as 55.08 % rising rate from 0.4452 in 1998 to 0.6904 in 2007. The efficiency value was 0.8008 in 2001 of Bank of China, which is the maximum efficiency value of the four state owned commercial banks during the sample period. In 1998–2001, the efficiency values of Industrial and Commercial Bank of China, Agricultural Bank, Bank of China were on rising, and fluctuated after 2001. Except for 1998 and 2001, the efficiency values of Agricultural Bank of China in four state owned banks in low position, and the minimum efficiency value also appeared in the ABC of the sample period. Low efficiency of ABC related to its distribution network and clients, because its network was largely in rural areas, and clients were mostly low income farmers, these two reasons had caused weakly profitability of ABC and impacted its efficiency.

In 9 joint stock banks, the top few are Huaxia Bank, China Minsheng Bank, Shenzhen Development Bank and China Merchants Bank. Especially Huaxia Bank, China Minsheng Bank, Shenzhen Development Bank's had balance development, little change in the efficiency values. There were some fluctuations of efficiency values of the Merchants Bank in sample period, the efficiency value from 0.8505 in 1998, reduced to 0.5411 in 2001, then began to rise after 2001. This phenomenon closely related to CMB development business investment which affected the efficiency of the bank in early stage, but with the organization's continuous improvement the efficiency value was continue to raise since 2001. The efficiency values of the Shanghai Pudong Development Bank had been relatively stable. Efficiency values of the Guangdong Development Bank ranked in the middle position of 9 joint stock banks, the efficiency value in 2004 reached 0.9021 which is the highest efficiency value of all sample joint stock commercial banks. Efficiency values of Bank of Communications, CITIC Bank with fluctuations, and the efficiency values need to be improved.

## 6.5 Empirical Analysis Summary

This paper researched the efficiency of the 13 commercial banks in China from 1996 to 2007 through the DEA cross evaluation mechanism. We can see that in the sample data period the efficiency of China's commercial banks on upward trend in whole, but the efficiency of the joint stock commercial banks better than the basic state owned commercial banks. Analyzed from the perspective of efficiency improvement, the improvement degree of average efficiency of the 4 state owned banks is greater than what of the 9 joint stock banks. There is a big difference of efficiency improvement degree on various commercial banks.

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# Chapter 7

## Comparative Study of the Executive Compensation Validity Between the Entity Economy and Virtual Economy Listed Company

Kun Zhang and Ming-yue Cui

**Abstract** In modern economic system, the average of the virtual economy enterprise executive compensation was significantly higher than the entity economy enterprises, and it is prone to extreme high pay executives. In this paper, we make a correlation analysis and comparison between the agricultural listed companies and financial industry listed company executive compensation and performance of the company, and give some suggestions on the design and effective development of the executives' incentives of listed companies.

**Keywords** Listed companies • Executive compensation • Company performance • Comparison

### 7.1 Introduction

About the listed company executive pay validity, other scholars at home and abroad have conducted research and have made the corresponding research results. However, is still rare for the comparative study of the effectiveness of the executive pay in listed companies within the context of the entity economy and the virtual economy. Research on this issue and striving to obtain the corresponding research results, have a major significance for a deeper, comprehensive understanding of the executive pay validity of these two types of listed companies. This paper intends to do on some useful exploration about the issue.

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The entity economy and virtual economy are the two economic forms in modern market economy. In recent years, enterprises under the form of virtual economy, with industry particularity, is often able to attract more investors' in the capital markets, and the average of the executive compensation of the industry is also higher, and Increased year by year (Xie and Guo 2011). However, this does not suggest that the executive compensation incentive of virtual economy enterprises is stronger than the entity economy enterprises. Considering the similar number of the listed companies of agriculture under the entity economy and financial industry under the virtual economy, this paper discussed from this perspective the effectiveness of the executive compensation validity between the entity economy and virtual economy listed company.

## 7.2 Research Hypothesis and the Framework

Agency theory says that managers' pay plan should be designed to make the interests of managers and shareholders consistent. Because principals' and agents' information is asymmetric, only shareholders and executives to signed a "reward performance" contract, can it reduce the agency costs, and maximize the operational efficiency (Guo 2008). Human resources theory suggests that the role of human capital' improvement to improve the performance, is much more important than physical capital increase. The human capital of corporate senior managers has the characteristics that the general staff do not have. So they should be given more Incentive and compensation. Only when the company gave them the pay fully enough to motivate them, can it avoid directors and senior managers do not consider what they should think. Under the "reward performance" contract, you can increase the return on the target as long as improving business performance and the corporate executives will work hard with high efficiency, resulting in the improvement of business performance and a corresponding increase in remuneration of executives (Rehbein 2007). Enterprises in the two different economic forms of entity economy and virtual economy, and the industry executives' corresponding average rate of return may vary toward corporate performance. Therefore, we propose the following assumptions:

H1: The executive compensation of entity economy (agriculture) listed companies is positively related to the company performance.

H2: The executive shareholding ratio of entity economy (agriculture) listed companies is positively related to the company performance.

H3: The executive compensation of virtual economy (financial industry) listed companies is positively related to the company performance.

H4: The executive shareholding ratio of virtual economy (financial industry) listed companies is positively related to the company performance.

H5: The executive compensation validity of entity economy (agriculture) listed company is more significant than that of virtual economy (financial industry).

## **7.3 Research Samples and Variable Selection**

### ***7.3.1 Data Source and Samples***

In accordance with the classification criteria of the SFC industry, we selected listed agricultural companies and listed companies of the financial industry that listed A shares as the research samples, we take the annual data of 2011 that listed companies reported for analysis. To use sampling mode select sample each other, detail principle of sampling shows below: (1) Reject ST and PT companies of poor performance and listed companies have been proposed qualified opinion, disclaimer of opinion, adverse opinion by certified public accountant. (2) New listed companies have been considered business performances that easily appear abnormal fluctuate, so new listed companies are also not been included in sample after 2011. (3) Reject deficiency samples of related business performance index. According to the above principles, the paper selects 39 companies of agricultural and 37 companies of financial industry listed companies as the final study sample.

The source of data is published relative information which is listed companies annual report as CSMAR database from exchange website in the two cities of Shenzhen and Shanghai. We wield SPSS 16.0 to analyze the data.

### ***7.3.2 Variables and Research Model Definition***

#### **7.3.2.1 Dependent Variable**

Rate of return on Net Assets (ROE): the ratio of net profit and net assets, it is a comprehensive financial ratios, and it can reflect company solvency, profitability and operational capacity from many aspects (Zhang and Gao 2011).

#### **7.3.2.2 Independent Variable**

1. Executive Compensation (InCOMP): calculated based on executive compensation of the top three in total from the annual reports of listed companies.
2. Executive Shareholding Ratio (MSR): when executives hold shares of the company, they have the residual claim, the better the performance of the company, the higher their returns. So when executives hold shares of the company, they will be more motivated to improve the company's performance (Zhang and Qi 2010).

**Table 7.1** Variable declaration table

Variable type	Variable name	Variable symbol	Variable definition
Dependent variable	Rate of return on net assets	ROE	Net profit/average shareholders' equity
Independent variables	Executive compensation	lnCOMP	Executive compensation of the top three in total
	Executive shareholding ratio	MSR	Managerial ownership/company total shares
Control variable	Earnings per share	EPS	Net income/weighted average of ordinary shares
	Company size	SIZE	Total liabilities/total assets
	Asset-liability ratio	LEV	Total liabilities/total assets

**7.3.2.3 Control Variable**

1. Earnings Per Share (EPS): the ratio of current net income with the weighted average of outstanding common shares issued, it is one of the financial indicators to measure the profitability of listed companies, and it reflects the level of ordinary shares in the profit (Zhang and Yang 2012).
2. Company Size (SIZE): total assets at the end of the year. According to management theory, the larger the size of the company, the more levels of management in the organization, the more resources executives control.
3. Asset-liability Ratio (LEV): the ratio of total liabilities with total assets at the end of the year, Used to measure the company's capital structure (Du and Wang 2007) (Table 7.1).

For H1, H2 and H3, the company performance index is used explained variable. Executives average salaries, executive shareholding ratio, earnings per share, company size and asset-liability ratio are used explanatory variable and control variable. Create fundamental multiple a regression equation. The equation is showed below:

$$ROE = \beta_0 + \beta_1 * lnCOMP + \beta_2 * MSR + \beta_3 * EPS + \beta_4 * SIZE + \beta_5 * LEV + \mu$$

*ROE* is dependent variable,  $\beta_0$  is constant term,  $\beta_1\beta_2\beta_3\beta_4\beta_5$  is regression coefficient,  $\mu$  is random error, the others are independent variable.

**7.3.3 Sample of Descriptive Statistics**

As can be seen from Tables 7.2 and 7.3, the maximum (approximately 17.04) of executive pay logarithm of listed companies of the financial industry, minimum (approximately 14.51), mean (approximately 15.72), are greater than agricultural

**Table 7.2** Descriptive statistics (agriculture)

	N	Minimum	Maximum	Mean	Std. deviation
ROE	39	-1.935667	0.220539	-4.84438462E-3	0.366638326
lnCOMP	35	12.568630	14.882391	13.74846459	0.6948010037
MSR	39	12.14	58.11	42.8656	14.32336
EPS	39	-2.0000	1.6800	0.293887	0.6405891
SIZE	39	5.72E8	1.80E10	2.8800E9	3.35114E9
LEV	39	0.0351742	0.9371737	0.393101607	0.2323757867
COMP	35	2.87E5	2.91E6	1.1627E6	7.44188E5

**Table 7.3** Descriptive statistics (financial industry)

	N	Minimum	Maximum	Mean	Std. deviation
ROE	37	-0.049104	0.373102	0.12272373	0.084389556
lnCOMP	33	14.519697	17.045772	15.71553797	0.6341247991
MSR	37	8.43	57.42	38.3022	18.39024
EPS	37	-0.24	2.47	0.6634	0.63127
SIZE	37	9.32E8	1.55E13	2.0331E12	3.99897E12
LEV	37	0.2871071	0.9518108	0.706205281	0.2290380959
COMP	33	2.02E6	2.53E7	8.1245E6	5.47739E6

listed companies (respectively about 14.88, 12.56, 13.74). Executive compensation of the two industries has such problems. This shows that, the executive pay of listed companies of financial industry is higher than that of listed companies of agriculture, and the degree of dispersion is higher than that of listed companies of agriculture.

As for the indicator MSR that reflect the executive shareholding ratio of the company executives, the mean of listed companies of financial industry is about 30.30, the standard deviation is about 18.39; the mean of listed companies of agriculture is about 42.87, the standard deviation is about 14.32. The respective mean and standard deviation of the two industries vary greatly, it means the two industries' executive shareholding ratio vary greatly.

## 7.4 The Empirical Results

1. As can be seen from Tables 7.4 and 7.5, the performance of the agricultural listed companies is positively related to their executive compensation (lnCOMP) and executive shareholding ratio (MSR), assumption 1 and assumption 2 are established. However, according to the correlation coefficient, the correlation is not significant. As for the control variables, among three control variables, only earnings per share (EPS) is significant positive correlated to return on net assets (ROE) in the 1 % level, and positively related to executive compensation (lnCOMP) and executive shareholding ratio (MSR),

**Table 7.4** Correlation coefficient matrix (agriculture)

	ROE	lnCOMP	MSR	EPS	SIZE	LEV
ROE	1	0.121 (0.489)	0.147 (0.372)	0.809** (0.000)	0.017 (0.919)	-0.529** (0.001)
lnCOMP		1	-0.023 (0.895)	0.143 (0.412)	0.255 (0.140)	-0.275 (0.110)
MSR			1	0.284 (0.080)	0.229 (0.161)	-0.219 (0.181)
EPS				1	0.000 (0.998)	-0.557** (0.000)
SIZE					1	0.253 (0.120)
LEV						1

\*\* Correlation is significant at the 0.01 level (2-tailed)

**Table 7.5** Correlation coefficient matrix (financial industry)

	ROE	lnCOMP	MSR	EPS	Size	LEV
ROE	1	0.049 (0.786)	-0.100 (0.554)	0.540** (0.001)	0.443** (0.006)	0.447** (0.006)
lnCOMP		1	-0.038 (0.833)	0.270 (0.129)	-0.034 (0.852)	0.217 (0.225)
MSR			1	-0.264 (0.115)	0.573** (0.000)	0.306 (0.065)
EPS				1	0.086 (0.612)	0.567** (0.000)
SIZE					1	0.523** (0.001)
LEV						1

\*\* Correlation is significant at the 0.01 level (2-tailed)

so we can see that earnings per share (EPS) is one of the factors that affect corporate performance and executive pay.

- As can be seen from Tables 7.5 and 7.6, the performance of the financial industry listed companies is positively related to their executive compensation (lnCOMP), but is not related to executive shareholding ratio (MSR), therefore, assumption 3 is established, assumption 4 does not. Similarly, although the company performance is related to executive compensation (lnCOMP), the correlation is not significant. In this model, the control variables, earnings per share (EPS), the company size (SIZE) and asset-liability ratio (LEV) are significant positive correlated to return on net assets (ROE) in the 1 % level.
- As can be seen from Table 7.6 the executive compensation (lnCOMP) and executive shareholding ratio (MSR) of the agriculture listed company are morerelated to the performance of than the financial industry listed company,

Table 7.6 Comparison of full-variable regression

Model	Agriculture				Financial industry			
	Coefficients			t	Coefficients			t
	B	Std. error	Sig.		B	Std. error	Sig.	
(Constant)	0.556	1.003	0.583	0.554	0.064	0.847	0.076	0.940
lnCOMP	0.032	0.067	0.639	-0.474	0.009	0.056	0.154	0.879
MSR	0.003	0.003	0.303	-1.049	-0.002	0.001	-1.938	0.064
EPS	0.438	0.078	0.000	5.642	0.054	0.029	1.857	0.075
SIZE	1.043E-11	0.000	0.508	0.670	1.321E-14	0.000	2.915	0.007
LEV	-0.256	0.253	0.318	-1.015	-0.009	0.078	-0.110	0.914
R-Square	0.683				0.520			
Adjusted R-Square	0.628				0.409			
F-statistic	12.498				4.689			
Sig.(F-statistic)	0.000				0.002			

<sup>a</sup> Predictors: (Constant), lnCOMP, MSR, LEV, SIZE, EPS

<sup>b</sup> Dependent Variable: ROE

that is to say, its executive compensation validity is significant than that of the financial industry listed company. Assumption 3 is established. But we can see from the correlation coefficients (0.32, 0.03 and 0.09,  $-0.02$ ) of the indicators, each index is not significantly related to the performance of the company, or is negatively correlative. It means that China's agricultural and financial industry listed companies' compensation system is not a good Incentive to company executives, so the salary incentive system is not reasonable.

## **7.5 Conclusion Analysis and Countermeasures**

### **7.5.1 Conclusion**

From the third part of the data analysis we can clearly see that although the executive compensation of the agricultural listed companies is related to their company performance, the correlation is not significant. The financial industry' is similar, but the executive shareholding ratio is not related to their company performance. Through the data can also be found that the financial industry executive compensation and its profits growth are difficult to converge, and the relevance is small. So how to establish and change executives pay reasonably according to the company's performance index is a big problem. Similarly, from the analysis, we can also know that the executive compensation of the agriculture listed company is more related to the performance of than the financial industry listed company. If this problem couldn't be solved for a long time, it may lead to executive compensation of the entity economy company relatively lower than that of the virtual economy, result to the dissatisfaction of the entity economy executives, and reduce their work efficiency. This requires the government's concern, identify the common problems of the financial industry in the aspect of executive pay incentives, and solve them.

### **7.5.2 Countermeasures**

1. Establish the decision mechanism of executive pay that accords with the characteristics of their industry.

Based on modern company management features, finding and designing a reasonable and effective index system of performance evaluation is the premise of enhancing the related degree of compensation performance (Kathy and Assem 1999). Each listed company should according to their own industry characteristics develop a comprehensive evaluation index that has both the universality and the industry specificity of the listed companies, give each quantitative and qualitative

evaluation index the corresponding weights, comprehensively considering the executives' contribution to the company, combine their personal interests with corporate short and long term interests, avoid executives' manipulation of the surplus.

2. Determine a reasonable and comprehensive performance assessment goal.

Determine a reasonable and comprehensive performance assessment goal, consistent changes in executive compensation with changes in company performance. In the salary incentive system that takes performance compensation as the subject, we must determine the reasonable comprehensive performance assessment index. Agricultural and financial industry listed company's executive compensation is linked to a number of indicators of company performance, so the assessment of executive performance must be based on a wide range of factors rather than a single standard, to avoid executives in pursuit of a single performance at the expense of other important aspects of the company (Balsam 2007).

The performance assessment target for executives should include the business unit' performance and individual performance, In order to stimulate executives combine the individual struggle with group coordination and make more contributions to improve the company's overall performance.

3. Taking into account the short-term growth and long-term development of the business, note the appropriate combination of short-term incentives and long-term incentive of the pay system.

The listed companies in China at present only concerned about the short-term profitability, lack of concern on the long-term interests. Long-term incentives are mainly reflected in the plan of stock option incentive that linked with the company's stock price (Chen 2002). The good performance of the stock market not only makes senior executives get rich report while in office, but also can be rewarded in retirement, this in effect increased the executives' concern about the company's long-term development, and make them to take the short-term growth and the long-term development into account.

4. Executive talent to be further market-oriented.

Compared with the agriculture listed company, finance and insurance industry listed companies in China, especially the larger several are all state-owned monopoly, so senior executives also are mostly appointed by the government, rather by competition in the market, therefore the level of their business may not have a very high standard. So in the finance and insurance industry listed companies managers' market competition mechanism should be pushed, basing on the inside and outside talent market, making full use of the function of the talent recommendation intermediary organizations, conducting the open and transparent approach, choosing professionals that the company's development needs to join the company.

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# Chapter 8

## Corporate Finances and Investor Relations Management: Empirical Evidence from the Chinese Listed Companies

Zhong-xin Wu and Yi-zhou Liu

**Abstract** In order to systemically develop researches on the financial situation's influence on investor relations, this paper chooses 348 Chinese listed companies as a sample and develops an empirical research on the financial situation's influence on the level of IR. The 12 indicators factor in the multivariate statistical analysis will reflect the financial situation of enterprises owned by five factors: profitability factor, operating capacity factor, shareholder profitability factor, business growth capacity factor and solvency factor. The results show that investor relations are positively related to the corporate profitability, development capability as well as company size. The result of this thesis has strong policy implications for the listed companies to concern about the financial situation of enterprises, and to improve the management of investor relations.

**Keywords** Financial situation of enterprises · Investor relations management · Influencing factors

### 8.1 Introduction

Investor relations management (IRM) originated in the west mature capital market. It is a product of market development and the rise of equity culture. In recent years, due to the integrity problems which caused by the crisis of confidence,

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Chinese enterprises renewed to draw a highly attention on the financial sector and the business sector to promote the exchange of listed companies and the investing public to communicate investor relations management business. On July 11, 2005, the China Securities Regulatory Commission issued the listed company and investor relations work guidelines, the guidelines further promote the in-depth development of the listed company and the investor relations management. Consequently, it has a positive meaning on promoting the cultural construction of China's securities market equity and market integrity shape, formed to protect the interests of investors in the market environment. However, in 2011, China's stock market ups and downs, and A-share fell down the point of 2,300 in the Shanghai Stock Exchange, falling back to the level of 10 years ago. This fully shows that the normative of the stock market remains to be strengthened, and the corporate governance still needs to improve, while the investor relations management is an important element of corporate governance. IRM is a complex concept; it is closely related to a series of activity is which include investment activities, financing activities, issuing new shares, disclosure and reporting requirements across the enterprise management, marketing, financial management and other disciplines. This study will be reviewed the existing research on investor relations management, and do an empirical analysis of the Chinese listed companies, to explore the impact mechanism of the enterprises and the most critical factors, and to improve the existing investor relations management.

## **8.2 Data Selection and Variable Definitions**

### ***8.2.1 Data Selection***

This article select the 2012 year's public disclosure of 472 listed companies in China as a sample, excluding \*ST, ST, S\*ST, SST 82 companies, excluding 10 listed companies in the finance and insurance companies, finally removing observation period not listed on the Web site and the Web site inaccessible 32 companies, eventually got the 348 sample companies.

### ***8.2.2 Variable Definition***

#### **8.2.2.1 Explained Variables: Internet Investor Relations Index**

Investor relations evaluation method can be summarized into two. one is building of the investor relations management index (Li Xin Dan 2005, 2006, 2007; Malian et al. 2008; He Yu 2009); the other is the use of content analysis method(such as Bin 2005; Malian et al. 2006). This article draw on the research results of Bin

(2005), calculating date between January 1, 2012 to May 2012, which is consisted of 48 website index.

8.2.2.2 Explanatory Variables: Financial Situation of Enterprises

As a result of reflecting the financial situation of the index is numerous and each index exists some correlations, the use of factor analysis can well solve the above problem, the variables are classified, use a factor to reflect most information of original data, simplifying the listing Corporation financial condition index. In this paper, according to the CSMAR database for listing Corporation financial index analysis, finally to 5 categories of 12 indicators (Table 8.1).

Steps to factor analysis of listed companies’ financial status as follows.  
Firstly, the appropriate indicators (current ratio, quick ratio, asset-liability ratio) should use the formula  $X = 1 \div |Xi - \overline{Xi}|$  for positive processing.

Secondly, in order to avoid different dimensions, the original data needed to be standardized.  $Xij' = (Xij - \overline{Xi}) \div Si$ , where  $Xij$  represents  $j$  index value of the  $i$  company.

$$\overline{Xi} = \frac{1}{n} \sum_{j=1}^n Xij$$
$$si = \sqrt{\frac{1}{(n - 1) \times \sum_{j=1}^n (Xij - \overline{Xi})^2}}$$

Thirdly, using KMO and Bartlett’s test to determine whether suitable for factor analysis (Table 8.2), KMO = 0.597, Bartlett’s value is sinificant ( $P < 0.01$ ), which meet the requirements of factor analysis.

Fourth, extracting the common factor and circulating factor loading matrix, we can get rotated component matrix, initial eigenvalues and cumulative contribution

Table 8.1 The financial indicators and abbreviations

Profitability index	Operating capacity index	Solvency index	Growth index	Shareholder profitability index
Return on asset (X1)	Current asset turnover (X4)	Current ratio (X6)	Total asset growth rate (X9)	Price to book rate (X11)
Return on equity (X2)	Total asset turnover (X5)	Quick ratio (X7)	Operating income growth rate (X10)	Tobin Q (X12)
Weighted average return on equity (X3)		Asset-liability ratio (X8)		

**Table 8.2** KMO and Bartlett's test

Kaiser–Meyer–Olkin measure of sampling adequacy		0.597
Bartlett's test of sphericity	Approx Chi Square	3648.409
	df	66
	Sig.	0.000

rate of variance. Specific summary of results is shown in Table 8.3. Fifth, what we should do is named and interpreted the main factor.

- (1) Main factor FAC1 includes X3, X2, X1 component which have the maximum load values, is higher than 80 %, this factor reflects the firm's profitability, which is defined as the profitability factor. Variance of the profitability factor contribution rate is the maximum of 6 common factors; represent their interpretation of all variables in the sample 23.6 %, showing that the profitability of the Chinese listed company's financial position is essential.
- (2) Main factor FAC2 in X4 and X5's load is higher than 90 %, this factor can reflect the corporate funding liquidity, so named for the operational capacity factor. FAC 2' s contribution rate is 15.42 %, which indicating the operational efficiency of enterprises plays an important role in the survival and development of the company.
- (3) Main factor FAC3 in X12 and X11 have a larger factor loading rate of net value exceeding 85 %, Tobin Q = market value/(total assets—intangible net assets), price/book value ratio = market price per share/net assets per share in common stock, and are able to reflect the common stock shareholders, we call

**Table 8.3** Rotated component matrix

	Component				
	1	2	3	4	5
X3	0.972	0.050	−0.120	0.070	0.020
X2	0.972	0.051	−0.120	0.066	0.019
X1	0.845	0.039	0.239	0.169	0.109
X4	0.032	0.944	−0.012	0.075	−0.082
X5	0.074	0.934	0.061	0.045	0.016
X12	0.243	0.009	0.879	−0.009	0.077
X11	−0.337	0.046	0.866	0.057	0.025
X9	0.132	−0.090	0.016	0.891	−0.008
X10	0.100	0.237	0.026	0.856	−0.017
X8	0.085	0.003	0.054	−0.135	−0.684
X7	0.113	−0.101	0.004	−0.056	0.573
X6	0.046	0.045	0.117	−0.069	0.521
Initial eigenvalues	3.055	1.932	1.632	1.371	1.017
% of variance	23.603	15.421	13.572	13.349	9.112
Cumulative %	23.603	39.023	52.595	65.945	75.057

- the shareholder profitability factor. FAC 3’s contribution rate is 13.57 %, so shareholder profitability is an important indicator of the financial situation in listed companies.
- (4) Main factor FAC4 in X9, X10’s factor load is higher than 85 %, and the contribution rate of variance is 13.35 %, this factor reflects the enterprise’s growth potential, we named the growth indicators. Potential growth can predict the future development of enterprises, provide the basis for investors to make investment decisions.
  - (5) Main factor FAC5 in asset-liability ratio X8 ratio, quick ratio X7, mobile X6 factor loading of larger value, the debt-servicing capacity factor reflects the enterprise’s long and short-term liquidity, we define for solvency indicators. F5 main factor contribution rate of 9.11 % of the variance, which can be used to reflect enterprise financial risk, so essential for the evaluation of an enterprise’s financial position.

Sixth, according to the factor score matrix (Table 8.4), the original indicator reduced to 5 integrated indicator of the financial situation, and then to each factor of variance accounted for the original five main factor contribution rate as a proportion of total variance weights, the formation of equation is as follows. Among the equation, FACi as the public factor, F represents the financial status of comprehensive scoring.

$$\begin{aligned} &0.301 * X1 + 0.352 * X2 + 0.352 * X3 - 0.025 * X4 - \\ &0.009 * X5 - 0.006 * X6 + 0.016 * X7 + 0.090 * X8 - \\ &0.034 * X9 - 0.054 * X10 - 0.106 * X11 + 0.117 * X12 = FAC1 \end{aligned} \tag{8.1}$$

**Table 8.4** Component score coefficient matrix

	Component				
	1	2	3	4	5
X1	0.301	−0.024	0.161	0.017	0.031
X2	0.352	−0.006	−0.049	−0.052	−0.029
X3	0.352	−0.007	−0.048	−0.049	−0.029
X4	−0.025	0.518	−0.038	−0.026	−0.021
X5	−0.009	0.516	0.003	−0.052	0.061
X6	−0.006	0.056	0.030	−0.058	0.479
X7	0.016	−0.022	−0.038	−0.040	0.525
X8	0.090	−0.034	0.101	−0.102	−0.653
X9	−0.034	−0.125	−0.015	0.587	−0.021
X10	−0.054	0.061	−0.019	0.541	−0.009
X11	−0.106	0.003	0.526	0.036	−0.028
X12	0.117	−0.031	0.553	−0.063	−0.019

$$\begin{aligned}
& -0.024 * X1 - 0.006 * X2 - 0.007 * X3 + 0.518 * X4 + \\
& 0.516 * X5 + 0.056 * X6 - 0.022 * X7 - 0.034 * X8 - \\
& 0.125 * X9 + 0.061 * X10 + 0.003 * X11 - 0.031 * X12 = FAC2
\end{aligned} \tag{8.2}$$

$$\begin{aligned}
& 0.161 * X1 - 0.049 * X2 - 0.048 * X3 - 0.038 * X4 + \\
& 0.003 * X5 + 0.03 * X6 - 0.038 * X7 + 0.101 * X8 - \\
& 0.015 * X9 - 0.019 * X10 + 0.526 * X11 + 0.553 * X12 = FAC3
\end{aligned} \tag{8.3}$$

$$\begin{aligned}
& 0.017 * X1 - 0.052 * X2 - 0.049 * X3 - 0.026 * X4 - \\
& 0.052 * X5 - 0.058 * X6 - 0.040 * X7 - 0.102 * X8 + \\
& 0.587 * X9 + 0.541 * X10 + 0.036 * X11 - 0.063 * X12 = FAC4
\end{aligned} \tag{8.4}$$

$$\begin{aligned}
& 0.301 * X1 - 0.029 * X2 - 0.029 * X3 - 0.021 * X4 + \\
& 0.061 * X5 + 0.479 * X6 + 0.525 * X7 - 0.653 * X8 - \\
& 0.021 * X9 - 0.009 * X10 - 0.028 * X11 - 0.019 * X12 = FAC5
\end{aligned} \tag{8.5}$$

$$\begin{aligned}
& (23.603 * FAC1 + 15.421 * FAC2 + 13.572 * FAC3 + \\
& 13.349 * FAC4 + 9.112 * FAC5) / 75.057 = F
\end{aligned} \tag{8.6}$$

### 8.2.2.3 Control variables—company's size, corporate governance, ownership structure variables

Based on previous research, in addition to financial factors, there are many other factors that may influence the level of investor relations management of listing Corporation. This paper chooses the scale of the company (Lnsiz), the proportion of independent directors (IDR), chairman and general manager of two duty synthetic (CEO), the proportion of shares in circulation (LIUTV), management ownership ratio (MO), foreign investment proportion (FC) as control variables. The variable specific metrics are shown in Table 8.5.

## 8.3 Empirical Testing and Results Analysis

### 8.3.1 Descriptive Statistics and Pearson Correlation Analysis

Table 8.6 is a descriptive statistical analysis on the main variables. The statistics show that the maximum value of IIRI is 0.79, the minimum is 0.21, the average is 0.45, and the standard deviation is 0.11, indicating that in 2012 year, the gap of investor relations management level between Shenzhen A-share listed companies

**Table 8.5** The variable definition table

Nature	name	symbol	Description
Dependent variables	Investor relations index	IIRI	level of investor relations in Internet
	profitability factor	FAC1	Including ROA,ROE,WAROE
	operating capacity factor	FAC2	Including CAT,TAT
Independent variables	shareholder profitability factor	FAC3	Including P/B, Tobin Q
	growth capacity factor	FAC4	Including RAGR,OIGR
	solvency factor	FAC5	Including CR,QR,ALR
	Size of the company	lnsize	Total assets at the end of the natural year
	The proportion of independent directors	IDR	The total number of independent directors/board size
Control variables	The unity of the two jobs	CEO	chairman and manager for one person, the CEO = 1; otherwise, the CEO = 0
	Proportion of liquidity shares	LIUTV	Outstanding shares/equity the total number
	Manager's stocks	MO	Number of shares/total number of shares
	The proportion of foreign shares	FC	B shares, H shares, or other foreign shares/total shares

**Table 8.6** Descriptive statistics analyse study on variables

	N	Minimum value	Maximum value	Mean	Std. deviation
IIRI	348	0.21	0.79	0.54	0.11
lnsize	348	19.10	26.41	22.24	1.24
CEO	348	0	1	0.19	0.39
IDR	347	0.25	0.71	0.37	0.06
MO	348	0.00	1.92	0.05	0.22
LIUTV	348	14.61	100.00	87.28	21.02
FC	348	0.00	53.73	3.28	9.57

is larger, some companies do not build website, so that investors cannot quickly understand the operating status of listed companies, investor relations management index should be improved. We also studied the main variables of the person correlation coefficient (table omitted), the results show that, the FAC 4 and the proportion of tradable shares's correlation is highest, the value  $-0.194$  is less than  $0.5$ , therefore, we believe that the model does not exist serious multicollinearity problems. Another paper also examines the VIF values (see Table 8.7), in model 1–2, all VIF values are less than  $2$ , therefore, it can be indicated that the model does not exist serious pluralistic collinearity problem.

**Table 8.7** Multiple regression analysis

Variable	Model 1			Model 2		
	Coefficient	sig.	VIF	Coefficient	sig.	VIF
(Constant)	−0.066	0.597		−0.098	0.406	
FAC1	0.008*	0.094	1.027	0.001	0.737	1.314
FAC2	0.004	0.444	1.025	0.000	0.880	1.035
FAC3	−0.007	0.256	1.172	−0.002	0.296	1.358
FAC4	−0.011*	0.065	1.053	0.002**	0.022	1.040
FAC5	0.001	0.809	1.010	0.001	0.405	1.007
lnsize	0.029***	0.000	1.275	0.030***	0.000	1.112
CEO	0.006	0.698	1.034	0.003	0.833	1.040
IDR	−0.103	0.286	1.025	−0.097	0.316	1.028
MO	0.015	0.567	1.044	0.014	0.600	1.036
LIUTV	−0.000	0.810	1.083	−0.000	0.790	1.064
FC	0.001	0.378	1.067	0.001	0.289	1.087
R2/Adj.R2	0.148/0.120			0.150/0.122		
D-W	1.819			1.798		
F-value	5.285***			5.373***		
F possibility	0.001			0.001		

\*indicates significant at 10 % significance level, \*\*significant at 5 % significant level, \*\*\*significant at 1 % significant level

### 8.3.2 Regression Results and Analysis

In the first place, this paper studies on controlling the company’s size, corporate governance, ownership structure, and then put factor variables in the regression model and construct regression Eq. (8.7).

$$\begin{aligned} &\alpha + \beta_1 \cdot FAC1 + \beta_2 \cdot FAC2 + \beta_3 \cdot FAC3 + \beta_4 \cdot FAC4 \\ &+ \beta_5 \cdot FAC5 + \beta_6 \cdot Lnsize + \beta_7 \cdot IDR + \beta_8 \cdot CEO + \beta_9 \cdot LIUTV + \beta_{10} \cdot MO + \beta_{11} \cdot FC + \varepsilon_i = IIRI. \end{aligned} \tag{8.7}$$

Results found that the financial position of the impact factor data on investor relations management is not significant, according to (Zhao 2011; Ma Lianfu 2011) by adding square to judge whether the variable fitting curve equation, the regression Eq. (8.8) is as follows.

$$\begin{aligned} &\alpha + \beta_1 \cdot FAC1^2 + \beta_2 \cdot FAC2^2 + \beta_3 \cdot FAC3^2 + \beta_4 \cdot FAC4^2 + \beta_5 \cdot FAC5^2 + \beta_6 \cdot LnAsset + \beta_7 \cdot IDR + \beta_8 \cdot CEO + \beta_9 \cdot LIUTV + \beta_{10} \cdot MO + \beta_{11} \cdot FC + \varepsilon_i = IIRI. \end{aligned} \tag{8.8}$$

Table 8.7 is a conclusion by the multiple regression analysis of Eqs. (8.1) and (8.2). It can be seen that all these two models adjusted R2 to over 10 %, model 2 reached to 12.2 %, indicating that the 12.2 % Internet Investor Relations Index (IIRI) can be explained by all the variables in the model and the linear fitting

degree is the best. The F value of two models is significant at the 0.01 level, so the overall significance of this equation is at a higher level. In addition, the D-W values of each model are near 2, indicating that the self-related problems do not exist. In addition, from the results of the regression, we can find:

1. In model 1, internet investor relations index and gain is significant positive correlation in confidence level of 90 %; model 2, IIRI and profitability factor is weak positive correlation, did not pass the significance test. Therefore, under the same condition, good profitable listed companies are more likely to conduct the investors relation management activities, create a good public image, strengthen the communication with investors and attract potential investors to reduce the cost of financing.
2. Model 1 shows that the operational capacity factor on site index of investor relations is weak positive correlation (correlation coefficient is 0.004), but not significantly, in the model 2 is not relevant. Empirical findings indicate that enterprises operating capacities and investor relationship management may not be in a linear relationship, even curve relationship does not exist, this indicates that the operational capacity factor does not have a direct impact on investor relations management.
3. IRI index and shareholders profit capacity factor in model 1 and model 2 is weak negative related. shareholders' profitability is a measure of the ability of listed companies to obtain the dividend, enterprises with high share gain is cash flow adequate and lack of financing motive, these may lead to listed company less for investors relationship management.
4. In linear and quadratic function model, the growth ability factor's explanatory power on investor relations are notable, which in model 1 is significant negative correlation at the 10 % level and significant positive correlation at 5 % levels in model 2. It can be seen that quadratic models explain better than linear models in this factor. It indicated that the growth capacity of enterprises and investors relations existed the U-shaped curve. If enterprise in early growing period, funds needs large and liabilities higher will reduced investors relationship management to savings cost. When listed company entered high growth period, liabilities financing cost high and financial risk large, enterprises have to reduced financing cost, maintained reasonable of capital structure, high growth listed company will strengthened investors relationship management to reduced information asymmetry, attract investors concern and support to solution funds needs.
5. Solvency factors on investor relations is not notable in the simple linear model regression, interpretation ability of the solvency on the investors relation is poorer. Its coefficients of quadratic function model is also not significant, explain ability is poor. This suggests that debt-servicing capacity to promote investor relations management role is very limited, a listed company shouldn't pay many attention to it.

In addition, we can found that company size and investor relations management is in 1 % levels significantly positive correlation both in model 1 and model 2, indicating large companies pay more attention to investor relations management.

## 8.4 Conclusion

We found that enterprise profitability and investor relationship management are positive, enterprise growth and an investor relations are in a U-shape relationship. Corporate profitability, shareholder and Enterprise solvency are to the less impact on the investor relation management. Through empirical research, we can see that an enterprise's financial position have a certain impact on investor relations management, but it is not obvious, most of the financial indicators of investor relations management was minimal, we should further explore the deeper factors affecting investor relations, this is what we need to continue efforts in the future.

From two aspects, we expand the existing research: on one hand, previous scholars on corporate governance (Xiaobin Qing et al. 2007), and the shareholder structure (Zhao Ying 2011) factors have impact on the study of investor relations management, the main contribution of this paper is using factor analysis on Chinese listed firms' financial condition, and put forward that the financial position of listed companies in China have an effect on the investor relations management system. On the other hand, our results showed growth capacity factor and internet investor relations index is a upward parabola. Empirical studies have identified the growth potential of enterprises contributed to raising the level of investor relations management of listed companies. Query

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# Chapter 9

## Empirical Analysis on the Impact of Informed Trading on Chinese Open Fund Performance

Lei Xia, Cui-cui Liu and Li-li Qing

**Abstract** Informed trading is that insiders use their own proprietary information (private information) to trade stocks based on asymmetric information in the market and use the price difference to profit. This paper studies the relationship between investment behavior of open funds and the performance of funds in China market. Using the measurement of the probability of informed trading in Easley et al. (1996). The empirical test shows that there is a significant negative relation between the open funds' PIN and the performance. This result means that the participation in informed trading of open funds can't increase their performance.

**Keywords** Fund performance · Informed trading · Informed trading probability · Open fund · Trade\_PIN

### 9.1 Introduction

Informed trading is that insiders use their own proprietary information (private information) to trade stocks based on asymmetric information in the market, and use the price difference to profit. Private information may include basic information of listing Corporation (Carhart 1997), distribution information of stock holding, emergency information and the change of stock price information by securities analysis etc. This paper analyzes the relationship between investment behavior of Chinese fund and the return of open-end fund.

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As we all knows, insider trading in the securities market is universal in the Chinese market. Has the fund involved in this phenomenon? If participating, is the relationship in Chinese fund market between informed trading and fund performance similar to the United States? Does it bring a better investment performance to the open-end funds? This is what this paper attempts to answer. In order to study the influence of informed trading on the open end funds, we introduce the probability of Informed Trading PIN, probability of informed based trading put forward by Easley et al. (1996) as index (Admati et al. (1986) to measure the influence of stock information. After the information trading identification and test, this paper will make in-depth study of the relationship between the total fund's insider trading information including investment portfolio and its performance.

## 9.2 Data Source and Method Instruction

### 9.2.1 Data Sources Instructions

This paper used mutual funds (Open fund and closed-end funds) (Coval and Moskowitz 2001) in Shanghai stock market and Shenzhen stock market as samples. The data is from Chinese Stock Market Research Database (CSMAR) and CCER economic and financial research database, Sample selection period is from 1st January 2007 to 31st December 2008. This paper is mainly based on the quarterly data, because we can quickly and accurately obtain the corresponding quarterly financial data.

### 9.2.2 Variables Description

#### 1. The probability of informed trading stock\_ PIN.

For informed trading probability measure (PIN), we follow the method of Easley et al., which is based on the principle that market transactions are caused by information trading and obeying Poisson distribution. In a series of assumptions, we can speculate probability caused by private information transactions from the perspective of micro-structure (Easley et al. 1997) of financial according to the orders of the direction and quantity of orders. In particular, the estimation of the PIN parameter is generally in accordance with the following steps, firstly determining the likelihood function of time (Chen et al. 2004):

$$\begin{aligned}
L(\theta|B, S) = & (1 - \alpha)e^{-\varepsilon_b} \frac{\varepsilon_b^B}{B!} e^{-\varepsilon_s} \frac{\varepsilon_s^S}{S!} \\
& + \alpha\delta e^{-\varepsilon_b} \frac{\varepsilon_b^B}{B!} e^{-(\mu+\varepsilon_s)} \frac{(\mu + \varepsilon_s)^S}{S!} \\
& + \alpha(1 - \delta)e^{-(\mu+\varepsilon_b)} \frac{(\mu + \varepsilon_b)^B}{B!} e^{-\varepsilon_s} \frac{\varepsilon_s^S}{S!}
\end{aligned} \tag{9.1}$$

Among them, B and S respectively represent the number of buying and selling in a trading days, of which 5 parameters are unknown variables, it means that need to use the maximum likelihood method of estimation. Here, is the probability of event occurrence, is the arrival rate of order, is the probability of bad news, 1- is the probability of good news, is the arrival rate of buying submitted by the outsider, is the arrival rate of selling submitted by the insider. This is the likelihood function of the unit of time, can also be considered as probability distribution of transaction number. We can work out that the probability of occurrence of good news in trading day is  $\alpha(1 - \delta)$ , the probability of occurrence of bad news in trading days is  $\alpha\delta$ .

When speculating the direction of order, we used the Lee and Ready methods to determine. If the current transaction price is higher than the median of the previous bid, it will be considered to be transaction initiated by buyer, otherwise, it is recognized as transactions initiated by seller. If the transaction cannot be judged in this criterion, then it will be traced back to the transaction before the earlier one. On the assumption that news of every trading day is mutually independent, we can be easily given a period time, as follows:

$$L(\theta|M) = \prod_{i=1}^I L(\theta|B_i, S_i) \tag{9.2}$$

$I = 1, 2, \dots, I$  is the likelihood function of the day  $I$ . Apparently, the logarithm of both sides in the condition does not change (Frank et al. 2004), we can be expressed as a sum of the form, on this basis, we can calculate easily according to the optimization procedure. Then get the PIN as follows:

$$PIN = \frac{\alpha\mu}{\alpha\mu + \varepsilon_b + \varepsilon_s} \tag{9.3}$$

## 2. The informed trade probability of fund (Trade\_PIN).

For each fund of each quarter, we can get the probability of informed trading fund: the weighted average of ten big awkwardness (Easley and O'Hara 1987) included in each fund as follows:

$$trade\_PIN_{j,t} = \frac{\sum_{i=1}^N PIN_{i,t} \times d_{i,j}}{\sum_{i=1}^N d_{i,j}} \quad (9.4)$$

Among them,  $d_{i,j}$  is on behalf of the proportion of I awkwardness in j fund, because the CCER only provides data of awkwardness. We use ten awkwardness to calculate the trade\_PIN. But if there is a more detailed portfolio, the results should be more precise. In addition, We get the new fund informed trading probability through the arithmetic average method based on informed trading probability of the top ten heavy shares for every fund. We use it as new index to measure the degree of influence of stock information event to examine whether the result is stable.

### 3. Fund Performance (Perf).

In this paper, Perf (Easley et al. 1996) is net value growth rate of each unit fund. It is shown as bellow:

$$Perf = \frac{NAV_t - NAV_{t-1}}{NAV_{t-1}} \quad (9.5)$$

## 9.2.3 Research Method Instruction

The first is descriptive statistics. Secondly, the empirical results and analysis, using multiple regression to study whether the probability of informed trading effect the fund's performance. Specific regression (Jensen 1968) model as follows:

$$Perf = A + \beta_1 \times trade\_PIN + \beta_2 \times RFund + \beta_3 \times SPro + \sum \delta_j \times Ydum_j + \varepsilon \quad (9.6)$$

In order to be simple, we omit the variable subscript i (subscript t fund logo) and subscript t (time identifier), in which Intercept regression is Regression intercept, Ydumj is virtual variables of the Year J (J = 2007, 2008), other variables are defined as what mentioned before.

Here, The last year of the return of fund RFund: pecifically, the summation of the fund net growth rate of June 2007, September, December, March 2008 is return on funds in the last year RFund (Kacperczyk et al. 2005), and so on are the other quarter of the situation.

Portfolio stock ratio SPro: the share investing in the stock assets of mutual funds in the portfolio.

Annual virtual variable Ydum: in order to control the time effect, we model added each year dummy variable. For example, the Ydum07 in 2007 (four quarter) of 1, or 0; all and so are other years.

9.3 Empirical Result Analysis

The final test result is shown in Table 9.1. The p-val in model 1 Breusch-Pagan test (Marshall 1890) is 0.015, refusing to accept the mixed regression model, accepting random effect model. Hausman test for p-val is 0.905, can't reject random effect model. So, in model 1 we used random effects regression. In the model 1 to model 3, p-val tested by the Breusch-Pagan refuse mixed regression model, Hausman test refused random effects model, so we use the fixed effect regression model. In the control of the time effect and fund type effect, probability of informed trading of fund performance has a negative effect, the performance of the fund will not improve, but fell after making use of the private information to trade. The test results of model 2 and model 3 indicated that different control variables did not influence this relationship. Obviously probability of informed trading and fund performance is significantly negative correlation.

In the control variables, the relationship between the ratio of stock and fund performance is significantly positive, this means that more proportion of stock brought higher performance, this may be because the stock profit is higher than other investment projects, such as a bond or a money market fund. So the stock proportion is bigger, the fund performance is better. Because the fund rate of fee is mostly fixed, therefore in panel data, the variables in the majority of cases were rejected.

Table 9.1 Impact factors of performance (quarterly)

	Model1		Model2		Model3	
	Coeff	t-Stat	Coeff	t-Stat	Coeff	t-Stat
Panepanel: test results Based on the performance (Obs: 1,512)						
A	0.251	12.73	−0.212	1.51	0.125	0.83
Trade_PIN	−0.442	−3.06	−0.493	−3.43	−0.471	−3.28
RFund			0.203	14.90	0.200	14.40
SPro					0.064	1.51
DUM05	−0.183	−12.84	0.028	1.29	0.029	1.34
YDUM06	−0.030	−2.64	0.078	4.83	0.077	4.79
Breusch-Pagan (p-val)	0.015		0.000		0.000	
Hausman (p-val)	0.905		0.0001		0.0015	

Note regression model:  $Perf = A + \beta_1 \times trade\_PIN + \beta_2 \times Rfund + \beta_3 \times SPro + \beta_4 \times OCdum + \sum \delta_j \times Ydum_j + \varepsilon$ . In different models of the table, Coeff is coefficient, t-Stat is t statistic; for diagnostic statistics Breusch-Pagan and Hausman, we report the  $p$  value, because the fund's rate of Fee are mostly fixed, therefore in panel data, the variables in the majority of cases were rejected

Through the above analysis, probability of informed trading (Paci and Usai 1999) and fund performance had a negative correlation. Therefore, using private information for stock trading has negative effect on revenue. That is to say, the higher the probability of informed trading, the less the risk of compensation is. The discovery is contrast to the results of Da et al. He thinks that they can gain excess profits if someone know about the value of securities private information in advance, and trading based on the private information. This is probably because the development of Chinese securities (Pakes and Griliches 1984) market has experienced a short time, there are many immature features, the fund manager's investment strategy is not mature and excessive speculation, but the American stock market fund managers more is cautious and rational to invest.

As shown in Table 9.1, We get the new fund informed trading probability through the arithmetic average method based on informed trading probability of the top ten heavy shares for every fund the model 1, 2, 3 are significant. On the whole, we believe that this conclusion is consistent with the front of the result of the empirical analysis, it is basically stable that this conclusion probability of informed trading and return is negatively related.

## 9.4 Conclusion

This paper makes an empirical study of the informed trading impact on fund performance in Chinese fund market. We found that the probability of informed trading and return are negative correlated. The reason is more complex. As a transition to the emerging market, compared with mature markets overseas, Chinese market system is uncompleted. Disclosure of listing Corporation (Romer 1986) and overall regulatory framework are insufficient. There are kinds of problems, such as insider trading of listing Corporations, the problem of fund management companies bargain system, and the benefit transportation among the major shareholders of listing Corporation, fund companies. Speculation in Chinese market is difficult, while Chinese institutional investors have significant retail.

Chinese market system is not complete as an emerging and transitional market, the listing Corporation information disclosure mechanism (Shefer and Frenkel 1998) is not perfect, compared with overseas mature market, For Chinese stock market, both the central and local government are very administrative, investors rely highly on government policies, several areas are lack of supervision, supervision is not waiting for a circumstance, so the overall regulatory framework is not perfect. Securities market regulation must rely on government regulation, industry self-regulation and self-restraint way of combining enterprise.

At the same time, compared with the mature markets overseas, it is difficult to investigate some illegal phenomenon of Chinese securities market at the present stage. The law enforcement efficiency should be enhanced. As an emerging market related laws and regulations are not perfect. So in the stock market of our country, it is necessary to further improve the information disclosure of listing Corporation,

strengthen supervision (Van Oort 2002), and increase the extent of information disclosure to decrease the market manipulation behavior of informed trading efforts and ensure the steady operation of stock market.

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# Chapter 10

## Empirical Research of the Relevance among Analysts Coverage, Institutional Environment and Earnings Management

Bo Xu, Kai Li and Wei Zhang

**Abstract** The paper uses discretionary accruals as the main substitute variable for earnings management, and analyzes the relationship between earnings management and analyst coverage and also concerns how the institutional environment impacts this relationship by 2,514 listed companies in Shanghai and Shenzhen Stock Exchange in China during the Period of year 2004–2005. We find that a higher level of analysts coverage is related to less earnings management. We also find that analysts coverage is more negatively associated with earnings management for companies in weak institutional environment regions than for companies in strong institutional environment regions. The result suggests that analysts coverage has a substitute role to investor protection. Analysts coverage can play effective external governance role.

**Keywords** Analysts coverage · Earnings management · Empirical research · Institutional environment

### 10.1 Introduction

With the constant improvement and development of Chinese capital market, securities analysts play an increasingly important role in corporate governance. As the external supervisor, analysts not only focus on the macro trend, but also matching, filtering and verifying all kinds of complicated information of listed companies in order to monitor the activities of the company effectively. Analysts track corporate financial statements on a regular basis in order to offer professional investment advice on earning forecasts. Capital market also will reflect the willingness and the number of analysts coverage.

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Earnings management has been a hot topic for quite a long time, it is known as “the game of market participants”. The behavior of earnings management contraries to the reliability and authenticity of the accounting principles and accounting information. The company processes accounting information in accordance with business goals, which reflects the distorted information out of line with the business practice to mislead some stakeholders.

Chinese securities market is still in the transition stage of emerging markets to mature markets. The events of investors’ interests being infringed happen frequently. Therefore, the investor protection has become the key problem for Chinese securities market. The objective of this study is to address this question by examining whether analysts coverage affects earnings management and whether institutional environment affects the relationship between analysts coverage and earnings management. The efficient corporate governance, the appropriate analysts coverage and the well established institutional system are propitious to improve quality of company information, and to protect the interest of other shareholder, and they also can improve the communication between the listed company and its investors.

## **10.2 Paper Review and Research Hypothesis**

### ***10.2.1 Governance Roles of Analysts***

Jensen and Meckling (1976) mentioned that the security analysts employed by institutional investors, brokers and investment advisory services as well as the analysis performed by individual investors in the normal course of investment decision making usually possess comparative advantages in these activities. To the extent that security analysis activities reduce the agency costs associated with the separation of ownership and control, they are indeed socially productive. They mentioned the governance role of analysts first, but they didn’t verify by empirical research.

Since then, many scholars verify the external governance role of analysts’ behavior from different aspects. Moyer et al. (1989) support the role of analyst monitoring as an efficient device for controlling agency-related costs of debt and equity and as a response to the information demands of investors. Bushman and Smith (2001) found a high level analyst coverage can contribute to create a better information environment thereby reducing the information asymmetry. Chung and Jo (1996) find that the level of analyst coverage has positive relationship with company value. Yu (2008) examines whether analyst coverage affects firms’ earnings management behavior and found that a higher level of analyst coverage is related to less earnings management and that change of analyst coverage is negatively related to change of earnings management. Knyazeva (2007) also concerns the relationship between analyst coverage and earnings management. Their

research also get the same conclusion that high analyst coverage is associated with less earnings management. Their research all suggests that analyst coverage really can play a governance role in capital markets. Du and Hui (2008) found that the increase in the number of analysts can reduce the earnings management.

### ***10.2.2 The Effect of Investor Protection***

La Porta et al. (1998) compared the difference between the various countries in investor protection laws and enforcement. La Porta et al. (2002) find evidence of higher valuation of firms in countries with better protection of minority shareholders and in firms with higher cash-flow ownership by the controlling shareholder. Lang et al. (2004) found that analysts are less likely to follow firms with potential incentives to withhold or manipulate information, such as when the family/management group is the largest control rights blockholder. Furthermore, this relation is stronger for firms from low-shareholder-protection countries. Hope (2003) investigated the relations between the accuracy of analysts' earnings forecasts and the level of annual report disclosure, and between forecast accuracy and the degree of enforcement of accounting standards. The research found that document that firm-level disclosures are positively related to forecast accuracy, suggesting that such disclosures provide useful information to analysts. Li and Jia (2009) examined the relationship among earnings quality, the institutional environment, and properties of analyst forecasts. A large number of scholars also researched the affection of investor protection to the quality of financial reporting or debt financing and so on (Kangtao et al. 2010; Luo and Rao 2010).

### ***10.2.3 Research Hypothesis***

Yu (Yu 2008) and Knyazeva (2007) examined relationship between analyst coverage and earnings management. Their research found high analyst coverage is associated with less earnings management. Yongtao (2008) measured earnings management from the aspect of below-the-line item and above-the-line item. The research found analysts coverage had a positive relationship with earnings management on basis of above-the line item, which supported that analyst coverage is often held responsible for creating excessive pressure on managers to manage earnings. On the other hand, analysts coverage had a negative relationship with earnings management on basis of below-the-line item, which supported that analysts can be deemed to be external monitors of managers.

This paper thinks there is no difference between below-the-line item and above-the-line item, whichever will appears a lot of fraud cases. Accounting information is the main source of analyst forecast. Analyst will constantly examine and question the information, thereby inhibiting the earnings management of company.

When the analysts follow up a company, the analysts' scrutiny may increase the transparency of the company, which make managers more difficult to implement the transfer of assets, excessive on-the-job consumption and corporate profits occupation. This article thinks that analysts coverage leads to the effect of supervision, and then made the following hypothesis:

H1: The extent of earnings management of listed companies has negative correlation with analysts coverage. Firms followed by more analysts, the extent of earning management is less.

The degree of investor protection in each region reflects the governance environment of different regions. Sun (2009) found that earnings management is more negatively associated with analyst coverage in weak investor protection countries than in strong investor protection countries. The findings suggest that analyst coverage plays a more important governance role in countries where investor protection is weak. This paper attempts to study the relationship between earnings management and analysts coverage under the circumstance of different institutional environment in Chinese emerging capital markets.

H2: The worse of the institutional environment, the greater the extent of earnings management of listed companies.

H3: The negative relationship between analysts coverage and earnings management is stronger for firms in worse institutional environment, which means analysts coverage will play more significant role.

## 10.3 Research Design

This article selects the listed companies from Shanghai and Shenzhen stock exchange in A-share market during 2004–2005 as a total research samples. In order to ensure the date validity, the research eliminated all the financial insurance listed company as well as the companies without complete data. Finally we obtain 2,514 valid samples.

### 10.3.1 Variable Definition

#### 10.3.1.1 Explained Variable

We use a modified version of the Jones model to measure earnings management (EM).

- a. Using following cross-sectional OLS regression to estimate coefficients  $\alpha_1$ ,  $\alpha_2$  and  $\alpha_3$ .

$$TA_{it}/A_{it-1} = \alpha_1(1/A_{it-1}) + \alpha_2(\Delta REV_{it}/A_{it-1}) + \alpha_3(PPE_{it}/A_{it-1}) + \varepsilon_{it} \quad (10.1)$$

Where  $i$  indexes firms,  $t$  indexes time,  $TA_{it}$  equals net income minus cash flow from operations.  $\Delta REV_{it}$  is the changes in sales revenues, and PPE is gross property, plant, and equipment.  $A_{it-1}$  is total assets of company  $i$  in time  $t-1$ .

b. Calculating nondiscretionary accruals

$$NDA_{it} = \beta_1(1/A_{it-1}) + \beta_2(\Delta REV_{it}/A_{it-1} - \Delta AR_{it}/A_{it-1}) + \beta_3(PPE_{it}/A_{it-1}) \quad (10.2)$$

Where  $\Delta AR_{it}$  is the change in receivables.

c. Deriving discretionary accruals

$$DA_{it} \equiv \varepsilon_{it} = TA_{it}/A_{it-1} - NDA_{it} \quad (10.3)$$

### 10.3.1.2 Explanatory Variable

a. *Analyst coverage variable (ANALF)*

The paper use the number of analysts coverage to measure analysts behavior. If analysts  $i$  issue  $j$  ( $j > i$ ) research reports for a listed company in a fiscal year, we think there are  $i$  analysts to follow this company.

b. *Institutional environment variable (INDEX)*

In order to test the impact of the institutional environment on the behavior of analysts coverage, the article use the index of the degree of development of the market intermediary organizations as substitution variable of institutional environment according to Fan and Wang (2009). The larger index indicates the higher degree of marketization, which means the better the legal regulatory environment.

### 10.3.1.3 Control Variable

MB-market to book ratio, the ratio of the price per share and net assets per share.

SIZE-the natural logarithm of total assets.

LEV-financial leverage, the ratio of total liability to total assets.

LOSS-loss-making dummy, coded 1 if annual net income is negative and 0 otherwise.

### 10.3.1.4 The Setting Model

Multiple regression models is as following,

$$EM_{it} = b_0 + b_1ANALF_{it} + b_2INDEX_t + b_3ANALF_{it} \times INDEX_t + b_4MB_{it} + b_5SIZE_{it} + b_6LEV_{it} + b_7LOSS_{it}$$

(10.4)

10.4 The Empirical Results and Analysis

10.4.1 Descriptive Statistics

Descriptive statistics shows as the follow Table 10.1.

The greater the absolute value of earnings management (EM), the higher the extent of earnings management. The maximum number of analysts coverage is 26, the minimum number is 0, which due to the immaturity of China’s securities market, and the number of analysts is generally inadequate. Institutional environment index also ranks from 0.02 to 10, which reflects different regions of the institutional environment does exist a wide gap.

10.4.2 Relevance Analysis

Correlation analysis between the variables shown in Table 10.2

Correlation coefficient between earnings management and analyst coverage is −0.65, which means analyst coverage has a negative correlation with earnings management. It is consistent to H1. Correlation coefficient between earnings management and Institutional environment is −0.23, which means Institutional environment has a negative correlation with earnings management. It is consistent to H2.

Table 10.1 Descriptive statisticstype

Variables	Min	Max	Mean	Std. Dev.
EM	0.	2.223	0.792	0.982
ANALF	0	26	1.45	3.073
INDEX	0.02	10.00	4.899	2.846

Table 10.2 Pearson aorrelation analysis

	EM	ANALF	INDEX	MB	SIZE	LEV	LOSS
EM	1	−0.065***	−0.023	0.074***	0.154***	0.087***	0.257***
ANALF	−0.65***	1	0.25***	−0.002	0.323***	−0.035	−0.137***
INDEX	−0.023	0.205***	1	0.001	0.102***	−0.025	−0.001
MB	0.074***	−0.002	0.001	1	−0.051***	−0.012	0.014
SIZE	−0.154***	0.323***	0.102***	−0.051***	1	−0.087***	−0.208***
LEV	0.087***	−0.035	−0.025	−0.012	−0.087***	1	0.023
LOSS	0.257***	−0.137***	−0.001	0.014	−0.008	0.023	1

\*\*\* Significant at the 5 % level (two-tailed test)

**Table 10.3** Regrssion results

Variable	Predicted sign	Standardized coefficients
ANALF	—	−0.084 <sup>a</sup>
INDEX	—	−0.022 <sup>a</sup>
ANALF × INDEX	+	0.097 <sup>a</sup>
MB	+	0.066 <sup>c</sup>
SIZE	+	−1.000 <sup>c</sup>
LEV	+	0.074 <sup>c</sup>
LOSS	+	0.236 <sup>c</sup>

N = 2,514, R<sup>2</sup> = 0.087, adjusted R<sup>2</sup> = 0.084

<sup>a,b,c</sup> reflecting significant at the 10, 5,1 % level in respectively

### 10.4.3 Collinearity Test

The variance inflation factor(VIF) is less than 5, and tolerances are less than 1,which means there is no collinearity among explanatory variable.

### 10.4.4 The Empirical Result Analysis

Empirical result analysis can be know from the Table 10.3. We can see analysts coverage and earnings management has a significant negative correlation, which verify the hypothesis H1. Institutional environment index and earnings management has significantly negative correlation, which verify the hypothesis H2. Interactive items of analysts coverage multiplied by institutional environment index has a significant positive correlation, which verify the hypothesis H3. MB, LEV and LOSS are positively correlated with earnings management, which means that the loss-making companies of has higher possibility to manage their earnings. SIZE has a negative correlation with earnings management, reflecting the greater the size of the company, the lower the extent of earnings management. That means the bigger company usually has a better corporate governance structure, which results in less earning management.

## 10.5 Conclusion

The paper selects non-financial listed companies in Shanghai and Shenzhen exchange in China by samples in 2004 and 2005. The paper examine the correlation among analysts coverage behavior, institutional environment and earnings management in order to examine the role of information intermediaries in corporate governance. We find that a higher level of analyst coverage is related to less earnings management. We also find that analyst coverage is more negatively

associated with earnings management for companies in weak institutional environment (investor protection) regions than for companies in strong institutional environment regions. The result suggests that analysts coverage has a substitute role to investor protection. Analysts coverage can play effective external governance role.

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# Chapter 11

## Fair Value Accounting Estimate: Theoretical Analysis

Yun Yu

**Abstract** Fair value measurement uses a lot of estimates and assumptions, the study of fair value measurement in this paper was based on the perspective of accounting estimate. Referring to International Financial Reporting Standard 13 (2011), Fair Value Measurement and Statement of Financial Accounting Concepts No. 8 (2010), Conceptual Framework for Financial Reporting, the paper examined the connotation of fair value accounting estimate and clarified that fair value accounting estimate was in accordance with the objective of general purpose financial reporting and qualitative characteristics of useful financial information.

**Keywords** Accounting estimate • Fair value accounting estimate • Fair value measurement • Faithful representation

### 11.1 Introduction

The risks and uncertainties of economic environment are growing, as a result, fair value measurement is becoming increasingly important, and in particular, the accounting estimate of fair value measurement is widely used.

The theoretical researches about fair value accounting estimate were mainly done by standards setting bodies. For example, International Auditing and Assurance Standards Board (IAASB) released International Standard on Auditing (ISA) 540 (Revised and Redrafted), Auditing Accounting Estimates, Including Fair Value Accounting Estimates, and Related Disclosures, in February 2008, the version of ISA 540 combined the previous version of ISA 540 and ISA 545, Auditing Fair Value Measurements and Disclosures, and it was helpful for the application and development of fair value accounting estimate. Chinese Institute of

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Certified Public Accountants (CICPA) published Chinese CPA Auditing Standard No. 1321, Auditing Accounting Estimates, Including Fair Value Accounting Estimates, and Related Disclosures, in 2010. This standard is similar to ISA 540 (Revised and Redrafted).

In addition to those, in the academia of China, professor Shifen Xie (2008) had a profound discussion about the meaning and the importance of fair value accounting estimate, except for that, most studies were concentrated on fair value instead of fair value accounting estimate. Some scholars misunderstood fair value accounting estimate, they questioned the reliability of fair value because of the inaccuracy of fair value accounting estimate, and what's more, they thought estimated price was not fair value.

However, these misunderstandings lose sight of a major notion that estimate is an indispensable component of accounting, namely, accounting is an estimate. Although the estimate in the third level of fair value hierarchy is estimated price, long since the opinion in Statement of Financial Accounting Standards No. 157 (SFAS 157), Fair Value Measurements stated clearly that the estimate was a market-based measurement instead of an entity-specific measurement (FASB 2006). Therefore, provided strict requirements and proper methods, estimated price in the third level of fair value hierarchy is still in accordance with the definition of fair value. Fair value accounting estimate is not only an indispensable part of fair value measurement, but also taking increasingly momentous proportion in it.

This paper examined the connotation and theoretical basis of fair value accounting estimate. In fact, it was a study of fair value based on fair value accounting estimate. It intended to help further understand the meaning and the importance of fair value accounting estimate and improve the application of fair value.

## 11.2 Connotation Study

### 11.2.1 Key Elements

International Accounting Standards Board (IASB) released International Financial Reporting Standard 13(IFRS 13), Fair Value Measurement, in May 2011. It is the result of the work by the IASB and the Financial Accounting Standards Board (FASB) to develop common requirements for measuring fair value and for disclosing information about fair value measurements in accordance with IFRSs and US generally accepted accounting principles (GAAP) (IASB 2011). The definition of fair value in the newly released standard is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date (IASB 2011). It dose not change the definition in SFAS 157, which was issued in September 2006 by FASB.

According to IFRS 13, the key elements of fair value accounting estimate are the followings:

- (1) *Subjects*: Assets, liabilities or equity instruments; the assets or liabilities might be either a stand-alone asset or liability or a group of assets, a group of liabilities or a group of assets and liabilities, it depends on its unit of account which is provided in related IFRSs (IASB 2011).
- (2) *Transaction*: Fair value accounting estimate assumes that the asset or liability is exchanged in an orderly transaction between market participants to sell the asset or transfer the liability at the measurement date under current market conditions. Orderly transaction is a transaction that assumes exposure to the market for a period before the measurement date to allow for marketing activities that are usual and customary for transactions involving such assets or liabilities; it is not a forced transaction (IASB 2011).
- (3) *Market*: Fair value accounting estimate assumes that the transaction to sell the asset or transfer the liability takes place in the principal market or in the most advantageous market when a principal market is absent. Principal market is the market with the greatest volume and level of activity for the asset or liability; most advantageous market is the market that maximizes the amount that would be received to sell the asset or minimizes the amount that would be paid to transfer the liability, after taking into account transaction costs and transport costs (IASB 2011).
- (4) *Market Participants*: They are buyers and sellers in the principal (or most advantageous) market for the asset or liability. They are independent of each other, knowledgeable, are able to and are willing to enter into a transaction for the asset or liability (IASB 2011).
- (5) *Price*: Fair value accounting estimate is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction in the principal (or most advantageous) market at the measurement date under current market conditions regardless of whether that price is directly observable or estimated using another valuation technique (IASB 2011).

According to the definitions of the key elements of fair value accounting estimate, the subjects of fair value accounting estimate are assets, liabilities and equity instruments; IFRS 13 emphasized that fair value accounting estimate was a market-based measurement instead of an entity-specific measurement and it clarified that fair value accounting estimate reflected market risks instead of entity specific risks and it adhered to exit price which reflected the economic essence of accounting items.

### ***11.2.2 Accounting Estimate, Fair Value Measurement and Fair Value Accounting Estimate***

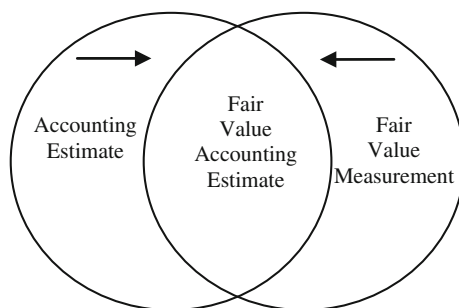
- (1) *Accounting Estimate and Fair Value Accounting Estimate*: The definition of accounting estimate in China's currently accounting standards is an entity's judgment about its uncertain transactions or items based on the available information. The issue of ISA 540 (Revised and Redrafted) transformed accounting estimate to a term containing a new meaning and it defined accounting estimate as an approximation of a monetary amount in the absence of a precise means of measurement. This term is used for an amount measured at fair value where there is estimate uncertainty, as well as for other amounts that require estimate. Where ISA 540 addresses only accounting estimates involving measurement at fair value, the term "fair value accounting estimates" is used (IAASB 2008).

In conclusion, accounting estimate is an approximation of a monetary amount in the absence of a precise means of measurement, and fair value accounting estimate is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date (IASB 2011), which is an estimated value of assets or liabilities based on market participants and it is a measurement based on estimate. In comparison with common accounting estimate, fair value accounting estimate is more complex because the estimate involves more judgments and difficulties. With increasing complexities and uncertainties appearing in economic environment, fair value accounting estimate will be widely used, fair value accounting estimate will take increasing proportion in accounting estimate. Therefore, fair value accounting estimate is a very crucial part of accounting estimate.

- (2) *Fair Value Measurement and Fair Value Accounting Estimate*: Fair value measurement could be quite simple when there are active markets for assets or liabilities, the quoted price in the first level of fair value hierarchy could be used or be adjusted simply, it is just need ordinary estimates or it is not need any estimates at all. However, in most cases, fair value measurement refers to numerous assumptions and estimates. As a result, not all of fair value measurements are fair value accounting estimates. Fair value accounting estimate is an important component of fair value measurement. The paper was aimed at discussing fair value on the basis of fair value accounting estimate, it paid more attention to the estimated nature in the process of fair value measurement.

To sum up, fair value accounting estimate occupies the mixed part of accounting estimate and fair value measurement. Furthermore, the mixed part is increasing. The relevance of accounting estimate, fair value measurement and fair value accounting estimate could be illustrated in Fig. 11.1.

**Fig. 11.1** The relevance of accounting estimate, fair value measurement and fair value accounting estimate



## 11.3 Theoretical Basis

### 11.3.1 Fair Value Accounting Estimate and Decision—Useful

IASB and FASB released the joint project of conceptual framework in September 2010, Statement of Financial Accounting Concepts No. 8 (SFAC 8), Conceptual Framework for Financial Reporting, Chap. 1, The Objective of General Purpose Financial Reporting, and Chap. 3, Qualitative Characteristics of Useful Financial Information, Chap. 1 is a replacement of SFAC 1, Objectives of Financial Reporting by Business Enterprises. The new statement defined the objective of general purpose financial reporting as: the objective of general purpose financial reporting is to provide financial information about the reporting entity that is useful to existing and potential investors, lenders, and other creditors in making decisions about providing resources to the entity (FASB 2010).

The objective of general purpose financial reporting was generated on the basis of the fully development of capital market. At the primal stage of market economy, the objective of accounting was to report how the management of an enterprise discharged its stewardship responsibility to owners; accounting was aimed at the past and emphasized income statement and used historical cost as the sole measurement. With the development of capital market, capital securitization prevails. As a medium, the capital market gathers enterprises those need capitals and investors who search for investment opportunities together. Before making decisions, investors would value all kinds of opportunities or securities and analyze the future cash flows and risks of the opportunities. In order to attract capitals and keep the existing investors, enterprises should report the information which could help investors value the opportunities and make decisions about whether investing, holding or selling the securities. Therefore, the accounting emphasizes the present and the future while reporting the past financial performance and it focuses on balance sheet instead of income statement; the accounting objective is to provide information about the value.

There are plenty of uncertainties and risks in economic environment, not all of the assets and liabilities have quoted prices, even if quoted prices are existing, they

might not be the appropriate estimates of the values. It could be gained from Marx's labor theory of value and utility theory of value of western economics that the measurement of value is a process which could just be approached by estimates and judgments. Firstly, according the law of value, a good's value is determined by socially necessary labor-time of producing the good. The exchange of goods is equivalent based on the magnitude of value. The price fluctuates around the value. In reality, the price fluctuates because of the good's value and the monetary value, the price is rarely equal to the value, the measurement of value could only be estimated. Secondly, according to utility theory of value, the value is people's sensations and evaluation about how a good satisfies the desires, the value is determined by utility and the utility is the foundation of value. Assets are probable future economic benefits obtained or controlled by a particular entity as a result of past transactions or events (FASB 1985). Therefore, the future economic benefits of the asset determine its utility and the present value. The future cash flow is the best way to measure an asset. It is the same case with a liability. However, the same asset or liability has different utilities for different entities and the utilities are different for the same entity in different situations. As a result, it is difficult to form a unified and stable evaluation criterion.

What kind of measurement is a way approaching value by estimates and judgments? Fair value accounting estimate fits the position, it lays emphasis on the second and the third level of fair value hierarchy and it reflects the estimate characteristic of fair value. The goal of fair value accounting estimate is to realize value measurement. Fair value accounting estimate gets close to value by estimate, reflecting the changes of the environment and the increasing risks and uncertainties of the economy timely by reasonable assumptions and scientific procedures, reporting the information of an entity's future cash flows and risks which is highly related with investment, credit or other similar economic decisions, and providing valuation and investment decisions basis (Barth 2006). In sum, fair value accounting estimate is comply with the objective of decision-useful.

### ***11.3.2 Fair Value Accounting Estimate and Relevance***

SFAC 8 defined relevant financial information as being capable of making a difference in the decisions made by users. The information has predictive value, confirmatory value, or both, having predictive value means that it can be used as an input to processes employed by users to predict future outcomes and having confirmatory value means that it provides feedback (confirms or changes) about previous evaluations (FASB 2010).

The qualitative characteristics of accounting information are restricted by financial reporting objectives. Decision-useful emphasizes the relevance of information, fair value accounting estimate is in accordance with the requirements of decision-making usefulness, so it is relevant.

Furthermore, the tradition accounting measurement model could not provide accounting information that was related with decision-making to managers, investors and creditors because historical cost measurement could just provide the past cost data, moreover, decision-making must be based on the present and future accounting data. Fair value accounting estimate could reflect the price changes of assets or liabilities dynamically and timely by estimates. It does not deny the book value of some assets or liabilities in initial transactions under historical cost measurement and it updates the book value along with the time lapses and price changes. It reports the pricing of assets or liabilities by market at a specific time and economic status. In conclusion, fair value accounting estimate could timely reflect market changes and objectively reflect the real value of assets under the changing of market and it would provide relevant accounting information to managers, creditors, investors and other information users.

### ***11.3.3 Fair Value Accounting Estimate and Faithful Representation***

It was a long process for faithful representation qualitative characteristic replacing reliability qualitative characteristic. Before the publishing SFAC 8, reliability was one of the main qualitative characteristics and faithful representation was belonged to the secondary characteristics of reliability. But the definition of reliability was not clear enough, which resulted in different understandings. Fair value accounting estimate was blamed for being lack of reliability because of it was not accurate. SFAC 8 replaced the term reliability with faithful representation and clarified the implication of faithful representation, thus it helped to understand fair value accounting estimate precisely and it established theoretical basis for fair value accounting estimate.

SFAC 2 (1980) (FASB 1980): Qualitative Characteristics of Accounting Information made reliability and relevance two major qualitative characteristics, but it did not define reliability clearly. In order to clarify the meaning of reliability, FASB held a board meeting in May 2005 on its joint IASB/FASB project and discussed that faithful representation of real-world economic phenomena was an essential qualitative characteristic, which included capturing the substance of those economic phenomena. Consequently, the common framework should drop the widely misinterpreted term reliability from the qualitative characteristics, replacing it with faithful representation. Then FASB published Conceptual Framework for Financial Reporting, Objective of Financial Reporting and Qualitative Characteristics of Decision-Useful Financial Reporting Information (Preliminary Views), in July 2006, it pointed out that faithful representation would replace reliability. Afterwards, in February 2007, respondents to that Preliminary Views raised some significant issues that would be considered by the Board in its red liberations, such that relevance and faithful representation should be distinguished

as necessary qualitative characteristics. After that, IASB and FASB issued Conceptual Framework for Financial Reporting, Objective of Financial Reporting and Qualitative Characteristics of Decision-Useful Financial Reporting Information [Exposure Draft], in May 2008; the ED made relevance and faithful representation the two fundamental qualitative characteristics of decision-useful information.

Finally, IASB and FASB issued its joint project of conceptual framework: SFAC 8. Chapter 3 of SFAC 8 is a replacement of SFAC 2. The statement stated that qualitative characteristics of useful financial information included fundamental qualitative characteristics and enhancing qualitative characteristics. Fundamental qualitative characteristics included relevance and faithful representation, which were necessary qualitative characteristics of information. And reliability was replaced by faithful representation which belonged to the secondary characteristics of reliability. To be a perfectly faithful representation, a depiction would have three characteristics. It would be complete, neutral, and free from error (FASB 2010).

IASB and FASB thought that Faithful representation did not mean accurate in all respects. Free from error means there are no errors or omissions in the description of the phenomenon, and the process used to produce the reported information has been selected and applied with no errors in the process. In this context, free from error does not mean perfectly accurate in all respects. For example, an estimate of an unobservable price or value cannot be determined to be accurate or inaccurate. However, a representation of that estimate can be faithful if the amount is described clearly and accurately as being an estimate, the nature and limitations of the estimating process are explained, and no errors have been made in selecting and applying an appropriate process for developing the estimate (FASB 2010).

For instance, valuation techniques should be used when there are unobservable inputs for measuring the fair value of an asset or a liability. The valuation techniques used should maximize the use of relevant observable inputs and minimize unobservable inputs (IASB 2011). Those inputs should be consistent with the inputs a market participant would use when pricing the asset or liability. The using of valuation technique is not completely accurate, but the estimate method is appropriate and the estimate result is close to the substance of economic phenomena. It is thus clear that the valuation is faithful representation. However, when reliability was one of the fundamental qualitative characteristics, the estimate was frequently criticized because of having no reliability. At present, faithful representation replaced reliability and it clarified the substance of reliability, namely reliability is not stand for accuracy, the appropriate estimate is for better representation of the substance of economic phenomena and is for better representing faithfully. Fair value accounting estimate could faithfully measure the present and the future economic activities of an entity. The fundamental objective of fair value accounting estimate is to represent the substance of economic phenomena, which is in accordance with the requirements of faithful representation.

Furthermore, IFRS 13 set the general principle for using inputs: fair value measurement should maximize the use of relevant observable inputs and minimize unobservable inputs (IASB 2011). In the developing of IFRS 13, some stakeholders concerned the observable inputs which were required to use in the global financial crisis began in 2007, at that time, the available observable inputs could not reflect the fair value of an asset or a liability, namely the observable inputs were irrelative. The fair value measurement of an asset or a liability should take into account the characteristics of the asset or the liability and the environment of the measurement date and make great adjustments to the available observable inputs. However, it was not suggested to do base on cost benefit principle. Considering the feedbacks, IASB determined that observability was not the only principle when choosing inputs for valuation techniques. In some cases, for example, at a market lacking of activeness or at an inactive market, unobservable inputs were more superior than observable inputs, that is, on the premise of keeping the measurement objective constant, the third level of fair value hierarchy could reflect the real economy better. Especially in the circumstance of increasing uncertainties and risks, the market situation where inputs could not be observed and the active markets were decreasing, a lot of measurements belonged to the second or the third level of fair value hierarchy, those measurements followed the certain measurement objective and the principle, using the reasonable assumptions and scientific procedures, reflecting the risks and uncertainties and representing the substance of economic phenomena faithfully.

## 11.4 Conclusion

According to the definition of financial reporting objective in Basic Standard of Chinese Accounting Standards for Business Enterprises (2006), it still emphasizes the accountability view. Furthermore, reliability is the main financial reporting qualitative characteristic and there is no hierarchical division of the qualitative characteristics. Therefore, the Basic Standard of Accounting Standards for Business Enterprises has many differences compared with the fair value oriented conceptual framework of IASB and FASB, which is not beneficial for the development of fair value accounting estimate. What's more, although China released the ED of Fair Value Measurement in May 2012 and its goal is generally convergent to IFRS 13, the ED was drafted on the basis of the Basic Standard.

This paper defined fair value accounting estimate and clarified its relationships with accounting estimate and fair value measurement and stated its theoretical basis, intending to help understand the significance of fair value's estimate nature which making fair value accounting estimate being a major part of fair value and fair value being an increasingly important measurement nowadays, trying to providing references to the problems of fair value in practice and promoting the revision of current Chinese accounting standards.

The research method of the paper was normative analysis and the conclusion was not studied empirically, which was a shortage of the paper. Future research should attempt to examine the topic with empirical researches.

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# Chapter 12

## Macroeconomic Condition, Firm's Financial Characteristics and Capital Structure Dynamic Adjustment

Zhi-xiong Ling and Ya-wei Lin

**Abstract** With a sample of listed companies from 2000 to 2010 and using Generalized method of moment (GMM), the paper researches the impacts of firms characteristics and macroeconomic factors on capital structure dynamic adjustment towards target leverage. Using integrated dynamic partial adjustment capital structure model, we find evidence that, relative to in bad macroeconomic states, firms adjust their leverage towards target faster in good states, and that large size firms adjust their leverage towards target faster than small size firms. So dose high growth firms. Our result also prove that, since small size firms are unable to adjust their leverage in time, especially in period of economic recession, they are more likely to face financial difficulties and capital chain ruptures.

**Keywords** Capital structure · Dynamic adjustment · Firm's characteristics · Macroeconomic condition

### 12.1 Introduction

One of the basic financial problems is how a company chooses their capital structure. This question is the key of “the capital structure puzzle” which is proposed by Myer in his inaugural speech of AFA (American Financial association). To answer it, researchers use a large number of mathematical models to analyze financing decisions of companies. As a result, Trade-off Theory, Pecking Order Theory and Market Timing Theory were proposed in order. With the development of econometrics, researchers gradually pay more attention to the impact of macroeconomic factors on

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financing strategy. Korajczyk and Levy (2003) found that for the nonfinancial constrained company, debt issue is procyclical and equity issue is counter-cyclical, while for the financial constrained company, leverage is procyclical (Korajczyk and Levy 2003). Levy and Hennessy (2007) build a General Equilibrium model from management benefit side. They suggested that in the period of economic expansion, managers tend to choose equity financing, while during the economic downturn, managers prefer to issue debt to ensure their benefit (Levy and Hennessy 2007). Dongwei and Haijian (2009) estimated Panel data fractional response model and found that corporate capital structure is significantly negatively related to proxies of default risk, but unrelated to credit quota and stock market performance (Dongwei and Haijian 1994). With the sample of listed companies from 1998 to 2009, Liang and Yue (2011) showed that financial constrained companies choose procyclical leverage and nonfinancial constrained companies choose counter-cyclical leverage (Liang and Yue 2011).

Most studies use two-steps dynamic partial adjustment capital structure model (Korajczyk and Levy 2003; Qu 2006; Cook and Tang 2008) to estimate the impact of macroeconomic factors on the speed of capital structure adjustment (Qu 2006; Cook and Tang 2008). In the two-steps model, we have to estimate the fitted value of target capital structure in the first step, and then use that fitted value in the second step. But it possibly leads to deviation of the result for the second stage. To solve this problem, the paper uses one-step dynamic partial adjustment capital structure model and generalized moment method (GMM), to study how macroeconomic factors influence capital structure dynamic adjustment.

## 12.2 The Model and Specification

### 12.2.1 Hypothesis

Trade-off theory implies procyclical leverage. In economy expansion period (When the capital market performs good and the cost of bankruptcy is low, corporates tend to have more tax shield and free cash flow.), debt financing is more attractive (Jensen and Meckling 1976). In the economic boom, firms face less resistance of capital structure adjustment than in the economic recession. Market timing theory also implies procyclical leverage. According to it, capital market is more active in the time of economic boom. It will be beneficial for firms' recapitalization frequently. Thus we suggest hypothesis 1: compared to the economic recession, the speed of recapitalization is faster in the economic boom.

Pecking Order Theory implies that when the funds that investment needed are more than the retained earnings, leverage ratio will improve (Drobtz et al. 2007). High growth companies have more potential investment opportunities so that they have stronger need for fund. Meanwhile, most of the high growth companies are young. That is to say high growth companies seldom own much operating cash

flow and internal retained earnings to satisfy their capital need for investment. The gap between the need for fund and the retained earnings urge companies to acquire external financing. Thus we suggest hypothesis 2: high growth companies recapitalize more quickly.

Large-size companies usually own stable cash flow, so they have lower probability of financial difficulties and lower bankruptcy cost (Rajan and Zingales 1995; Hovakimian et al. 2001). Meanwhile, large-size companies have more mortgage assets. In the General Equilibrium model designed by Suarez and Sussman (1997), procyclical mortgage leads to procyclical leverage. The more mortgage assets a company owns, the easier it can receive loans. Compared to small-size companies, large-small companies face less resistance in recapitalization. We propose hypothesis 3: the speed of recapitalization is faster in large-size companies.

### 12.2.2 Data and Sample

We chose balanced panel data of Chinese listed companies over the sample period 2000–2010. Five rules of sample selection are blow. (1) All the companies in sample have accomplished IPO before December 31th, 2000. (2) Get rid of companies in financial area. (3) Get rid of ST, PT companies. (4) Get rid of companies in which earning is less than 0. (5) Get rid of the sample in which data is in absence or abnormal. Finally, we obtained a sample of 742 companies, 8162 observations.

To test the 3 hypotheses proposed above, we separate the sample into two groups with 3 different criteria. According to the GDP growth rate in each sample year, we split our sample into sample of good economic and sample of bad economic sample (group 1). Taking a firm's size as criteria, we obtain two subsamples that is sample of large size company and sample of small size company (group 2). Considering a firm's growth, we separate our sample into two part—high growth sample and low growth sample (group 3).

### 12.2.3 Integrated Dynamic Partial Adjustment Capital Structure Model

Target leverage:

$$Lev_{i,t}^* = \sum_{j=1}^L \alpha_j X_{i,j,t-1} + \sum_{K=1}^N \gamma_K macro_{i,k,t-1} \quad (12.1)$$

Large amount of empirical results confirmed that target leverage level truly existed. Relating to the study before, we specify target leverage,  $Lev_{i,t}^*$ , as a function of prior period macroeconomic variables and firm characteristic variables.  $X_{i,j,t-1}$  denote firm characteristic variables of corporate I in year  $t - 1$  and  $\alpha_j$  are the

coefficients of firm characteristic variables.  $Macro_{i,k,t-1}$  are macroeconomic variables and  $\gamma_k$  are coefficients of it.

Dynamic partial adjustment capital structure model:

$$Lev_{i,t} - Lev_{i,t-1} = \delta(Lev_{i,t}^* - Lev_{i,t-1}) \quad (12.2)$$

Due to adjustment cost, most of the companies recapitalize partially. Thus we specify a partial adjustment model.  $LEV_{i,t}^*$  and  $LEV_{i,t-1}$  represent leverage level for firm  $i$  in period  $t$  and  $t - 1$  respectively, and  $\delta$  represents the proportion of leverage deviation away from the firm's target leverage in the next period.  $\delta = 0$  indicates that firms dose not recapitalize at all.  $\delta < 0$  means that company adjust capital structure away from target leverage.  $\delta = 1$  indicates that firms fully adjust for any deviation away from their target leverage.  $0 < \delta < 1$  means that corporate adjust their leverage partially.  $\delta > 1$  means that firms adjust capital structure excessively so that real leverage surpass target

Integrated dynamic adjustment capital structure model:

$$\begin{aligned} Lev_{i,t} &= (1 - \delta)Lev_{i,t-1} + \delta Lev_{i,t}^* \\ &= (1 - \delta)Lev_{i,t-1} + \delta \left( \sum_{j=1}^L \alpha_j X_{i,j,t-1} + \sum_{k=1}^N \gamma_k macro_{i,k,t-1} \right) \end{aligned} \quad (12.3)$$

With Eqs. (12.1) and (12.2), we get a one-step model. Since the independent variable  $LEV_{i,t-1}$ , is the lagged dependent variable. To avoid dynamic panel bias, we use Generalized Method of Moments (GMM) to estimate Eq. (12.3). Thus we need to do two tests for GMM estimation. One of them is the Sargan Test which is used to examine whether the instrument variables we selected are efficient. And the Zero Hypothesis is that the instrument variable is effective. The other test is Correlation coefficient test. The Zero Hypothesis is that there is no correlation between  $\Delta\mu$  it and  $\Delta\mu i$ . If the residual is not autocorrelated, the random disturbance with the first order difference just has first-order autocorrelation, not second-order autocorrelation (Table 12.1).

## 12.2.4 Variables

## 12.3 Empirical Results

We analyze the data with software eviews 6.0 and stata 10.0. Firstly, according to Eq. (12.1), we examine whether the variables we chose are determinants of the target leverage level. Secondly, we use generalized moment method (GMM) to estimate the adjustment speed  $\delta$ . Thirdly, we separate our sample with 3 different criteria and still use GMM to estimate the effect that macroeconomic factors and firm's characteristics have on dynamic recapitalization.

**Table 12.1** Variables

Indicator type		Variable	Definition
Capital structure proxy		Lev	(short-term interest-bearing debt + long-term interest-bearing debt)/total assets
Determinants of leverage	Firm characteristic target determinants	tang	The ratio of gross plant and equipment to total assets
		grow	Tobin Q ratio
		prof	The ratio of earnings before interest and taxes to total assets
	Macroeconomic target determinants	size	Ln (total assets)
		m	(M2-M1)/M1
		r	Annualized five-year lending rate
		equi	Value of circulation stock market/GDP

### 12.3.1 Determinants of Target Leverage

Our Hausman test result reject zero hypothesis in which fixed effect model and random effect model is equivalent. Thus we use fixed effect model to estimate Eq. (12.1). Table 12.2 shows us estimator of Eq. (12.1). In Table 12.2, we can see that Variance Inflation Factor (VIF) of independent variables is less than 10. It means that there is no multicollinearity among the variables. Adj-R2 is 0.69, indicating that our model is appropriate and variables we chose are the determinants of target leverage level. Coefficient estimators are the same as our forecast. Tangibility is positively correlated with target leverage level, which indicates that with more mortgage assets, firms are easier to obtain debt financing. The coefficient estimators of firms size is positive, indicating that, compared to small size firms, large size firms can get liabilities more easily. Growth is negatively

**Table 12.2** Target Leverage

Variable	Forecast symbol	VIF	Lev coefficient
tang	+	1.05	0.05507(***)
size	+	1.37	0.080852(***)
grow	−	1.57	−0.01186(***)
prof	−	1.16	−0.26569(***)
m	+	2.14	0.255571(***)
r	−	3.03	−0.02909(***)
equi	−	3.13	−1.0187(***)
Observation	7420		
Hausman test	151.6317(***)		
R2	0.723206		
Adj.R2	0.692123		
F(Prob.)	23.26745(0.000)		

We report coefficient estimates in the tables (standard errors are in parenthesis) with \*, \*\*, and \*\*\* indicating significance at the 10, 5, and 1 % levels, respectively

correlated with target leverage level, meaning that high growth firms confront with more investment opportunities so that they intend to maintain their existing leverage level. The coefficient estimator of profitability (prof) is negative. That is to say, firms with more retained earnings need relatively less external financing. A credit quota (M) is negatively correlated with target capital structure, implying that in high liquidity economic environment, bank will loosen their loan requirement, and firms tend to choose debt financing. Coefficient estimator of R is negative, suggesting that, due to capital cost, high interest rate prevent firms from debt financing. Variable equi is negatively correlated with target leverage level, implying that development of capital market has important effect on firm's capital structure (Table 12.3).

### 12.3.2 Estimation of Capital Structure Dynamic Adjustment

According to Eq. (12.3), the coefficient of  $Lev_{i,t-1}$  is  $(1 - \delta)$ . In Table 12.2, we can see that in group one, the coefficient of  $Lev_{i,t-1}$  in sample of good economic is 0.2499 while in sample of bad is 0.5665. That is to say, the speed of recapitalization  $\delta$  is 0.7501 in sample of good and is 0.4335 in sample of bad. Thus we can conclude that in economic boom, firms adjust their capital structure more quickly than in economic recession. Similarly, with the coefficients in group 2 and group 3, we can see that the speed of recapitalization in sample of large is faster than in sample of small, and the speed in sample of high is more quickly than in sample of low. In a word, the results of Table 12.2 improve all hypothesis we proposed above.

Table 12.2 also shows us some results of GMM test. AR (1) and AR (2) are the abbreviation of Arellano-Bond Test For AR (1) In The First Order Differences and Arellano-Bond Test For AR (2) In The First Order Differences, respectively. Arellano & Bond require that residual is not autocorrelated, and if there is only first-order autocorrelation, GMM estimator is fit. In Table 12.2, AR (2) of full sample is 0.162, indicating that there is no second-order autocorrelation and our GMM estimator is appropriate. So does all the subsamples. The results of Sargan Test are presented in Table 12.2. Hypothesis 0 of Sargan Test is that instrument variables are not weak. We can see that p value of Sargan Test in full sample is 0.455, implying that our result accept Hypothesis 0 and instrument variables are efficient.

## 12.4 Conclusion

Firm's decision of financing is closely relative to the macroeconomic environment. Factors influencing target leverage level are not only firm characteristic variables, but also macroeconomic characteristic variables. Target capital structure is

Table 12.3 Dynamic adjustment of capital structure

Lev <sub>i,t</sub>	full sample	Group 1 (economic state)		Group 2 (firm size)		Group 3 (growth)	
		Good	Bad	Large	Small	High	Low
Lev <sub>i,t-1</sub>	0.485(**)	0.250(***)	0.567(***)	0.448(***)	0.561(***)	0.436(***)	0.549(***)
tang	0.767(***)	0.167(***)	0.027(***)	0.028(***)	0.036(***)	0.119(***)	0.051(***)
grow	2.473(*)	0.003	-0.004	-0.020(***)	-0.003(*)	-0.006(**)	-0.028(**)
prof	9.743	-0.477(***)	-0.217(***)	-0.541	-0.310(***)	0.127(*)	-0.545(***)
Size	0.069(***)	0.078(***)	0.062(***)	0.054(***)	0.109(***)	0.046(***)	0.054(***)
m	0.758(**)	0.363	-0.191(***)	-0.086(***)	-0.074(***)	-0.047	-0.079(***)
r	-2.693(*)	0.052(**)	0.019(***)	0.004(***)	0.002(	-0.009(**)	0.012(***)
equi	-1.39.0	0.401	0.736	-0.847(***)	-1.932(***)	0.164(**)	-0.858(**)
Obs	8162	2226	2963	3185	3726	1203	2812
sargan	0.455	0.272	0.108	0.670	0.200	0.339	0.372
AR(1)	0.000	0.045	0.006	0.012	0.000	0.099	0.000
AR(2)	0.162	0.323	0.510	0.553	0.206	0.637	0.454

We report coefficient estimates in the tables (standard errors are in parenthesis) with \*, \*\*, and \*\*\* indicating significance at the 10, 5, and 1 levels, respectively

positively related with tangibility, firm size and credit quota, and is negatively related with firm's growth, profitability, interest rate and the development of stock market.

In the time of economic prosperity, firms move towards target leverage level faster than during economic recession. Compared with small size firms, firms with large size confront with less resistance of financing, so that they are able to adjust their leverage level to target in a relatively short time. Firms with high growth have faster speed of leverage adjustment due to their strong need for capital.

Faulkender et al. (2008) have ever studied the importance of adjustment cost of dynamic recapitalization. He suggested that firms with faster adjustment have access to capital market more easily (Faulkender et al. 2008). Our conclusions also confirm this point of view. In the time of economic boom, with more frequent investment and financing activities, capital market is more active. It makes companies can access into capital market more easily. Large size firms have lower cost of bankruptcy and more mortgages, leading to less resistance in external financing market. Our conclusions also can prove that, since small size firms are unable to adjust their leverage in time, especially in time of economic recession, they are more likely to face financial difficulties and capital chain ruptures. On the other hand, fragility of small size firms aggravates economic deterioration.

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# Chapter 13

## Private Placement Discount of Chinese Listed Companies Based on the Perspective of the Investors' Sentiment

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**Abstract** This paper explored the main driving force of private placement discount based on the perspective of the investors' sentiment. The results show that: (1) The private placement discount has been influenced by the dual effects of rational and irrational factors, but the irrational factors are the main driving force. Also, there is a significant positive correlation between investors' sentiment and private placement discount: the more optimistic (pessimistic) the investors' sentiment is the greater (smaller) the private placement discounts are. (2) Short-term excessive optimism of investors led to the phenomenon of the long-term vulnerable private placement market.

**Keywords** Investors' sentiment • Market effect • Overreaction • Private placement

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## 13.1 Introduction

May 8, 2006, China promulgated “Administrative Measures for the Issuance of Securities of the Listed Companies”, for the first time by private placement into the legal constraints category. According to WIND database, From 2006 to 2011, the number of listed companies through the private placement financing reached 93.84, 267.10, 175.99, 274.08, 313.32, 358.59 billion, accounting for the corresponding total equity refinancing was 89.18, 74.64, 72.79, 88.17, 63.43, and 83.56 %, and the number of successful private placement of listed companies is 50, 133, 102, 118, 158, 176, accounting for corresponding equity refinancing was 84.75, 78.24, 73.91, 83.10, 83.60, and 88.89 %. Private placement has become a major measure for the listed companies to collect capital after China’s share reform. This has caused extensive attention from scholars.

The structure of the rest is organized as follows: the second part describes the study design and the introduction of relevant models; the third section is the empirical test results and analysis; The last part is summarized in this paper.

## 13.2 Study Design

### *13.2.1 Sample Selection and Data Sources*

This paper takes A-share listed companies, whose successful private placements from May 8, 2006 to December 31, 2011, as our samples. Based on the research needs, this paper is handled as follows: (1) Remove the sample companies belonging to the finance and insurance industry, for 22 observations; (2) Exclude the sample companies carried out allotment, for 17 observations; (3) Remove the sample companies, which had public issuance of shares during event period, for 33 observations; (4) Exclude the sample companies lack of market data, for 103 observations. Finally, we get to meet the requirements of 582 observations. The private placement data is from WIND database and other data is from the RESET Database and Eastern wealth network.

### *13.2.2 Variable Definition*

#### **13.2.2.1 Discount rate of Private placement**

According to Wruck and Wu (2009), Barclay et al. (2007), Bin and Jing (2010a, b) we describe discount by  $(P_1 - P_0)/P_1 \times 100 \%$ .  $P_0$  represents issue price of the private placement and  $P_1$  is on behalf of the closing price of the last day of private placement issue. If Discount is greater than 0, it means allowance. If Discount is

less than 0, it means premium. Discount farther deviation from 0, the greater the extent of the discount or premium.

### 13.2.2.2 Composite Index of Investor Sentiment

A single investors' sentiment index can only reflect Some aspect of investor psychology, but it can lead to inaccurate measurements. For more accurate and comprehensive measure of investors' sentiment. According to, Baker and Wurgler (2006) this paper select the closed-end fund discount (DCEF), number of shares of IPO (IPON), the rate of return on the first day of IPO (IPOR), the consumer confidence index (CCI) to build the monthly index of the composite index of China's stock market investors' sentiment (CICSI).

#### (1) *Closed-end fund discount*

Zweig (1973) found that the closed-end fund discounts can reflect investors' sentiment. Closed-end fund discount is rate of the difference between the net value of fund share and its market price divided by the net value of fund share (Zweig 1973). If the discount rate decline, it means that investors are optimistic about the earnings prospects of listed companies and have positive assessment of asset prices. Therefore, investors' sentiment tends to optimism. If the discount rate rises, it means that investors' underweight earnings prospects of listed companies and have conservative assessment of asset prices. Therefore, investors' sentiment tends to pessimism.

#### (2) *The number of IPO (IPON), The market yield of IPO on the first day (IPOR)*

Ljungqvist et al. (2006), Barberis et al. (1998) think that IPON and IPOR can be used to measure investors' sentiment. IPON and IPOR are greater, which means that investors' sentiment is higher. We select the IPON as natural logarithm and select IPOR as the mean of the yield.

#### (3) *Consumer confidence index (CCI)*

Yi and Mao (2009) think that the index of consumer confidence is high, consumers will have full confidence in the current and future economic situation, investors' sentiment will rise. Therefore, the consumer confidence index reflects in part the level of investors' sentiment.

#### (4) *Investor sentiment composite index constructed*

This paper selects DCEF, IPON, IPOR, CCI investors' sentiment as proxy variables for 68 months, and uses principal component analysis method to construct the composite index of investor sentiment (CICSI) monthly to measure investor sentiment, while assuming investor sentiment is the same during the same month. In order to eliminate dimensionless influence, this paper first standardized DCEF, IPON, IPOR, CCI, each variable with mean 0 and standard deviation of 1, then principal component analysis of variables. We select the eigenvalue greater than one of the main ingredients, labeled  $F_1$ ,  $F_2$ , as weights to the variance contribution rate, with the corresponding principal component score by multiplying the sum of the resulting aggregates is

the composite index of investor sentiment (CICSI), and thus to define the state of investor sentiment. If CICSI is greater than 0, it indicate that investor sentiment is in high stage, denoted by CICSI (up), if CICSI is less than or equal to 0, it indicate that investor sentiment is in low stage, as CICSI (down). The investor sentiment index formula is as follows:

$$\text{CICSI} = 39.44 \% F_1 + 37.70 \% F_2 \quad (13.1)$$

### 13.2.2.3 Other Variables

Motivation for tunnel: according to Wang and Liu (2011) approach, the variable is defined as the ratio of the private placement of shares with controlling shareholders to purchase, reflecting the intensity of controlling shareholders conveying (Tunnel). The controlling shareholders buy the greater proportion of the private placement of stock, it indicates the greater motivation of the interests of shareholders output, there is a transfer of wealth is also higher.

Information asymmetry factors: The scale of private placement (Proceeds) is used as an alternative variable for asymmetric information (Zhu 2009). If the scale is larger, the unit cost of the information will be lower. We use the natural logarithm of the raising funds of private placement (million) to represent the scale.

Monitoring factors: We choose the size of the company (Assets) on behalf of the monitoring hypothesis. The larger the size of the company is, the more information about the company on the market will be, the lower degree of information asymmetry will be, then private placement identity will pay less cost in determining the placement price (Baek et al. 2006). Therefore, the required level of discount may be lower. We use the natural logarithm of total assets on behalf of the company size.

IPO liquidity: IPO liquidity (Liquidity) is used as alternative indicators of liquidity compensation hypothesis. If the lock-up period is the longer, the new shares of liquidity will be the lower, and it will increase the shareholders risk. Investors will demand a greater discount. According to Weidong Zhang, Ming Zhang and Siyong Guo (2009), the new shares liquidity is defined as the natural logarithm for locked month multiplied by the retail portion (Weidong 2007) (Zhang and Guo 2009).

## 13.2.3 Model Design

### 13.2.3.1 Multiple Regression Model

This paper introduces the multiple regression model to test what extent private placement discount is affected by investor sentiment, motivation for tunnel, information asymmetry factors, monitoring factors and IPO liquidity.

$$\text{Discount}_t = \beta_0 + \beta_1 \text{CICSI}_t + \beta_2 \text{Tunnel}_t + \beta_3 \text{Proceeds}_t + \beta_4 \text{Assets}_t + \beta_5 \text{Liquidity}_t + \varepsilon \quad (13.2)$$

$\text{Discount}_t$  represent discount rate of private placement in the  $t$  period.  $\text{CICSI}_t$  represent investor sentiment composite index.  $\text{Tunnel}_t$  represent retail portion of controlling shareholders for tunnel.  $\text{Proceeds}_t$  represent the scale of private placement in  $t$  period, for information asymmetry factors;  $\text{Assets}_t$  represent the size of the company in  $t$  period, for monitoring factors;  $\text{Liquidity}_t$  represent IPO liquidity;  $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$  represent each variable's regression coefficient;  $\varepsilon$  represent then error.

### 13.2.3.2 Buy-and-Hold Abnormal Return, BHAR

In the methods based on, Tan et al. (2002), Teoh et al. (1998), we use the buy-and-hold abnormal return for private placement issue in the future for some time on behalf of the listed company's long-term market gains. The formula is as follows:

$$\text{BHAR}_i = \text{BHR}_{i,t} - \text{BHR}_{\text{bm},t} = \prod_{t=1}^T (1 + R_{i,t}) - \prod_{t=1}^T (1 + R_{\text{bm},t}) \quad (13.3)$$

$\text{BHAR}_i$  represent buy-and-hold abnormal return for sample companies in the holding period;  $\text{BHR}_{i,t}$  represent buy-and-hold return for sample companies in the holding period;  $\text{BHR}_{\text{bm},t}$  represent buy-and-hold return for matching company in the holding period;  $R_{i,t}$  represent stock monthly returns for sample companies in  $t$  period;  $R_{\text{bm},t}$  represent stock monthly returns for matching company in  $t$  period.

The average buy-and-hold abnormal return for all sample companies is calculated as:

$$\text{BHAR} = \frac{1}{N} \sum_{i=1}^N \text{BHAR}_i \quad (13.4)$$

$N$  is the number of sample companies.

## 13.3 Results

### 13.3.1 The Initial Proceeds of the Private Placement of Listed Companies

#### 13.3.1.1 The Descriptive Statistical Analysis

As can be seen from Table 13.1, the private placement discount rate mean of China's listed companies is 24.59 %, with a median of 24.00 %, indicating that the

**Table 13.1** Descriptive statistical analysis of private placement discount

	N	Mean	Median	Minimum	Maximum
Discount	582	0.2459	0.2400	−1.8600	0.9000
Include:allowance	520	0.3173	0.2650	0.0000	0.9000
Premium	62	−0.3553	−0.1900	−1.8600	0.0000
CICSI	582	0.1049	0.0700	−1.0500	1.0700
Tunnel	582	27.9187	0.0000	0.0000	100.0000
Proceeds	582	11.3754	11.1850	8.8300	14.8800
Assets	582	12.4313	12.3050	3.8700	16.9500
Liquidity	582	21.9673	16.3700	12.0000	36.0000

private placement issue price is far lower than the closing price of the last day, and more than the private placement discount rate 15–20 % of foreign listed companies. Among all sample, 520 listed companies issued at a discount, whose mean reach 31.73 % and whose median reach 26.50 %. 62 listed companies issued at a premium, accounting for the proportion of the total sample was 10.65 %. The frequency is small.

**13.3.1.2 Multiple Regression Analysis**

From Table 13.2, we can find that the correlation coefficients between the private placement discount rate and investor sentiment composite index, motivation for tunnel, information asymmetry factors, monitoring factors and IPO liquidity are 0.2470, 0.0530, −0.0340, −0.1410, 0.1180, which shows these five variables associated with the former. That is, the private placement discount is affected not only by rational factors, such as transportation motivation of the largest shareholder, information asymmetry compensation, monitoring compensation, the impact of liquidity-constrained compensation, but also by the market irrational factors, such as investor sentiment. In five variables, the relationship between investor sentiment composite index and private placement discount is most closely related, whose coefficient is 0.2470, in the 5 % level of statistical significant positive correlation. It is consistent with Bin and Jing (2010) findings, namely, the private placement discount in secondary market is up (down) with optimistic (pessimistic) sentiment. Motivation for tunnel is not significant on the private placement discount, may be due to the lock-up period existence. This increases the risk for the holding, forcing the large shareholders of listed companies to invest in accordance with the intrinsic value of the stock, and inhibited the controlling shareholders transportation behavior.

**Table 13.2** Pearson correlation

	CICSI	Tunnel	Proceeds	Assets	Liquidity
Discount	0.2470***	0.0530*	−0.0340	−0.1410***	0.1180***
Sig.	0.000	0.0990	0.2070	0.0000	0.0020

Note \*\*\*, \*\*, \* denote significant level of 1, 5 and 10 %

**Table 13.3** F-test

Anova					
	Sum of squares	df	Mean square	F	Sig.
Regression	5.7680	5	1.1540	12.8500***	0.0000 <sup>a</sup>
Residuals	51.7990	577	0.0900		
Total	57.5670	582			

Note \*\*\*, \*\*, \* denote significant level of 1, 5 and 10 %

**Table 13.4** Multiple regression analysis

	DIS( $\beta$ )	T	Sig.
Constant	0.4770	3.2020***	0.0010
CICSI	0.1710	6.4550***	0.0000
Tunnel	0.0000	-1.4620	0.1440
Proceeds	0.0130	0.8670	0.3860
Assets	-0.0390	-3.3430***	0.0010
Liquidity	0.0050	2.7720***	0.0060

Note \*\*\*, \*\*, \* denote significant level of 1, 5 and 10 %

Table 13.3 is about F-test on the regression equation. We can see the equation is meaningful in the 1 % significance level. From Table 13.4, we can see  $\beta_1, \beta_4, \beta_5$  is significant in 1 % level studies. So, the regression equation as follows:

$$\text{Discount} = 47.70 \% + 17.10 \% \text{CICSI} - 3.90 \% \text{Assets} + 0.50 \% \text{Liquidity} \quad (13.5)$$

From the above, we can see regression coefficient between investor sentiment composite index and private placement discount rate is 0.1710, greater than those of the monitoring hypothesis variables and flow compensation hypothesis variable. It indicates that investor sentiment is the main driver of private placement discount. Namely, high investor sentiment will push the high discount, low investor sentiment also pulled down the discount. The regression coefficient for monitoring factors is -0.0390, indicating that the larger company is, the smaller the unit monitoring cost is and the discount required by the investors will accordingly smaller. Regression coefficient for mobility compensation factor is 0.005, indicating that the longer the lock-up period, the greater the degree of liquidity-constrained will be and the greater private placement discount will be. The above conclusions match previous expectations. Although the private placement discount is affected by the enterprise internal factors and market irrational factors, investor sentiment is the orientation of the main driving force.

**Table 13.5** Descriptive statistics of investors' sentiment variable

	N	Mean	Plural	Median	Minimum	Maximum
DCEF	67	-0.1769	-0.1200	-0.1800	-0.340	-0.0700
IPON	59 <sup>①</sup>	9.5068	8.2700	9.2300	7.940	12.4400
IPOR	59 <sup>①</sup>	0.8805	0.1500	0.7000	0.020	3.3500
CCI	68	98.3235	94.0000	97.1000	90.200	108.100
CICSI	68	0.0551	-0.1100	0.0750	-1.050	1.0700
CICSI(up)	43	0.3363	0.0700	0.2600	0.000	1.0700
CICSI(down)	25	-0.4284	-0.1100	-0.1900	-1.050	0.0000

① Note There is no issuance of new shares in nine months. In principal component analysis, we have them as missing values

### 13.3.2 Long-Term Market Effects In The private Placement of Listed Companies

#### 13.3.2.1 Descriptive Statistics of Investors' Sentiment

In accordance with the foregoing investors composite index constructed, we can find that investor sentiment index is relatively high during 43 months and is relatively low during 23 months (Table 13.5).

#### 13.3.2.2 Long-Term Market Performance After the Private Placement of Listed Companies

This paper lists BHR and BHAR between the sample companies and the Shanghai Composite Index in 6, 12, 24, 48, 68 months holding period. Firstly, we removed the sample which had more than twice the private placement. Secondly, we calculated BHR and BHR of the sample companies and the Shanghai Composite Index. Thirdly, we used Wald-Wolfowitz test and Kolmogorov-Smirnov test for independent samples test. Finally, we calculated the BHAR of different holding period. From Table 13.6, we can find the BHAR value is 187.27, 41.96, 53.00, 20.00, -5.00 % in five different holding period, and at least significant at 5 % level. Thus, there will be a positive return in the short term after private placement of listed companies, mainly because of overconfident investors. They overreact

**Table 13.6** Buy-and-hold abnormal return of private placement (wald-wolfowitz test)

	(1,6)	(1,12)	(1,24)	(1,48)	(1,68)
BHRi (%)	292.07	150.80	157.00	122.00	97.00
BHRbmk (%)	104.81	108.83	104.00	103.00	102.00
Wald-Wolfowitz test	0.002	0.000	0.000	0.000	0.000
BHAR (%)	187.27***	41.96***	53.00***	20.00***	-5.00***

Note \*\*\*, \*\*, \* denote significant level of 1, 5 and 10 %

**Table 13.7** Buy-and-hold abnormal return of private placement (kolmogorov–smirnov test)

	(1,6)	(1,12)	(1,24)	(1,48)	(1,68)
BHRi (%)	292.07	150.80	1.57	1.22	0.97
BHRbmk (%)	104.81	108.83	1.04	1.03	1.02
Kolmogorov–Smirnov test	0.005	0.034	0.002	0.000	0.000
BHAR (%)	187.27***	41.96**	0.53***	0.20***	−0.05***

*Note* \*\*\*, \*\*, \* denote significant level of 1, 5 and 10 %

easily in the state of sentiment and overestimate the value of the stock, which push stock prices constantly higher. In the long run, as investor enthusiasm subsided, investors will gradually correct the cognitive bias, stock prices have been in an adjustment process. The share price eventually return to intrinsic value and may even lower than the intrinsic value. That is, the private placement market of listed companies will appear a share price improved significantly in the short term and a continuous weak phenomenon in the long term (Table 13.7).

## 13.4 Conclusion

This paper takes successful private placements of A-share listed companies as our samples from May 8, 2006 to December 31, 2011. It explored the main driving force of private placement discount based on the perspective of the investors' sentiment. The results show that: (1) The private placement discount has been influenced by the dual effects of rational and irrational factors, but the irrational factors are the main driving force. Also, there is a significant positive correlation between investors' sentiment and private placement discount: the more optimistic (pessimistic) the investors' sentiment is, the greater (smaller) the private placement discounts will be. (2) Short-term excessive Over-optimistic mood of investors led to the phenomenon of the long-term vulnerable private placement market.

The innovation in this paper may be: We have studied the short-term and long-term market effects in the private placement of China's listed companies from a new perspective, that is, from the irrational investors' sentiment perspective. In addition, we have used the principal component analysis to build investors' sentiment composite index in order to measure investors' sentiment.

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# Chapter 15

## Research on Pricing Mechanism of Mergers and Acquisitions of China's Listed Companies

Wei Liu

**Abstract** Mergers and acquisitions of listed companies has become an important part of China's capital market. This paper describes the existing M & A pricing method and analyzes the defects of the existing pricing methods. Based on this, we propose how to improve the pricing of listed companies in mergers and acquisitions, and also analyze the improved pricing method. Finally, the paper puts forward relevant policy recommendations for the reform of the pricing mechanism, in order to better adapt and promote the development of capital market mergers and acquisitions business.

**Keywords** Listed company · Mergers and acquisitions · Pricing mechanism

### 15.1 Introduction

The mergers and acquisitions of company refer to two or more companies merging to form a new company or mutual shares. It is often in the same sense with a broad concept of mergers and acquisitions, it also refers to in the role of market mechanism, in order to get the other corporate control, the company should carry out the property rights trading activities. In the continuous development process of the company, to seek a variety synergies of management, operation or finance, carry out diversification, achieve strategic mergers and acquisitions, or to eliminate competitors through lower the cost of expansion and seek tax incentives, it can use M & A means to achieve this purpose, thereby increase the interests of the shareholders.

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The efficiency of company mergers and acquisitions plays a vital role on the stock market which can achieve the efficient allocation of resources or not (Zhang 2003). In the dual context of economic globalization and transition period, company mergers and acquisitions in China's stock market becomes an important means of inter-enterprise resource reconfiguration and outside governance of the enterprises (Li et al. 2004). Mergers and acquisitions can help reduce the growth costs and transaction costs of listed companies; meanwhile, it is also beneficial to lower the entry threshold of the securities market. However, in the process of mergers and acquisitions, transaction pricing is the core problem and the key factor for trading success achieved. For listed companies, mergers and acquisitions is not only related to the operation of the market pricing mechanism, as well as the distribution of benefits between the parties, but also related to damage the interests of minority shareholders. So this paper summarizes the existing method of value assessment of the listed company merger and reorganization, and analyses the shortcomings of the current pricing method. Based on this, we analysis the pricing of mergers and acquisitions, and also propose the corresponding recommendations.

## **15.2 The Current Pricing Method of Mergers and Acquisitions About Listed Company**

For the pricing of mergers and acquisitions in listed companies, we can analyze it from the following valuation indicators (Kuipers et al. 2008; Moeller et al. 2004).

### ***15.2.1 The Book Value Pricing***

Book value refers to total assets minus total liabilities in the balance sheet, which is the number of owners' equity; it is the accounting reflects of the equity of company shareholders and net asset value of the company. Because the company's net assets are calculated by the historical cost, this index does not reflect the real market value of net assets; therefore it is only used to compare with other methods.

### ***15.2.2 Assessed Value Pricing***

Assessed value is every asset of M & A to be assessment in accordance with the current market value at a fixed point, and then calculate the cumulative value of the assets based on the assessed value, this value minus the value of the company's liabilities; the resulting value is the value of the assessed company. This method is generally to increase the value of fixed assets of the acquired companies; thereby it

can increase depreciation and reduce taxes. Its inadequacies are that the total assessment of individual asset is little relationship to the value of the overall profitability and going concern.

### ***15.2.3 Stock Market Value Pricing***

The stock market value pricing is for the listed companies, according to the market price of the corporate stock to assess the value of its assets, for the non-listed companies, it can refer the market price of comparable listed companies. This way is currently also one of the more commonly used methods, but the speculative behavior, emotions and personal judgment also have an impact on the stock price.

### ***15.2.4 Spin-off Value Pricing***

Spin-off value pricing is to compare the company's current value and the total value after spin-off, then determines the assessment value to be overvalued or undervalued. This method is adapted to diversified companies, investors can choose the lower value of current value and the spin-off value to purchase the assets.

### ***15.2.5 Cash Flow Pricing***

When we use the cash flow pricing to assess the value of the acquired company, it need to predict the cash flows generating after the acquisition, and also use the appropriate discount rate to calculate the purchase cost of capital. This method makes the discounted value of cash flow after M & A as the upper limit of the purchase value, which accurately forecasts the cash flow of the acquisitions is the key factor in merger analysis.

## **15.3 The Limitations of Existing Pricing Methods**

Although there are many pricing methods about mergers and acquisitions about company, the current pricing method can not fully reflect the consideration pricing factors. In the complex situation of different types of domestic market of mergers and acquisitions, the current pricing also can not provide a reasonable platform for all parties involved to reach a balance of interests.

### ***15.3.1 The Current Pricing Mechanism is Not Well Reflected the Pricing Factors to be Considered***

Liquidity is an important factor affecting the valuation of assets. The current high liquidity leads to internal and external market valuation system for the domestic stock market, such as the motherboard market valuation, small and medium plate market valuation and the GEM market valuation. In addition, the length of the shares lock-up period can also affect liquidity.

Whether you gain control or not will also affect the valuation of assets. Premium for control of the overseas capital markets is often more than 30 %, we choose Hong Kong capital market as an example, in statistics from 2000 to 2010 (Rhodes-Kropf and Robinson 2008), Premium for control of control transaction is 35.70 %, as shown in Table 15.1

The pricing process of market-oriented mergers and acquisitions should be subject to its own checks and balances of the market, is determined by supply and demand, is also the embodiment of game strength between transaction parties. The illiquidity discount and control premium usually need to be considered an important factor in M & A transaction pricing. In addition, expected the restructuring to inject high quality assets tend to bring stock prices, drives up the cost of restructuring acquire shares.

### ***15.3.2 The Current Pricing Mechanism is Not Able to Adapt to Different Types of Restructuring***

Under the current pricing system, backdoor listing and listed as a whole reorganization of the two types of parties to the transaction can be found equilibrium point of interest. After the reorganization of listed companies, the profitability and asset quality have mostly been improved, the listed company and its shareholders

**Table 15.1** 2000–2010 different types of M & A transactions premium levels in Hong Kong capital market

The type of transaction	Relative to the closing price one day before the announcement date (%)	Relative to the average price one week before the announcement date (%)	Relative to the average price one month before the announcement date (%)
Equity-type transactions	8.96	10.61	15.12
The acquisition of control over transactions	29.42	34.55	35.71
Privatization transactions	37.15	42.33	47.95

can achieve a win-win situation, which is the intrinsic economic motivation of these two types of restructuring higher proportion (Mueller 1985).

These is a little completely market-oriented case of the listed company issued shares to an independent third party to purchase the assets at the same period, the reorganization of the intention of the number of listed companies is terminated for failing to find the equilibrium point of interest with stakeholders, it is difficult to achieve the strategic development planning and consolidation in the industry (Marks and Mirvis 2001).

### ***15.3.3 The Current Pricing Mechanism Fails to Solve the Problem of Timeliness***

The transaction price of M & A has certain timeliness. Mergers and acquisitions in domestic have many procedures and long cycle. In the context of market volatility, the price of the shares locked in the restructuring plan may not meet the actual situation of significant changes occurred. The existing provisions are not set aside room for adjustment to the share offering price, give rise to contradictions among the transaction parties, lead to the restructuring plan can not be completed (Moore 2008).

## **15.4 The Improvement and Analysis of Pricing Methods of M & A in Listed Company**

At present, in accordance with the principles and the different routes, the main pricing methods of mergers and acquisitions are market approach, cost approach and income approach (Bjorvatn 2004). From the view of China's capital market, the application of the income approach is more widely used. For example, 57 cases of mergers and acquisitions in the year of 2009 audit, there are 53 projects directly using the income approach, or using the income approach as the authentication (Stein 1997). Although the income approach is in the line with the principle of mergers and acquisitions, in practice there are operational risks, so how to use the income approach is the focus of this study. According to the model of discounted cash flows of the income approach, the vale of the assessed firms in the baseline day ( $V$ ) is equal to.

$$V = \sum_{i=1}^{\infty} \frac{FC_i}{(1 + WACC)^i}$$

Among them, the indicator is calculated as follows:

$$FC = EBIT \times (1 - t) + DEP - CE - \Delta OC$$

$FC$  represents free cash flow of the company,  $WACC$  represents the weighted cost of capital of the company,  $EBIT$  represents equity before interest and taxes,  $t$  represents income tax rate of the corporate,  $DEP$  represents depreciation and amortization,  $CE$  represents the capital expenditure,  $\Delta OC$  represents the amount changes of working capital.

It can be seen from the above formula (1), to calculate the value of the company must solve two problems. First, the company's future cash flow distribution, how much cash flow will produce in each time period? Second, to determine the discount rate, that is how high of the cost of capital?

### 15.4.1 Cash Flow Problems

In order to accurately assess the value of company, we need to forecast the future cash flow for a period of time, but it is a quite cautions and arduous work for accurately predict future cash flows of the enterprises (Healy et al. 1992). We apply simplifies and approximate method in this paper, the cash flow is divided into two calculations, a detailed forecast from the first year to the  $n$ th year, then accordance the annuity calculation after the  $n$ th year.

$$V = \sum_{i=1}^n \frac{FC_i}{(1 + WACC)^i} + \sum_{i=n+1}^{\infty} \frac{FC_i}{(1 + WACC)^i}$$

Assume the company enters the stage of steady development after  $n$  years, the annual growth rate is  $g_n$ , the value of the company is the follow formula.

$$V = \sum_{i=1}^n \frac{FC_i}{(1 + WACC)^i} + \frac{FC_{n+1}/(WACC - g_n)}{(1 + WACC)^n}$$

We can see that the general  $n$  is five from the computing experience, then accordance with a fixed annuity to calculate after five years, and one year is calculated first, and then extrapolates to the remaining four years.

### 15.4.2 Discount Rate Problem

According to the Ministry of Finance enterprise value assessment guidance, the discount rate model used by the income approach is the weighted cost of capital model ( $WACC$ ).

$$WACC = K_e \frac{EC}{EC + DC} + K_d(1 - t) \frac{DC}{EC + DC}$$

$K_e$  represents cost of equity capital,  $EC$  represents the market value of equity capital,  $DC$  represents the market value of debt capital,  $K_d$  represents the cost of debt capital (interest-bearing debt after interest rates in the income tax),  $t$  represents income tax rate.

$K_e$  is to be calculated by the capital asset pricing model (CAPM).

$$K_e = E(R_i) = R_f + \beta(R_m - R_f)$$

$K_e$  represents cost of equity capital,  $R_f$  represents the risk free rate.

$$\beta = \frac{Cov(R_i, R_m)}{Var(R_m)}$$

(a) The error analysis of the cost of capital to the assessment results.

Assumption the fixed cash flow and the company can be continue going, the assessed value is as follows.

$$V = \frac{FC}{WACC}$$

If the assessment of the cost of capital errors is  $\Delta WACC$ , then

$$V' = \frac{FC}{WACC + \Delta WACC}$$

The error of the assessed value is that.

$$\frac{V' - V}{V} = \frac{1}{1 + \frac{\Delta WACC}{WACC}} - 1$$

The above formula shows that, if the WACC overestimation is 30 %, it has 23 % of the impact on the assessed value of the company.

(b) Beat error analysis of the assessment results.

Accordance with the enterprise value to assess the requirements of the guidance, through a number of cases (at least five) as a compare, we calculate the financial leverage  $\beta_y$  in the case, and then translated into financial leverage  $\beta_n$ , use the average of the financial leverage  $\beta_n$ , combined with the object to be estimated financial leverage ratio, translation of the object was to assess the financial leverage  $\beta_y$ . In this process, it should be very cautious to prevent errors and human adjustment, otherwise a great impact on the assessed value (Cui and Mak 2002).

To illustrate this phenomenon, this paper builds a corporate financial model. Suppose  $DC = EC/3$ , the gearing ratio of the company is 33 %, the capital costs of debt is  $K_d = 5\%$ , income tax rate is  $t = 25\%$ , equity cost of capital is to be derived from the CAPM,  $K_e = E(R_i) = R_f + \beta(R_m - R_f)$ . According to one-year deposit rate of China's state-owned commercial banks is 3.5 %, we choose

$R_f = 3.5\%$ . Reference to the Shanghai and Shenzhen 300 historical annual rate of the return is 9.15 %, Shanghai Composite historical annual rate of the return is 11.33 %, Shenzhen into the historical annual rate of the return is 11.85 %, so we choose  $R_m = 11.5\%$ . And also assume the existence of error of the  $\beta$  is  $\Delta\beta$ , the assessment of error as follows.

$$\frac{V' - V}{V} = \frac{3.563\% + \beta \times 6\%}{3.563\% + (\beta + \Delta\beta) \times 6\%} - 1$$

It shows that the beta error has an important influence of corporate valuation, and the degree of influence is closely related to the beta itself. If the higher of beta, it is the greater impact errors of the results on the valuation.

(c) Comprehensive error impact analysis on the assessment results.

In theory, the above error can cancel each other out under normal circumstances. However, if the existence of man intentionally overestimated or underestimated, the different types of assessment errors will be superimposed, the results deviating from the enterprise value itself will be quite large (Grubb and Lamb 2000). The following derived the degree of influence of various errors which are role at the same time, it still illustrates using the above corporate financial model.

When the errors are all existence of cash flow and beta, the assessed value is that:

$$V' = \sum_{i=1}^{\infty} \frac{FC_i + \Delta FC}{(1 + 3.563\% + (\beta + \Delta\beta) \times 6\%)^i}$$

Suppose further that the cash flow constant growth.

$$V' = \frac{FC + \Delta FC}{3.563\% + (\beta + \Delta\beta) \times 6\% - (g + \Delta g)}$$

There are cash flow error, beta error and the growth rate of error at this point.

While the actual value of the company is  $V = \frac{FC}{3.563\% + \beta \times 6\%}$ , the error rate of the assessed value is,

$$\frac{V' - V}{V} = \frac{FC + \Delta FC}{FC} \times \frac{3.563\% + \beta \times 6\% - g}{3.563\% + (\beta + \Delta\beta) \times 6\% - (g + \Delta g)} - 1$$

By the above equation, in the case of the same parameter error, the extent of overvaluation is much larger than the degree of underestimation of the price.

## 15.5 Some Suggestions

Based on the foregoing analysis, it proposes to take full account of the feature of market-oriented, diverse, complex in mergers and acquisitions transactions, give more flexibility to the issue of shares pricing (Claessens 2003). So vigorously promote market-oriented reforms as a path to increase the development vitality in mergers and acquisitions market (Chen and Yuan 2004). At the same time, in order to reduce the possible adverse impact of the reform to pricing mechanism and protect the interests of small shareholders, it is accompanied by the necessary supporting mechanisms.

For the pricing issues of mergers and acquisitions in listed companies, this paper proposes the following suggestion. First, allow the share offering price to be determined in consultation. Second, set up institutional arrangements to protect the interests of minority shareholders. Third, the introduction of the price after the adjustment mechanism to increase the timeliness of the price, further improve the internal and external oversight mechanisms.

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# Chapter 16

## Research on the Influence of FDI on Improving Technological Progress of China's Western Region

Hai-bing Wu, Yan-qiong Zhou and Hua Li

**Abstract** This article has summarized China's western region's characteristics of attracting and utilizing foreign capital from 1986 to 2010. It has described the present situation that the distribution of FDI here is unbalanced and the ability of absorbing foreign investment of this region is weak. TFP of the provinces in China's Western Region has been calculated, and been used to measure technological progress. Through constructing VAB Model, this article has empirically analyzed the relationship between FDI and TFP. The result proves that FDI has some facilitation to the technological progress of China's Western Region, but is not very significant. In the process of attracting and using foreign investment, the Western Region of China should optimize investment environment, and expand FDI scale; change the concept of attracting investment, and improve the performance of foreign investment; encourage Sino-foreign joint venture, and strengthen technical cooperation.

**Keywords** China's western region · FDI · Technological progress · VAR model

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—Empirical analysis based on VAR model.

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## 16.1 Introduction

With the deeper development of economic globalization, capital flows, which across the national boundaries, becomes an important factor of promoting urban, regional and national economic development. China, which in the spring tides of economic globalization, is no exception. In the 30 years of reform and opening up, China's foreign direct investment (FDI) is increasing with a high speed, and became important strength in promoting the economy to grow. Eastern region is the earliest area of China opened to the outside world. In this region, the scale of absorbing foreign investment is large, and the performance of foreign investment is high. As relatively backward areas, central region and western region of China also need supports from foreign investment to develop economy.

In previous researches, domestic and foreign scholars such as Tao Xu, Zhan Pan, Cave and Blomstrom supported Technology Spillover Effect; they believed that the inflows of FDI would promote technical progress of local enterprises (Cave 1974; Blomstrom and Persson 1983; Xu 2003; Zhen 2005). However, some other scholars, such as Yungui Wang, Lin Ma, Borensztein and Aitken, held different opinions. They argued that the influence of FDI on promoting technological progress is not significant (Borensztein et al. 1998; Aitken and Harrison 1999; Wang 1998; Ma and Zhang 2008). How FDI effect the economic development of China's western region? Through analyzing the influence of FDI on improving technological progress of China's western region, the article aims at supplying certain references for this region to adjust and perfect policy of attracting FDI.

## 16.2 Situation Analysis of Western Region's FDI Absorption

Western region is an important strategic economic area of China. It shares common borders with some countries of Southeast Asia and West Asia. China's western region has the greatest industry difference gradient; economic cooperation with foreign countries is getting increasingly close. It has strong developmental potentials. As China deeply undertakes international industrial transfer and China's eastern region speed up to optimize and upgrade the industrial structure, western region has become main destination of FDI. This part focus on analyzing China's western region's present situation and characteristics of attracting and utilizing foreign investment.

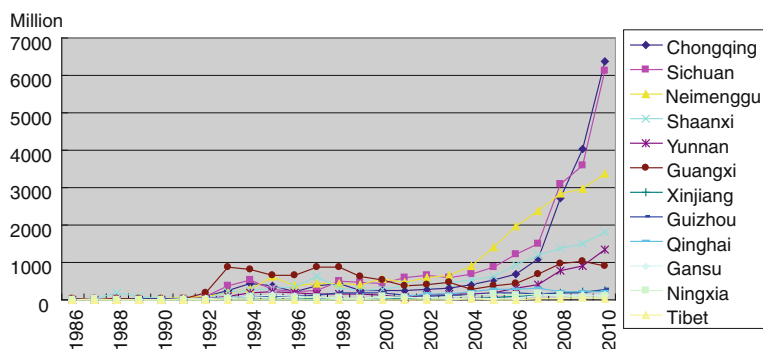
### 16.2.1 Rapidly Expanded FDI Scale

From perspective of historical development, there is a big gap between the western region and the eastern region of China in attracting foreign investment, especially the far western region, which obtained less than 100 million dollars (present value, similarly hereinafter) of FDI before 1990s. However, with the greater openness to the outside world, FDI scale in China's western region trends to be expanded. Figure 16.1 shows the gross of FDI of the provinces and autonomous regions of the western region in China (from 1986 to 2010). From the figure, it can be seen that after the Chinese characteristic socialist market economy system has been founded in 1992, the total amount of FDI of the western region climbed from 613 million dollars in 1992 to 2,218 million dollars in 1993, and it topped 10 billion dollars, amounted to 12.647 billion dollars in 2008 (CNKI).

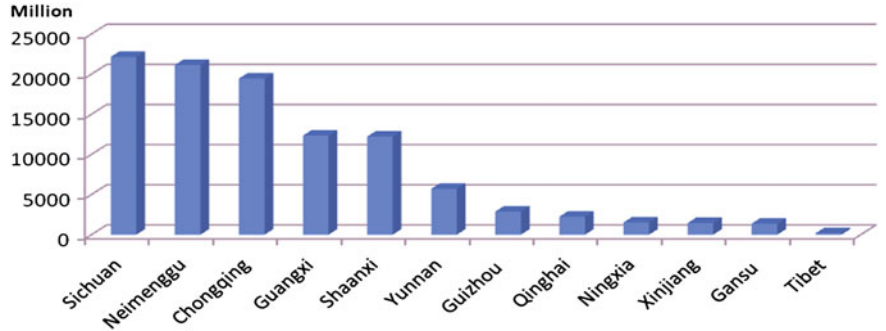
From 1986 to 2010, the total amount of FDI in this region increased from 109 million dollars to 20.933 billion dollars, have been multiplied up 191 times. The average annual growth rate is 24.5 %, with 3.1 % higher than the national average (21.4 %). In 2010, Chongqing and Sichuan, municipality and province in western region respectively, absorbed FDI more than 6 billion dollars, which are near Beijing's level. It proves that western region's ability of attracting FDI was increasing steadily.

### 16.2.2 Unbalanced FDI Distribution

From Fig. 16.1, it can be seen that there are enormous differences in the FDI scale among 12 provinces and autonomous regions in China's western region. Figure 16.2 shows the accumulated FDI scale of 12 provinces and autonomous regions in the western region by 2010. The top two are Sichuan and Inner Mongolia, whose accumulated FDI scale are over 20 billion dollars. Chongqing is in



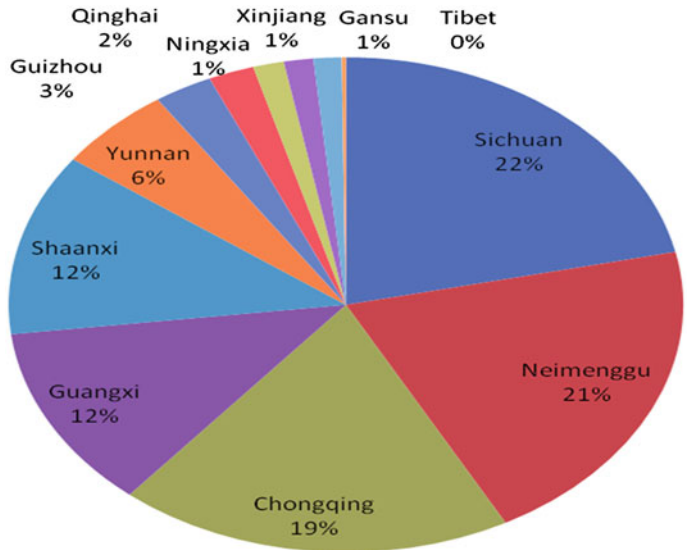
**Fig. 16.1** Line chart of the FDI scale of all the provinces and autonomous regions in China's western region from 1986 to 2010



**Fig. 16.2** Accumulated FDI gross of 12 provinces and autonomous regions in western region by 2010

third with accumulated FDI scale of 19.4 billion dollars. Sichuan, Inner Mongolia and Chongqing comprised the first echelon. The accumulated FDI gross of Guangxi and Shanxi are 12.3 billion dollars and 12.2 billion dollars respectively; they are in the second echelon. The other seven provinces and autonomous regions, with accumulated FDI gross fewer than 5 billion dollars, has formed the third echelon.

Figure 16.3 visually reflects the differences between the 12 provinces and autonomous regions in China’s western region. The accumulated FDI gross of Sichuan, Inner Mongolia and Chongqing, in total, account for 62 % of Western



**Fig. 16.3** Distribution pattern of accumulated FDI gross of 12 provinces and autonomous regions in western region by 2010

Region's FDI scale. Tibet, Ningxia, Gansu and Sinkiang, which in last fourth place, accounting for only 4.4 % of the western region's FDI scale. There is a big gap between all the provinces and autonomous regions in western region in the FDI scale, so the distribution pattern of FDI here can be summarized as: small scale and unbalanced distribution (CNKI).

### ***16.2.3 Weak Ability of Attracting FDI***

Inward FDI Performance Index is used to measure a region's success of absorbing FDI, and eliminate the influence of factors such as different economic scale on absorbing FDI. The calculating formula is:

$$\text{Inward FDI Performance Index} = \frac{\text{FDI}_p/\text{FDI}_c}{\text{GDP}_p/\text{GDP}_c}$$

Where

FDI<sub>p</sub>—FDI inflows in a province;

FDI<sub>c</sub>—FDI inflows in a country;

GDP<sub>p</sub>—GDP of a province;

GDP<sub>c</sub>—GDP of a country.

In this formula, if Inward FDI Performance Index is 1, that means the proportion of the province's FDI inflows to the country's FDI inflows is equal to the proportion of the province's GDP to the country's GDP; If Inward FDI Performance Index is larger than 1, the province's FDI inflows is larger than the expectations of FDI which can be absorbed according to the GDP of this province; If Inward FDI Performance Index is less than 1, that means this province's FDI inflows are smaller than the expectations. The reasons are probably unstable economy, invalid policy, weak competitiveness, etc. According to calculation, Inward FDI Performance Index of the 12 provinces and autonomous regions in China's Western Region are shown by Table 16.1.

According to the comparison, it can be found that the average Inward FDI Performance Index of this region is less than 1. It proved that the ability of attracting FDI here is weak. From the data in Table, it can be seen that Inward FDI Performance Index swings above and below 0.3. Since 2008, the index number was increasing significantly, but still less than 1. In 2010, Inward FDI Performance Index of this region is 0.61, comparing with eastern region (1.15), northeastern region (0.72), and central region (0.72), there is still an obvious variation.

In 2010, only Chongqing, whose Inward FDI Performance Index is larger than 1 (1.9), get to the level of China's eastern region. The past records of Chongqing were steadily rising, and the index of 2008 and 2009 are 1.04 and 1.42 respectively. It can prove that Chongqing, with strong regional competitiveness, liberalized more, and the economic development here have been a strong attraction to foreign investment.

**Table 16.1** Inward FDI performance indexes of the 12 provinces and autonomous regions in China's western region from 1986 to 2010 (some important years)

Years	Western	Chong-qing	Si-chuan	Inner mongolia	Shaanxi	Yun-nan
1986	0.43	–	0.23	0.25	0.31	0.13
1990	0.24	–	0.07	0.41	0.53	0.03
2000	0.32	0.32	0.24	0.76	0.34	0.14
2006	0.35	0.40	0.31	0.89	0.44	0.17
2007	0.36	0.51	0.31	0.81	0.45	0.18
2008	0.46	1.04	0.54	0.74	0.41	0.30
2009	0.51	1.42	0.58	0.71	0.43	0.34
2010	0.61	1.90	0.84	0.69	0.43	0.43
	<i>Qing-hai</i>	<i>Guang-xi</i>	<i>Gui-zhou</i>	<i>Tibet</i>	<i>Ning-xia</i>	<i>Xing-jiang</i>
1986	0.01	1.24	0.63	–	0.33	0.78
1990	0.00	0.34	0.59	–	0.85	0.13
2000	0.32	0.54	0.40	0.00	0.65	0.03
2006	0.95	0.21	0.18	0.12	0.43	0.08
2007	0.85	0.26	0.12	0.15	0.40	0.08
2008	0.48	0.31	0.11	0.13	0.22	0.10
2009	0.46	0.31	0.11	0.30	0.12	0.12
2010	0.38	0.23	0.15	0.11	0.11	0.10

*Information source* Collect from China statistical yearbooks database

It is worthwhile to note that, not all Inward FDI Performance Index of the provinces in western region increased, and some provinces' indexes trend to decrease. Take 2000–2010 as the period of observation, it can be seen that there are six provinces whose indexes in 2010 are below the average number of the 11 years. Take Qinghai as example, in the period of observation (from 2000 to 2010), the average index number is 0.72; in particular, the indexes of 2004 and 2005 are above 1. However, the index of 2010 dramatically decreased to 0.38. It shows that Qinghai's FDI scale is incompatible with the GDP here, so it needs to make effort to improve the ability of attracting FDI.

## 16.3 Empirical Analysis Based on Var Model

After analyzing the present situation of attracting and utilizing FDI of China's Western Region, the metering model will be founded to empirically analyze the influence of FDI in this region on promoting technological progress.

### 16.3.1 Measuring and Calculating Method of CRTP

"Solow Residual" is commonly used to measure and calculate the contribution rate of technical progress (CRTP) in so far. Total factor productivity (TFP) is used

to quantize the indexes of technical progress. And the CRTP can be shown as the residual of outputs growth minus growth of capital input and labour input. The formula is giving below:

$$\Delta Y/Y = \alpha(\Delta K/K) + \beta(\Delta L/L) + (\Delta A/A)$$

Therefore:

$$TFP = \Delta A/A = (\Delta Y/Y) - \alpha(\Delta K/K) - \beta(\Delta L/L)$$

Where,

$\Delta Y/Y$  represents outputs;

$\Delta K/K$  is capital input;

$\Delta L/L$  is labour input;

$\Delta A/A$  is contribution rate of technical progress;

$\alpha$  represents capital output elastic;

$\beta$  represents labor output elastic.

And,  $\alpha + \beta = 1$ .

### 16.3.2 Determination and Cancelation of All Indexes

Y: This article will take GDP of 12 provinces and autonomous regions in China's western region from 1987 to 2010 as samples, which based on GDP and GDP deflator of 1978.

K: Firstly, the physical capital stock in 1978 of all provinces and autonomous regions was determined. Jun Zhang regarded the price of 1952 as the fixed price, and calculated the physical capital stock in 1978 of all provinces and autonomous regions. And he also afforded the price indices for investment in fixed assets of 1978, using 1952 as the basis year. Then the physical capital stock which takes the price of 1978 as the fixed price can be figured out. According to the formula of "Perpetual Inventory Method":  $K_t = K_{t-1} \times (1 - \delta_t) + I_t$ , each year's capital stock could be calculated. Referencing the measuring and calculating method of Jun Zhang,  $\delta_t$ , the rate of depreciation, can be described as 9.6 %, It is annul gross fixed capital formation, and deflated by price indices of investment in fixed assets.

L: L represents labour input. According to the employment figures at the end of the year, the change rates of labour input of each year are figured out.

$\alpha$  and  $\beta$ :  $\alpha$  and  $\beta$  represent capital output elastic and labour output elastic respectively. Take the output elasticity, which calculated by Jun Zhang in the process of counting China's TFP, as reference, capital output elastic and labour output elastic are 0.609 and 0.391 respectively.

### 16.3.3 Correlation Analysis of FDI and TFP

According to the Vector Autoregressive Model (VAR Model), the correlation of TFP and FDI is going to be estimated. TFP is a relative quantity, while FDI is an absolute quantity. The different dimensions may cause error in the result of the model, so the amount of variation of the western region's FDI from 1987 to 2000 is used here to take place of absolute quantity.

(1) Determining Lag Phase

Construct VAR Model in Eviews software, then determine optimal lag phase by lag length criteria. All lag orders selected by the criteria are second-order, so the lag order of VAR Model can be regarded as second-order.

(2) Unit Root Test

Through unit root test in Eviews, it can be known that all characteristic roots are smaller than 1, and all on the unit circle, so time series datum have satisfied the requirements of stability of the model.

(3) Granger Causality Test

Granger Causality Test about TFP and FDI was carried out in the second lag phase. And the result has rejected the first hypothesis, however could not reject the second hypothesis. So it proves that FDI is TFP's Granger cause, and it also a kind of uni-directional causality.

(4) VAR Model Estimation

TFP and FDI were estimate in VAR Model, the result is giving below:

$$\begin{aligned} \text{TFP} = & -0.09\text{TFP}(-1) + 0.31\text{TFP}(-2) + 0.03\text{FDI}(-1) + 0.04\text{FDI}(-2) + 0.03 \\ \text{T: } & (-0.41) \quad (1.42) \quad (1.27) \quad (1.90) \quad (1.56) \\ R^2 = & 0.51 \end{aligned} \tag{16.1}$$

$$\begin{aligned} \text{FDI} = & -1.24\text{TFP}(-1) + 4.32\text{TFP}(-2) + 0.87\text{FDI}(-1) - 0.60\text{FDI}(-2) - 0.01 \\ \text{T: } & (-0.61) \quad (2.14) \quad (4.52) \quad (-2.85) \quad (-0.06) \\ R^2 = & 0.57 \end{aligned} \tag{16.2}$$

According to the result of Granger Causality Test, TFP is not the Granger Cause of FDI, so the formula 16.2 is not established. From formula 16.1, it can be seen that the variation rate of FDI in lag phase 1 and lag phase 2 could introduce 0.03 and 0.04 units of the TFP respectively, the coefficient is small. Moreover, the amount of inspection of T is only 1.27 and 1.90, the relative coefficients are indistinctive. Therefore, VAR Model shows that FDI would promote technical progress of China's Western Region, but is not significant. Contribution of FDI to technical progress is limited.

(5) Impulse Response Function

Impulse response function describes the reaction of endogenous macroeconomic variables such as output, consumption, investment, and employment at the time of the shock and over subsequent points in time. It could visually describe the dynamic interaction and action among variables. In this article the lag length was determined as 20. Use software to get the following figures (Fig. 16.4):

From the dynamic analysis of impulse response function, it can be known that TFP could have certain response to the standard information of FDI. However, the fluctuation is not great, only from 0 to 0.03, and reach to the peak at lag phase 3, then swings above and below. Lag phase 6 and lag phase 11 are negative values, but the number is small; then gradually return to 0. Impulse response function indicate that FDI of China's Western Region has positive effects to TFP of this region, but only in primary stage and then rapidly reduce.

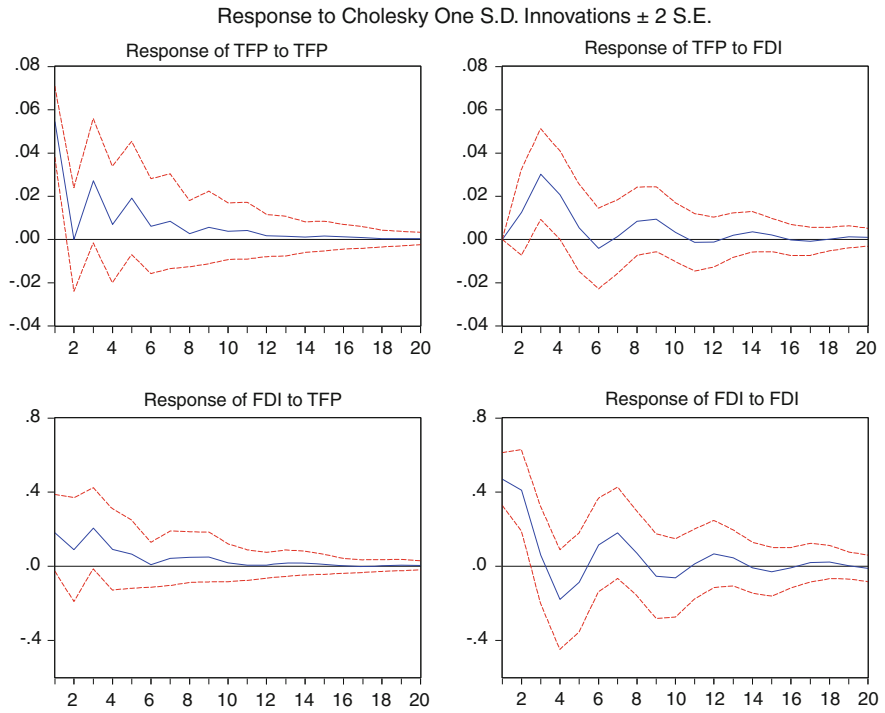


Fig. 16.4 Impulse response function

## 16.4 Conclusion and Political Suggestions

### 16.4.1 Conclusion

This article targets to research the influence of FDI on promoting technological progress in China's western region. Through qualitative analysis of theory and empirical analysis of VAR Model, it can be seen that FDI has some certain positive influences on promoting technological progress, but is not significant. And from the long-term dynamic analysis, it can be founded that some FDI in lag phase even can negatively affect technological progress. Impulse Response Function swings above and below 0. Therefore, the effect of the FDI to the technological progress of China's Western Region is not prominent.

### 16.4.2 Political Suggestions

#### (1) Optimize Investment Environment and Expand FDI Scale

Through the above- mentioned analysis, it can be known that comparing with the whole country, the FDI scale of the western region is still small, the provinces and autonomous regions' ability of attracting FDI is still weak, and the FDI scale is incompatible with the GDP in this region. Therefore, the provinces and autonomous regions here need to optimize the foreign investment environment in further. Firstly, resource advantages and Characteristic industries should be developed. Provinces and autonomous regions here are suggested to strengthen publicity and make greater effort on attracting foreign investment. Secondly, strengthening system building based on the traditionally preferential policies. According to the characteristics of the foreign investment, policies of attracting, encouraging, retaining and flourishing FDI should be published (Wei et al. 2006). Thirdly, completing supporting facilities, and increasing supportive strength of industry. It is suggested to improve high-tech service industry, such as financial service, modern logistics service, information technology and some other relative supporting industries. Fourthly, according to the local industry development planning, FDI should be absorbed in key industries. It is wisdom for provinces and autonomous regions in China's western region to use the impetus of foreign investment to promote the formation of the industry system.

#### (2) Change the Concept of Attracting Investment and Improve the Performance of Foreign Investment

The annual data showed that the FDI growth of China's western region is faster than the average level of the whole country. And the FDI scale and the abilities of absorbing FID of some provinces and autonomous regions in this region achieved to or even above the developed provinces in Eastern Region. In the developmental

period ahead, China's western region is still potential to attracting and utilizing FDI. Provinces and autonomous regions here should publish relative development planning, and change the concept of attracting FDI. It should change from attracting investment to select investment, and introduce talent, so as to improve the performance of foreign investment. Local governments should encourage foreign enterprises to set up research center locally, strengthen the technological communication between enterprises, focus more on employees' technological training, and improve the technology spillover effect of FDI, so as to enhance the effect of FDI to promote the technological progress in China's Western Region.

### (3) Encourage Sino-foreign Joint Venture and Strengthen Technical Cooperation

Local government should guide the cooperation between foreign-funded enterprises and domestic enterprises, and encourage foreign investment to enter China's western region by the way of establishing joint venture subsidiary, merging local enterprises, etc. It is also worth considering the involvement of foreign investment in the reorganization and transformation of state-owned enterprises. State-owned enterprises have certain equipment foundation, gathered rich labor resources. And there is usually a set of auxiliary industries in the region where state-owned enterprises concentrate. These advantages are attractive to foreign-funded enterprises.

In addition, in the field where the foreign investment enter, the local government need to enhance the industry correlation, establish supporting enterprises surrounding upstream and downstream of foreign-funded enterprises, so that can be the suppliers and partners of foreign-funded enterprises. Moreover, it is important to set up cooperation platform of scientific research, improve mechanism of scientific communication, reduce technological monopoly of foreign-funded enterprises, advance foreign-funded enterprises to join the activities of local technological market, strengthen technological exchanges among foreign-funded enterprises, local enterprises and local research institutions, in order to maximize the technology spillover effect of FDI. Finally, domestic enterprises' scientific research capabilities should be enhanced so that the technological barriers of technology spillover could be break down, and will create a virtuous cycle of technology spillover effect.

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# Chapter 17

## Research on the Listed Pharmaceutical Manufacturing Companies Performance Evaluation System

Zhi-yi Long and Jing-meng Mao

**Abstract** The passed “the 12th Five-Year’ national strategic emerging industries development plan” gave some guidance and advice on the sound development of strategic emerging industries, withal energy saving and environmental protection industry ranked first of the seven strategic emerging industries, which had brought the pharmaceutical industry opportunities and challenges. By constructing the operating performance evaluation system of pharmaceutical industry, this paper analyzed the empirical data in 2011 of some listed pharmaceutical manufacturing companies with principal component analysis, and found that the profitability of the business and operating conditions influence the results of operations more than other components. We proposed that the pharmaceutical manufacturing can improve business performance by increasing fixed assets investment and the technical research and development investment, raising the financial leverage, as well as improving the green development and the level of informationization.

**Keywords** Business performance evaluation · Pharmaceutical manufacturing · Principal component analysis · The new GSP

### 17.1 Introduction

On May 30, 2012, the State Council discussed and adopted the “the 12th Five-Year” national strategic emerging industries development plan (hereinafter referred to as the “Plan”), which focused on the development direction and major

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Empirical Evidence from the A-Share Market.

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tasks of the seven strategic emerging industries. The 12th Five-Year is the critical period of China's Pharmaceutical Industry for structural adjustment and transformation and upgrading, but the uncertain impacts of enterprise development will increase. Secondly, in August 2011, the State Food and Drug Administration issued a "drug quality management practices" (Draft) (hereinafter referred to as "the new GSP"), proposed normative requirements on the operation of the pharmaceutical industry, for both drugs manufacturing, warehousing, transportation, sales, after-sale service and other related links, in order to stabilize the quality and safety of drugs, at the same time, ensure that the medicine usage of people is safe and effective. In addition, with the gradual improvement of "the health care reform" and the social security system, the demand for pharmaceutical products and medical devices has released in a certain degree. The pharmaceutical industry has entered a period of opportunities and challenges, this paper designed evaluation index based on the new GSP, and sought appropriate business performance evaluation system for the pharmaceutical industry to help companies find the problems in business, as to distribute the resources reasonably, improve business performance, and achieve new development in the "12th five-Year" period.

## 17.2 Theoretical Basis and Method

With the gradual improvement of China's capital market, the business performance evaluation studies, especially of listed companies become a central issue. Business performance evaluation system is developing all the time, the history of its development almost can be classed to four periods: the observation of the performance evaluation stage, the performance evaluation stage of statistical performance evaluation stage, the nature of financial and strategic performance evaluation of four stages (Zhang 2008). In the following passage the main research results were reviewed from evaluation index, evaluation model and so on.

Selecting business performance evaluation indexes is the first step of evaluation system design. America's Joel Stern and Bennett Stewart first officially founded the Economic Value Added (EVA) the performance evaluation, Wang (2007) pointed out that this index considered the opportunity cost of capital provided by the shareholder, and it was incorporated into the enterprise performance evaluation index after quantization, to make up for the defect of traditional performance evaluation index. Furthermore, Market Value Added (MVA) included the evaluation of the risk to the company and the growth of evaluation. Ma and Song (2008) designed a dynamic performance evaluation index system with finance and non-financial indicators of the organic combination, which could fully embody the role of the construction enterprise strategic management requirements, the core competitiveness and knowledge and intellectual capital. In conclusion, evaluation

index has experienced the process from a single financial index gradually developed into financial index and the financial indicators in combination.

The design of the operating results evaluation model is related to the indicator selection. Early evaluation judged the performance by examining the size of a single financial indicator, and the evaluation model with the weighted relative integrated performance score was widely used. Alexander. Wall constructed a comprehensive ratio evaluation system by certain financial ratios combined with a linear relationship in 1928 (Norton 1996). Later, DuPont analysis regarded the return on assets as the starting index, and then, the index is resolved into several financial indicators to evaluate performance, while the way to improve the performance can be obtained with the reference of the evaluation result (Yuan 2006). Kaplan's Balanced Score Card (BSC) model achieved the organic combination of strategy and performance by linking the corporate vision, mission and development strategy with corporate performance evaluation systems (Teng et al. 2007; Libby et al. 2004). Deng (2011) pointed out that the evaluation method of the comprehensive utilization of EVA and MVA were greatly helpful to judge whether the enterprise value was overestimated or underestimated, and it helped investors make right decisions.

That Zhou (2011) made some adjustments on the BSC and increased measure of green products effectiveness, showed the evaluation system matched the business strategy in the recycling economy. Liu (2011) designed the BSC evaluation system under the background of low-carbon economy after adjusting for the system dimensions and indicators.

In the design of evaluation system, the study by Xue et al. (2006) showed that the "economic benefits" and "accounting income" based on the index system could be better evaluated in the operating results of listed companies, at the same time, Jean-Francos Henri's survey results also showed that most of the surveyed enterprises evaluated performance using financial indicators and the evaluation results could mainly reflect corporate performance conditions (Henri 2006). Therefore, this paper selected financial indicators as the evaluation indexes, choose the method of integrated weight, used the method of principal component analysis to evaluate the performance (Jin et al. 2011).

### 17.3 Performance Evaluation System

As to build the operating performance evaluation system, namely the new GSP, this paper selected the indicators which could reflect the business performance better, and designed a suitable financial indicators system for this study, and used the principal component analysis to do a comprehensive analysis of the indicators, and built the pharmaceutical industry operating performance evaluation system.

### 17.3.1 Evaluation Index

In order to judge business performance, we can examine four aspects: profitability, risk, growth and operating conditions (Bacidore et al. 1997; Anderson et al. 2004). Profitability refers to the ability of an enterprise to make profits; risk refers to a company which is unable to pay the debt risk; growth refers to the growth rate of enterprises and their potential; operating conditions is about associated indicators of assets use and costs.

The new GSP standardizes the operating conditions of the pharmaceutical manufacturing companies; we will set the relevant requirements for the performance of the indexes to judge the business situation of enterprises. For example, the quality management of computer system requirements, personnel training, and health system will increase the enterprise's "management cost"; limit of production equipment and workshop, storage conditions of the warehouse and requirements of the equipment to effect the enterprise's investment of "fixed assets". In addition, considering the characteristics of high and new technology industry, input of intangible assets and research and development will be directly related to enterprise development potential.

In this paper the performance evaluation of the selected indicators and their calculation method are shown in Table 17.1.

**Table 17.1** Performance evaluation index system for the listed pharmaceutical manufacturing

Performance factor	Code	Financial index	Calculation method
Profitability	Arr	Assets return ratio	(Income before tax + financial expense)/average total assets
	Npfa	Net profit ratio of fixed assets	Net income/average fixed assets
	Opr	Operating profit ratio	Net income/sales
Risk	Alt	Asset-liability ratio	Total liabilities/total assets
	Cr	Current ratio	Total current assets/total current liabilities
	Cfr	Cash flow ratio	Net operating cash flow/total current liabilities
Growth	Npt	The net profit ratio of technology	Net income/(intangible fixed asset + development expenditure)
	Grt	Growth ratio of total assets	The total assets growth/total assets last year
	Groi	Growth ratio of income	Sales growth/sales last year
	Grnp	Growth ratio of net profit	Net income growth/net income last year
Operating conditions	It	Inventory turnover ratio	Cost of sale/average inventories
	Fat	Fixed asset turnover ratio	Sales/average fixed assets
	Mcr	Management cost ratio	Management cost/sales

### ***17.3.2 Samples***

This paper sifted pharmaceutical manufacturing company listed before 2011, for a total of 152. This study eliminated the enterprises in ST with bad financial condition or with abnormal data for special purpose and incomplete report data. In addition, in order to make sample companies more comparable, the study also did not involve Growth Enterprises Market and B shares listed companies. Thus, the paper had won 106 research samples, and its basic data is from countries CSMAR database and WIND database.

### ***17.3.3 Principal Component Analysis***

We used SPSS 19.0 to evaluate performance status of the listed pharmaceutical manufacturing in 2011 with principal component analysis. Before the analysis, data standardization was needed, including disposing the problems of undimensionalization and convergence, which could make each index comparable and homogeneous.

### ***17.3.4 The Correlation Analysis and KMO Inspection***

Those evaluation indexes which were more relevance with each other were the first condition of this study method application; it found that the correlation between financial indexes met the requirements after the actual financial index samples analysis. Furthermore, by KMO examination, we got Bartlett ball degrees of observation test statistics for 515.927, which showed correlation coefficient matrix had a significant difference; that KMO value was 0.711 implying that the index system suits principal component analysis.

### ***17.3.5 The Number of Main Component***

We used SPSS to do the principal component analysis to evaluation index, from 13 index variables extracted in the 4 principal components, the accumulative contribution was 64.981 %, namely, using the 4 principal components instead of the original evaluation index could reflect 64.981 % of all information, and it had good reflection. The principal components and its variance contribution ratios were shown in Table [17.2](#).

**Table 17.2** Eigenvalue and contribution rate of each principal component

Principal component	Initial value			Value after rotating		
	Eigenvalue	Contribution rate// %	Cumulative contribution rate// %	Eigenvalue	Contribution rate// %	Cumulative contribution rate// %
1	3.982	30.631	30.631	2.765	21.268	21.268
2	1.934	14.879	45.511	2.194	16.874	38.142
3	1.386	10.660	56.170	2.180	16.769	54.912
4	1.145	8.811	64.981	1.309	10.070	64.981
5	0.923	7.099	72.081			
6	0.758	5.834	77.914			
7	0.721	5.545	83.459			
8	0.652	5.012	88.472			
9	0.550	4.233	92.705			
10	0.365	2.806	95.511			
11	0.241	1.854	97.365			
12	0.178	1.372	98.736			
13	0.164	1.264	100.000			

**17.3.6 Principal Component Named**

Load coefficient of each variable in principal component was shown in Table 17.3. From the table data we can see that: (1) asset return ratio, the net profit of technology, cash flow rate, operating profit ratio and the net profit of fixed assets were of high load on the first principal component, so the factor could be named as “the profit factor”; (2) growth ratio of income, growth ratio of total assets and growth ratio of net profit are in the second principal components on a higher load, so the factor could be named as “the growth factor”; (3) management cost ratio, inventory

**Table 17.3** Load coefficient of each variable in principal component

Principal Component	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>
Arr	0.845	0.080	−0.111	0.160
Npfa	0.549	0.197	0.631	0.067
Opr	0.776	−0.329	0.324	0.099
Alt	−0.397	0.547	−0.393	−0.279
Cr	0.335	−0.226	0.767	0.002
Cfr	0.829	−0.097	0.226	−0.088
Npt	−0.180	−0.035	−0.002	0.688
Grta	−0.062	−0.080	0.812	0.033
Groi	0.272	0.360	0.136	0.541
Grnp	0.228	−0.193	−0.006	0.616
It	0.044	0.627	−0.151	−0.067
Fat	−0.046	0.836	0.274	−0.088
Mcr	0.151	−0.643	0.307	−0.157

turnover ratio, and long-term asset turnover ratio were in the third principal component on a higher load, so the factor could be named as “the assets cost factor”; (4) the current ratio and the asset-liability ratio in the fourth the principal components were of high load, so the factor can be named “payback factor”.

### 17.3.7 Calculation of the Score of Principal Component

The weight of each index elaborated the importance degree of single index to principal component, and determined the practical significance of the principal component. According to the calculation equation of principal component, linear combinations of the 4 principal components and the 13 original indices were as follows:

$$\begin{aligned}
 F_1 &= 0.416Arr + 0.124Npfa + 0.271Opr - 0.040Alr \\
 &\quad - 0.024Cr + 0.353Cfr - 0.171Npt - 0.221Grta + 0.054Groi \\
 &\quad + 0.026Grnp + 0.097It - 0.029Fat - 0.011Mcr \\
 F_2 &= 0.078Arr + 0.175Npfa - 0.091Opr \\
 &\quad + 0.210Alr - 0.032Cr + 0.013Cfr - 0.016Npt + 0.022Grta \\
 &\quad + 0.208Groi + 0.073Grnp + 0.294It + 0.424Fat - 0.238Mcr \\
 F_3 &= -0.249Arr + 0.265Npfa - 0.009Opr - 0.100Alr \\
 &\quad + 0.361Cr + 0.060Cfr + 0.035Npt + 0.488Grta \\
 &\quad - 0.047Groi - 0.071Grnp - 0.050It + 0.238Fat + 0.097Mcr \\
 F_4 &= -0.028Arr - 0.010Npfa - 0.020Opr - 0.168Alr \\
 &\quad - 0.043Cr - 0.173Cfr + 0.575Npt + 0.031Grta \\
 &\quad + 0.408Groi - 0.465Grnp - 0.049It - 0.053Fat - 0.155Mcr
 \end{aligned}$$

Bringing the standardized date into  $F_1$ – $F_4$ , the 4 principal components were obtained. The comprehensive performance evaluation model was:

$$F = (21.268F_1 + 16.874F_2 + 16.769F_3 + 10.070F_4)/64.981)$$

## 17.4 Conclusion and Suggestion

### 17.4.1 Conclusion

With the evaluation of listed pharmaceutical companies in 2011 by the above-mentioned evaluation system, we found the level of the pharmaceutical manufacturing operating condition was below the average, the difference of the enterprise performance was not obvious with the focus on between 0.5 and 0.5.

From the main factors score we can see that, the performance of the enterprise's profit factors were better than other factors, which implied that company profit attracted more attention, and the assets investment could bring more benefits. And we also found that, the enterprise performance in "growth factor" was generally poor, the growth was not high, which mainly led to poor performance. "Debt factor" score was low, which may be the result of low liability level.

### ***17.4.2 Suggestion***

From the above analysis of the listed companies, we thought that pharmaceutical manufacturing focused too much on the profit indexes and neglected the cultivation of growth, and this would not benefit for further development. In order to improve the situation, we should improve from the following several aspects:

1. Increase fixed assets investment. The new GSP had higher requirements of real estate and equipment of the pharmaceutical companies, as to those enterprises that had not yet reached the standard, its primary task was to build a warehouse, and purchase equipment.
2. Strengthen technology research and development input, enhance the ability to create new drugs. The "12th Five-Year" Plan focused on planning the development of high-tech industries, and also put forward higher requirements on the new drug of the pharmaceutical industry capacity and the quality level of medicines safety. The pharmaceutical industry is one of the high-tech industries, and its development is inseparable from the investment of scientific research, labor and financial resource. Only by developing more efficient, high-quality products could the pharmaceutical industries win the market.
3. Get suitable enlargement of financial leverage coefficient. Liabilities would affect the financial leverage coefficient, and factor contribution showed that the influence enterprise's liabilities for enterprise achievement was not big, what's more, pharmaceutical companies had the characteristics of lower debt levels. Therefore, we believed that the proper use of leverage was helpful to financial leverage usage.
4. Improve the level of green development and informationization of the pharmaceutical industries. This was a request made for the 2012 new situation, to respond to the call of the "the 12th Five-Year" Plan, the pharmaceutical industries need to improve the level of the cleaner production and pollution control, promote energy saving system optimization projects, the modification or optimization of high energy consumption, low efficiency of the process equipment, improve the input-output efficiency and green production levels. Strengthen the application of computer control in the production process, promoting the digital transformation of the pharmaceutical production line and quality testing facilities, and the control of automated data acquisition in the whole process.

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# Chapter 18

## Research on the Principal-Agent and Game Theory of Logistics Finance Oriented to the Financial Institution

Peng-fei Li, Li-jie Feng and Yao-hui Li

**Abstract** Logistics Finance don't only bring new opportunities, but also more risks and challenges to the financial institutions. In the process of developing Logistics Finance, building and maintaining a good cooperative relationship with logistics companies is of extreme importance to financial institutions. In this paper, the principal-agent model and the game decision-making model between the financial institutions and logistics companies is established. And then, the factors which affect the behavior can be got through the two models. This paper aims at providing reference for decision making in the process of developing the Logistics Finance in order to promoting sustainable and healthy development of Logistics Finance.

**Keywords** Financial institution · Game theory · Logistics finance · Principal-agent theory

### 18.1 Introduction

Logistics Finance is a new kind of composite business which derives from the dynamic integration between the financial industry and the logistics industry (Biederman 2004). Based on the movable property, order form and accounts receivable and so on, the financial institution provide financial service which include the financing, insurance and evaluation of assets and so on for the logistics companies. Through regulating and organizing the currency and capital of the supply chain effectively, the logistics financial don't only meet the demand of improving the utilization of company's capital, but also expand the scope of business and reduce the credit risk of the financial institution. Meanwhile, the logistics financial provide new revenue growth opportunities for the logistics companies.

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Thus, the logistics financial have developed rapidly because of the character of the multilateral win-win consequence (Li 2011); (Diercks 2004). According to the recent research, some banks involves five state-owned commercial banks and thirteen joint-stock commercial banks have already developed the Logistics Finance service, and some non-bank financial institutions have also pushed forward the financial products which is closely bound up with the Logistics Finance.

In recent years, the cooperation between the financial institutions and logistics companies has attracted lots of researches at home and abroad. The operation principle of the Logistics Finance is studied through a principal-agent theory by Chu and Xu (2011). In the paper, the author didn't only draw the conclusion that the key of integrating the Logistics Finance services is to set up the cooperative partnership among different fields, but also give a proposal for reducing the risk of the Logistics Finance from the point of information-asymmetry. The principle-agent relation of the Logistics Finance services is elaborated and analyzed by Teng and Peng (2009). Meanwhile, the conclusion that the construction and maintenance for trust mechanism among all relevant parties is good for the operation of the Logistics Finance. The moral hazard which is due to the information asymmetry among all relevant parties is analyzed by Corbet (2005). Using the gray multi-level appraisal, Jing Zhang has established a multi-targets early-warning model of Logistics Finance crisis and provides an efficient method for disposing the risk problem in the Logistics Finance systemic (Zhang et al. 2012). By the view of the finance institution, Guang-pei Yuan made analysis and model about the risk so as to get the optimal decision in the process of promoting Logistics Finance service (Yuan 2011).

According to the previous literature, the key of developing and operating the Logistics Finance services successfully is to keep good cooperative relationship between the financial institution and logistics companies (Bai and Liu 2011). Taking the cooperation relationship between the finance institution and logistics companies in logistic finance as the breakthrough point, the paper analyzes the factors which can affect behaviors through the principal-agent model and decision-making model, in order to promoting sustainable and healthy development of Logistics Finance.

## **18.2 The Principal-Agent Relationship Between Finance Institution and Logistics Company**

### ***18.2.1 Principal-Agent Model***

The principal-agent relationship is defined as a kind of relationship between the customers which have unsymmetrical information on the same thing. In this relationship, one side which has enough information is known as agent and another side which lack of information is known as principal. The agent which grasp the

dominant information always maximize themselves benefit at the expense of principal's benefit (Dai 2004).

In this model, there are two important conditions: participation restraint and encouragement allowance restraint. The participation restraint is defined as a hypothesis. In this hypothesis, the expectation utility which the agent got through the principal mechanism isn't less than the maximum expectation utility which the agent got on the condition of refusing the principal mechanism (Zhao 2010). The encouragement allowance restraint is defined as a hypothesis. In this hypothesis, principal devise reasonable mechanism to make accordance between the agent's behavior on the condition of maximizing benefit and the principal expectant behavior. The typical principal-agent relationship is common between the finance institution and logistic company. Because of lack of information, the finance institution is deemed as agent, on the contrary, the logistic company is deemed as principal because of the information superiority (Xiao et al. 2012). The analysis of the principal-agent model is as follows:

In order to propose a model for the problem, the following notation is introduced.

$C$	the opportunity cost which the logistics company get from the principal.
$a$	the degree of effort and its value range is a continuous interval.
$D(a)$	the cost functions of endeavor.
$\pi(a)$	the financial institution's total revenue.
$s(\pi)$	the reward which the logistics company get from this cooperation.
$j$	the regular fee.
$k$	the dividend income coefficient.
$s(\pi) = j + k\pi$	the function of incentive contract.
$\pi(a) - s[\pi(a)]$	the financial institution's total profit.
$s[\pi(a)] - D(a)$	the logistics company's total profit.

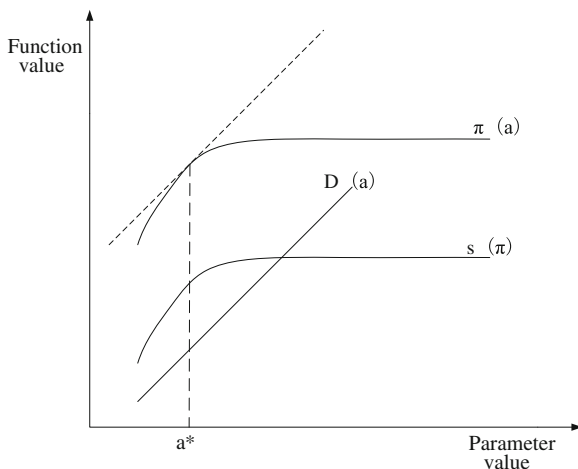
From the definition of the constraints, only on the condition that income returns are more than opportunity cost, the logistics company can participate in the cooperation, that is  $s[\pi(a)] - D(a) \geq C$ .

Indeed, for maximizing self-interest, financial institution often cut down the reward as far as possible, then the function of the financial institutions' total profit is  $\pi(a) - s[\pi(a)] = \pi(a) - D(a) - C$ . The relation between parameters and function is shown as Fig 18.1.

### 18.2.2 The Analysis of Principal-Agent Model

On the condition that  $a$  equals  $a^*$ , the differences between  $\pi(a)$  and  $D(a)$  are maximal.  $C$  is unexpected constant, so the financial institution's total profit is

**Fig. 18.1** The relation between parameters and function



maximal. On the condition of take appropriate measures to improve endeavor of the logistics company to the ideal level, the financial institution can get its maximal profit. The financial institution's total profit can reduce in case of oversize or undersize degree of endeavor.

The functional image of  $s(\pi)$  is decided by relevant constant  $i$  and  $k$ . The function of  $s[\pi(a)] - D(a)$  can get it's maximal value by means of designing the function of  $i$ , the value of  $i$  and  $k$  rationally and satisfy the incentive compatibility constraints. Then, reasonable compensation mechanism has effect of improving the cooperative initiative and continuity of logistics company.

## 18.3 The Game Theory Model of Financial Institution and Logistics Company

### 18.3.1 The Establishment of Game Theory Model

Based on the analysis of the principal-agent model above, the game theory model with regard to the different strategies is analyzed in the course of cooperation (Lu 2008). On the condition of logistics company's honesty, including that the irregularities of the logistics company won't exist, the decision-making according to maximizing the itself profit won't exist, the behavior of holding back and declaring falsely the quantity, the quality and value of pledge, the total profit which the financial institution get can be referred as  $\pi$  and the reward which the logistics company get is  $s(\pi)$ . Inversely, if the cheat exist, the total profit which the financial institution get is  $\pi'$  ( $\pi' \leq \pi$ ), the reward which the logistics company get is  $s(\pi')$ , and the incomes because of the violation is  $Q$ , the supervision cost from financial institution in the course of cooperation is  $M$ , and when the violation exist, the fine

**Table 18.1** The pay-off matrix of financial institution and logistics company

Logistic company financial institution	Honesty	Cheat
Supervision	$\pi - s(\pi) - M,$ $s(\pi)$	$\pi' - s(\pi) - M + N,$ $s(\pi') - N + Q$
No supervision	$\pi - s(\pi),$ $s(\pi)$	$\pi' - s(\pi'),$ $s(\pi') + Q$

which the logistics company should pay is  $N$ . The pay-off matrix of financial institution and logistics company is as Table 18.1.

In reality, the mixed strategy game is made by means of choosing different strategies at a certain probability (Ding and Wu 2012). The probability of supervision which the financial institution make is  $\alpha$  and the probability of no-supervision is  $(1 - \alpha)$ . The probability of keeping logistics company's promise is  $\beta$  and the probability of not keeping promise is  $(1 - \beta)$ .

The pay-off matrix of the financial institution:

$$A = \begin{bmatrix} \pi - s(\pi) - M & \pi' - s(\pi) - M + N \\ \pi - s(\pi) & \pi' - s(\pi') \end{bmatrix}$$

The prospective earnings:

$$E_1 = (\alpha, 1 - \alpha) \begin{bmatrix} \pi - s(\pi) - M & \pi' - s(\pi) - M + N \\ \pi - s(\pi) & \pi' - s(\pi') \end{bmatrix} (\beta, 1 - \beta)^T$$

Through calculating and making an order derivative of  $\alpha$  to be zero, we will get  $\beta = 1 - \frac{M}{N}$ .

The pay-off matrix of the logistics company:

$$B = \begin{bmatrix} s(\pi) & s(\pi) \\ s(\pi') - N + Q & s(\pi') + Q \end{bmatrix}$$

The prospective earnings:

$$E_2 = (\beta, 1 - \beta) \begin{bmatrix} s(\pi) & s(\pi) \\ s(\pi') - N + Q & s(\pi') + Q \end{bmatrix} (\alpha, 1 - \alpha)^T$$

Through calculating and making an order derivative of  $\beta$  to be zero, we will get  $\alpha = \frac{Q + s(\pi') - s(\pi)}{N}$

The probability of supervision which the financial institution make is  $\alpha = \frac{Q + s(\pi') - s(\pi)}{N}$ , because  $s(x)$  is increasing function and  $\pi' \leq \pi$ , then,  $s(\pi') \leq s(\pi)$ ,  $\Delta s = s(\pi) - s(\pi')$ ,  $\alpha = \frac{Q - \Delta s}{N}$ , the probability of keeping logistics company's promise is  $\beta = 1 - \frac{M}{N}$ .

### 18.3.2 Analysis of Game Theory Model

The mixed strategy Nash equilibrium is got because of the analysis above, namely,  $\alpha = \frac{Q-\Delta s}{N}$ ,  $\beta = 1 - \frac{M}{N}$ . Under the Nash equilibrium, the probability that the financial institution choose to supervise logistics company is  $\alpha = \frac{Q-\Delta s}{N}$  and the probability of keeping logistics company's promise is  $\beta = 1 - \frac{M}{N}$ .

From the mixed strategy Nash equilibrium above, the conclusion can be got as follows. In the process of cooperation, the probability that the financial institution choose to supervise logistics company is  $p$  and the probability of keeping logistics company's promise is  $q$ . When  $p$  is less than  $\alpha$ , the optimal choice of the logistics company is to maximize itself profit, namely, to make the strategy of cheat. When  $p$  is greater than  $\alpha$ , the optimal choice of logistics company is to maximize both sides' profit, namely, to make the strategy of honesty. When  $q$  is less than  $\beta$ , the optimal choice of financial institution is to make the strategy of supervision. When  $q$  is greater than  $\beta$ , the optimal choice of financial institution is to make the strategy of no-supervision.

The conclusion can be got from this model, in the logistics financial service, the principal-agent relations can be affect by the supervision cost, the fee and the income because of violation and so on. The specific analysis is as follows.

1. When  $Q$  and  $N$  are in a certain level, the greater the  $\Delta s$ , the less the  $\alpha$ . Namely, when the fee and income because of violation is certain relatively, the greater the differences of reward which logistics company get because of fraud decision-making, the less the profit of the logistics company, so the logistics company is inclined to not make fraud decision-making and the financial institution will lower the supervision probability. On the contrary, the less  $\Delta s$ , the greater  $\alpha$ . Under this condition, the less the differences of reward which logistics company get because of fraud decision-making, the greater the profit of the logistics company, so the logistics company is inclined to make fraud decision-making and the financial institution will increase the supervision probability.
2. When  $\Delta s$  is at a certain level, the less the  $Q$ , the greater the  $N$ , and the less the  $\alpha$ , then the less the violation profit of logistics company, the greater the fee which the financial institution make because of violation, so the logistics company is inclined to choose honest behavior and the financial institution will lower the supervision probability. On the contrary, the greater the  $Q$ , the less the  $N$ , and the greater the  $\alpha$ , then the greater the violation profit of logistics company, the less the fee which the financial institution make because of violation, so the logistics company is inclined to make fraud decision-making for the maximal profit and the financial institution will increase the supervision probability.

3. The less the  $M$ , the greater the  $N$ , the greater the  $\beta$ , then the less the supervision cost which the financial institution pay and the greater the fee because of violation, the financial institution is inclined to make strategy of supervision and the logistics company is inclined to make strategy of honesty. On the contrary, the greater the  $M$ , the less the  $N$ , the less the  $\beta$ , then the greater the supervision cost which the financial pay and the less the fee because of violation, the financial institution is inclined to make strategy of no-supervision and the logistics company is inclined to make strategy of cheat.

## 18.4 Conclusion

From the analysis of principal-agent model and game theory model above, the conclusions are drawn as follows. Firstly, the suitable salary level should be determined by the financial institution on the basis of market and is favor for making cooperation with the logistics company. Secondly, the suitable incentive mechanism, that is the function of salary, should be devised to determine the appropriate regular fee and bonus and improve the endeavor of logistics company to a certain level so that both side's profit can be maximized. Thirdly, the supervision cost should be lower by ways of improving the supervision mechanism and the suitable violation fee should be set by ways of collecting security bond and signing a penalty clause to reduce the violation income as much as possible and to urge the logistics company to make strategy of honesty.

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# Chapter 19

## Studies of CSI-300 Index Futures

### Volatility on Garch Models and CARR Models

Sulin Zhang

**Abstract** GARCH model is the most common way of financial assets volatility, recent Chou's CARR model to estimate volatility also shows some advantages. This paper deals with the subject of CSI-300 Index Futures. We fit GARCH-GED model, EGARCH model, CARR model and CARRX model to the volatility of the CSI-300 Index Futures, and comparing and analyzing the predictive power of a variety of models based on the Mincer-Zarnowitz regression equation and Diebold-Mariano test. Our conclusion is that CARRX model on volatility research is better than any other model

**Keywords** GARCH model • CARR model • Volatility • CSI-300 index futures

## 19.1 Introduction

In recent years, the volatility of financial asset prices modeling is an important financial economics and financial econometrics Subject. First of all, as a measure of the risk of financial asset prices, the volatility for understanding the dynamic of asset prices State characteristics are extremely important. In fact, the volatility is a core variable in the portfolio theory, capital asset pricing model (CAPM), Arbitrage Pricing Model (APT) and option pricing model. Second, volatility has an important influence in industry investment, financial leverage decision-making, consumer behavior and patterns and the economic cycle and macroeconomic Variable. Finally, the volatility of financial markets is one of the most simple and most effective indicators to reflect the quality and efficiency of financial markets,

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volatility is also the decision-making with the regulatory authorities pay close attention to the object.

However, the volatility is a vague concept, with many measurement methods and models. Currently there are two kinds of models GARCH model and SV model describing the volatility of assets. Engle (1982), Bollerslev (1986), Nelson (1991) put forward GARCH model and the Taylor (1986) put forward Stochastic Volatility model (SV model). The GARCH model has an excellent statistical characteristic, the accurate description of volatility phenomenon and operational convenience, which drives an extensive application in the analysis and research of financial data.

Recently in the research on volatility, the main achievement should be CARR (the Auto- Regressive of the Conditional Range) model advanced by Doctor Chou (2000) The main contents of model are to combine range with GARCH model and depict range's dynamic structure appropriately to make range at advantage in estimating volatility, which at some stock markets has got an substantial evidence examination. CARR model is better than GARCH model mainly because of such a theoretical basis. Volatility is closely related to the information of market, GARCH model makes use of the information of a sub- zone time point (usually the closing price everyday), but CARR model uses, the information of two sub- zone points (daily ceiling price and bottom price), therefore, CARR model uses more information and the efficiency should be higher theoretically, which got confirmed by Parkinson (1980). Under perfect state, using range formed by ceiling price and bottom price not only makes daily volatility unbiased estimation, but is five times more efficient than the traditional way.

This paper deals with the subject of CSI-300 Index Futures contract. We fit GARCH-GED model, EGARCH model, CARR model and CARRX model to the volatility of the CSI-300 Index Futures, and comparing and analyzing the predictive power of a variety of models based on the Mincer-Zarnowitz regression equation and Diebold-Mariano test.

## 19.2 Methodology

ARCH model advanced by Engle and Russell (1998) was afterwards taken into an enlargement by Bollerslev and Wooldridge (1992) to have become for the GARCH family model. The GARCH family model has become one of the most popular volatility models in finance measure research. The GARCH (p, q) model is as the formula (19.1):

$$\begin{aligned} R_t &= \varepsilon_t \\ \delta_t^2 &= \omega + \sum_{i=1}^p \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^q \beta_i \delta_{t-i}^2 \end{aligned} \quad (19.1)$$

where,  $R$  represents stock rate of return of natural logarithm. Estimating parameter,  $\omega \geq 0$ ,  $\alpha_i \geq 0$ ,  $\beta_j \geq 0$ , and  $\sum_{i=1}^p \alpha_i + \sum_{i=1}^q \beta_i < 1$ .  $\varepsilon_t$  is an iid white noise and is often assumed to be a generalized error distribution.

Nelson (1991) put forward EGARCH model, which simulates the biased distribution and compared with the GARCH Model it has a loose parameter restriction and Variance's dynamic model is more flexible. It has been proved that it has a good estimating ability. This paper chooses Model EGARCH, whose mean equation is in line with Model GARCH, Variance equation is as the formula (19.2):

$$\ln(\delta_t^2) = \omega + \alpha_t \frac{\varepsilon_{t-i}}{\delta_{t-i}} + \sum_{i=1}^{p_2} \beta_i \log(\delta_{t-i}) + \sum_{i=1}^{q_2} \left[ \eta \left| \frac{\varepsilon_{t-i}}{\sqrt{\delta_{t-i}}} - E\left(\frac{\varepsilon_{t-i}}{\sqrt{\delta_{t-i}}}\right) \right| \right] \quad (19.2)$$

Taiwan scholar Chou put forward the Conditional Autoregressive Range model, which combines the idea of Model GARCH and depicts finance asset volatility's Conditional Autoregressive Range dynamically. Therefore, this paper uses this model as an analysis model, The CARR (p, q) model is as the formula (19.3):

$$\begin{aligned} R_t &= \lambda_t \varepsilon_t \\ \lambda_t &= \omega + \sum_{i=1}^p \alpha_i R_{t-i} + \sum_{i=1}^q \beta_i \lambda_{t-i} \\ \varepsilon_t &\sim \text{iidf}(\cdot) \end{aligned} \quad (19.3)$$

Here,  $\varepsilon_t \sim \text{iid f}(\cdot)$ ,  $R$  is range of stock price taken from the natural logarithm range. Calculated as follows:

$$P_t = \ln P_t^{\text{High}} - \ln P_t^{\text{Low}} \quad (19.4)$$

The  $\lambda_t$  is the conditional mean of range before time  $t$  under the condition that there is all information. Error  $\varepsilon_t$  is Standardization range:  $\varepsilon_t = R_t / \lambda_t$ , whose distribution is supposed to obey the distribution of function  $f$  which has a unit mean.  $\omega$  is range's intrinsic uncertainty, or represents range's initial value.  $\alpha_i$  is range's Lag coefficient, which represents the short term effect of range conditional mean.  $\beta_i$  is Lag coefficient range of conditional mean, which represents the long term effect of range conditional mean. Three parameters  $\omega$ ,  $\beta_i$  and  $\alpha_i$  mentioned above are all positive numbers. To make sure that the model is a stationary random process, the characteristic root of conditional typical polynomial is outside of the unit circle.

The advantage of CARR model is that the model can be expanded, adding some exogenous variables to the conditional mean equation. For example, Chou joined early stage rate of return to the CARR model and formed CARRX model, that is to say that volatility's non-symmetry is as the formula (19.5):

$$\lambda_t = \omega + \sum_{i=1}^p \alpha_i R_{t-i} + \sum_{i=1}^q \beta_i \lambda_{t-i} + \phi(ret_{t-1}) \tag{19.5}$$

Therefore, this paper again selects CARR model and CARRX model to research the volatility of CSI-300 Index Futures contract.

19.3 Date and Models Estimations

This paper selects the CSI 300 stock index futures contract as research object. This futures contract includes the current month contract, next month contract and the subsequent two quarters, four contracts varieties. According to the CSI 300 stock index futures trading as well as the practice of other researchers, we select the most actively traded recently maturity contract as the research object and the formation of rolling historical data. The dataset used in the study comprises The dataset’s sample zone is from April 16, 2010–2011 April 15, just a year of historical transaction data, with 734 sample points, 733 weekly rate of return and 734 ranges. Table 19.1 below presents the important descriptive statistics relating to the variables of return and ranges.

From Table 19.1 Descriptive statistics, we can see the rate of return and ranges’ distribution of CSI 300 stock index futures has emerged as a partial and peak characteristics, the Jarque–Bera test rejected the unconditional normal distribution assumption of the poor, in line with the characteristics of the distribution of financial assets in general. The rate of return’s standard deviation is greater than the ranges’ standard deviation, implies that the ranges is a better measure of the volatility. From the autocorrelation coefficient and the Q statistic

Table 19.1 Descriptive statistics

	Return	Ranges
Mean	−0.016	0.834
S.D.	0.032	0.00831
Skewness	−0.113	3.42
Kurtosis	3.757	21.57
J-B	19.11	6218.5***
$\rho_1$	0.019	0.251***
$\rho_2$	0.021	0.275***
$\rho_5$	−0.034	0.274***
$\rho_{12}$	−0.041	0.263***
Q(12)	13.39	239.21***
ADF	−26.54***	−5.054***

$\rho k$  is series’ autocorrelation coefficient with lag k steps(n) represents Ljung-Box-Q statistic with 20 lag for the normalized residuals (level). \*\*\* means  $p$  value is less than 1 %; \*\* means  $p$  value is less than 5 %; \* means  $p$  value is less than 10 %

**Table 19.2** Estimations of various models

Parameters and diagnostics	GARCH –GED (1,1)	EGARCH (1,1)	CARR (1,1)	CARRX (1,1)
$\omega$	0.081***	0.054*	0.014***	0.010***
$\alpha_1$	0.021***	0.038*	0.070**	0.066**
$\beta_1$	0.965***	0.952***	0.889***	0.929***
$\eta$		−0.085*		
$\eta+\alpha_1\beta_1$	0.986	0.921	0.959	0.996
ret(−1)				−0.021***
Q(12)	15.580(0.166)	15.216(0.182)	13.16(0.290)	13.128(0.305)
Q <sup>2</sup> (12)	11.442(0.577)	12.921(0.452)	8.9664(0.788)	43.409(0.99)
LLF	−894.4	−887.9	−515.7	−498.3
ARCH(3)	1.626(0.2338)	1.739 (0.2030)	1.794(0.214)	0.213(0.89)

Notes the symbol \*\*\* means  $p$  value is less than 1 %; the symbol \*\* means  $p$  value is less than 5 %; the symbol \* means  $p$  value is less than 10 %. Q (12) is Ljung-BoxQ statistic with standardized residuals lagged 12 steps, the Q<sup>2</sup> (12) is Ljung-BoxQ statistics of standardized square residuals lagged 12 steps. The ARCH (3) is the ARCH statistics lagged 3 steps

of the return series point of view, the correlation between samples is very small, ranges in the 1 % significance level rejected the non-existent self-correlation null hypothesis, has a strong autocorrelation, effective dynamic modeling on ranges. ADF test confirms that he rate of return and ranges refuse the null hypothesis that the presence of unit root stationary time series can be directly measured modeling.

This paper makes use of GARCH-GED model, EGARCH model, CARR model and CARRX model to fit the volatility of CSI 300 stock index futures contract. First we ascertain various models lag step numbers and the assurance standard is Schwartz information standard (BIC) and function of the Log Likelihood (LLF). After repeated calculations and comparisons, we came to the conclusion that when lag step members (q, p) = (1, 1), the fit effect is better. What’s mean is shown in Table 19.2

From Table 19.1, we can see estimated various parameters are statistically significant. Each  $\omega$  is a Positive number,  $\sum_{t=1}^p \alpha_t + \sum_{t=1}^q \beta_t$  is less than 1, satisfying the convergence condition of models. The statistics of Q (12) all right-ness has a bigger homologous  $p$  value, indicating that we should accept the conjectural assumption with no autocorrelation between residual errors. Q<sup>2</sup>(12) Statistics aren’t all statistically significant, indicating that residual error sequences do not have varying variance phenomenon any longer. ARCH (3) indicates residual error sequences do not have Heteroskedasticity any longer. Therefore, each of the various models fits the volatility of CSI-300 Index Futures contract the nicely.

19.4 Evaluating the Predictive Capability on Various Models

19.4.1 Mincer-Zarnowitz Regression Equation

After comparing the sample period predictive abilities of various models, this paper uses the MZ regression equation advanced by Mincer-Zarnowitz. This regression equation is as the formula (19.5):

$$MV_t = a + b \cdot FV_t + \varepsilon_t \tag{19.6}$$

where,  $MV_t$  represents the real volatility. But as we know, real volatility of financial assets is unknown, we can replace real volatility (causing measurement error margin) with observable volatility (Volatility Proxy) (Schwartz 1989). We select the square of the rate of return and the absolute value of the rate of return as the Volatility Proxy of real volatility. The  $FV_t$  represents the fitted Volatility from Table 19.2. The coefficient of determination ( $R^2$ ) from MZ regression equation means that  $FV_t$  explains  $MV_t$  a great deal, therefore, by comparing the value of  $R^2$ , we can get the discretion standard of a good model or a poor one. The above is shown in Table 19.3.

CARR model and its extended model's  $R^2$  values are larger than the corresponding GARCH models, which indicates that relative to the GARCH model CARR model and its extended model are more accurately predict the true volatility. We can also observe that the GARCH-GED (1, 1) model's predictive ability is better than GARCH (1, 1) model, generally the CARRX model is superior to other models in sample period predictive ability.

19.4.2 Diebold-Mariano Test

We make use of Diebold-Mariano test to compare the significant predictive ability of each model. Here we draw on the ideal of Diebold and Mariano (1995): First we construct  $d$  series, this series comes from residual error of the different kinds of M-Z regression equation mentioned above. Second, we construct the  $d$  statistics, and calculate its  $p$  value of normal distribution on the assumption in order to judge whether the forecasting accuracy of various models is consistent (Table 19.4).

Table 19.3  $R^2$  from MZ regression equation

Model	Square of the rate of return	Absolute value of the rate of return
GARCH-GED (1,1)	0.436	0.489
EGARCH (1,1)	0.545	0.514
CARR (1,1)	0.599	0.576
CARRX (1,1)	0.712	0.739

**Table 19.4** The D statistics' *P* value

Model	GARCH-GED (1,1)	EGARCH (1,1)	CARR (1,1)	CARRX (1,1)
GARCH-GED (1,1)	0	6.4584***	0.2158	0.2105
EGARCH (1,1)	2.5662***	0	0.7729	0.0028
CARR (1,1)	0.3199	0.3252	0	8.0099***
CARRX (1,1)	0.3236	0.3295	3.8525***	0

From this table we can see the examination conclusion of the Diebold-Mariano and Mincer-Zarnowitz regression equation have consistency. EGARCH model at forecasting accuracy is better than GARCH-GED model, and significant statistically; CARRX model at forecasting accuracy is better than CARR model and significant statistically; The CARRX model is superior to the EGARCH model in the accuracy of predictive ability. Compared with EGARCH Model, CARRX Model is slightly better at predictive ability but not statistically significant. Therefore, the CARRX model is superior to other models in volatility estimation.

## 19.5 Empirical Results

This paper covers CSI-300 Index Futures contract for research object, using GARCH-GED model, EGARCH model, CARR model and CARRX model to research the volatility of CSI-300 Index Futures contract and carry on the fitting, and compare and analyze the predictive ability of the relative models on the Mincer-Zarnowitz regression equation and Diebold-Mariano test. We get the following conclusions.

Various types of model are well fitted the volatility of CSI-300 Index Futures contract, but the predictive ability of the predictive ability of the CARRX model is best, followed by CARR model, followed by GARCH-GED model, relatively speaking, the forecasts of the GARCH model have the least capacity. On Diebold—Mariano test result, the forecasting ability of CARR model and the extended have a significant difference from GARCH models; CARR model and the extended are better than the GARCH models in predict performance. To change the GARCH model error distribution of GED distribution, although the forecast improved performance but not significantly. CARR model of extended form improve the predictive ability of the model significantly increases the predictive ability of the CARR model, and therefore predict the performance in terms of the CARRX model is the optimal model.

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# Chapter 20

## Study on Finance Contributions and Efficiencies Comparations and Market Position of Credit Guarantee Organizations

Xue-zhou Wen and Jin-wen Zhang

**Abstract** From the standpoint of enterprises financing cost minimization, finance contributions and efficiencies of three types of credit guarantee organizations (CGOs) are analyzed and compared. By comparison, market position and harmony developing countermeasures of three types of CGOs are put forward: policy CGOs should duratively exert dominant role in improving finance for small and medium enterprises (SMEs), mutual CGOs support financing for SMEs in enterprise clusters, and as a complement, commercial CGOs could relieve financing difficulties of SMEs.

**Keywords** Credit guarantee organizations • Finance contributions • Market position • Small and medium enterprises

### 20.1 Introduction

According to the statistical survey conducted by Ministry of Industry and Information Technology of the People's Republic of China, the number of national credit guarantee organizations (CGOs) have amounted to 5547, raising a total of guarantee funds 338.9 billion yuan by the end of 2009, and the loan guarantees for small and medium enterprises (SMEs) are a total of 2.5052 trillion yuan provided

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by them for SMEs. There are accumulatively 1.12 million enterprises that have been guaranteed. The development of three types of CGOs plays an important role in promoting the credit ability and development of SMEs.

At the same time, there is an urgent and important problem in our country's CGOs which main mode we should choose from policy CGOs, mutual CGOs and commercial CGOs. And after choosing the dominant mode whether it need and how to develop other modes. These problems are significant because the future development direction of CGOs is decided by them, which directly relating to the success and security effect of SMEs. This paper mainly discusses these problems from theoretical point.

## 20.2 Domestic and Foreign Researches Review About Credit Guarantee Modes

Since 1970s, foreign experts and scholars have mainly studied finance guarantee in four aspects, that is the function of finance guarantee solving incentive conflict, the relationship between the debt contract structures, the contribution to macro-economy and the feasibility of credit guarantee to enterprises financing Boot et al. (1991). Jensen and Meckling (1976), Leeth and Scott (1989) both studied financing guarantee, and their studies are separately from the effect of asset substitution, the dilution of debt value in the process of financing and the functions of guarantee. Peek and Rosengren (2003) systematical studied international and domestic guarantee's interactions between the two markets in theory (Peek and Rosengren 2003). Kang and Heshmati (2008), Uesugi et al. (2010) thought that regular using of credit guarantee can not only increase the availability of loans for SMEs, but also can improve the loan performance of enterprises.

Here are several aspects that were studied by domestic experts and scholars on the problems of credit guarantee: (1) Studies on the feasibility of credit guarantee. Cao, Chen, and other scholars thought that credit guarantee plays an important role for a country's economy, which should be encouraged. Mei and Zhongming (2002) thought that overall credit status of a regional business determines the area's guarantee size while a great credit environment is the key of the survival and the development of CGOs. Of course, there are also some scholars who worry about the negative impact, which may be caused by CGOs, such as Wu. (2) Researches on policy CGOs. Zhu, Li (2008) separately discussed the following aspects: the role of policy CGOs, the key factor to success, the prevention mechanism of credit risk and so on. (3) Studies on mutual CGOs. Wang and Wang (2006), Cui and Zhong (2010) respectively studied mutual CGOs from the aspects of its validity, feasibility, the orientation of the government functions, operating mechanism. (4) Researches on commercial CGOs. Ye Xiang rong, Wang (2005) studied commercial CGOs in more perspective, the limited role of commercial CGOs and so on.

In conclusion, foreign experts and scholars mainly studied mortgage guarantee by banks, and only a small number of studies involved in the problem of credit guarantee. While domestic studies mainly focused on how to improve the system of credit guarantee, how to effectively control risks and the situations and problems of three types of CGOs developing in different places. The academic results of domestic and foreign researches made contributions in promoting healthy developments of CGOs and settlement of financing problems of SMEs. However, there are still some shortcomings in the above studies: foreign researches are less involved in the operating characteristics analysis and financing effect comparisons of policy, mutual and commercial CGOs, while domestic theoretical comparisons are not systematical enough, which are about the financing contributions and efficiencies of three types of CGOs. Therefore, this article will compare the two sides of three types of CGOs on the basis of previous studies, and it will give developing orientation and policy suggestions to Chinese CGOs.

## 20.3 Financing contributions and Efficiencies Analysis of Three Types of CGOs

Lei and Xi (2005) proved the choosing problem of enterprises between mutual CGOs and policy CGOs, which is based on financing cost minimum. The article will give further demonstration about the problems of financing contributions and efficiencies of policy and commercial CGOs, commercial and mutual CGOs. Direct comparisons among three types of CGOs involve in too much variables, maths educations are very complex, so this paper adopts the route of comparison each other. The specific demonstrations of the process are as the following.

### 20.3.1 *Comparison of Financing Contributions and Efficiencies of Policy CGOs and Commercial CGOs*

Because most of SMEs in China are out of the enterprise clusters and the financing guarantee services providers are mostly policy and commercial CGOs. So the comparisons of two types of CGOs can elicit the SMEs number that they support, then we will theoretically deduce the respective function size of the CGOs in the credit guarantee system.

1. Mode assumptions
  - a. Neutral hypothesis of loan participators

All loan participators are neutral in risk, i.e.,  $u' > 0$ ,  $u'' = 0$ . It can be directly involved in the return value equaling to the effect value.

b. The hypothesis about bank

Supposing that there is only one bank in the market and the bank provides loan  $L$  for the enterprises, and the rate of interest is fixed at  $R$ ; Guarantee requirements of the bank is  $F$ , but if the endowments of the enterprise is  $A > F$ , then the amount of the guarantee is paid in full by the enterprise; If endowments of the enterprise is  $A < F$ ,  $F = A + G$ , then the amount will be shared by the enterprise and the CGOs ( $G$  is the amount which is supported by the CGOs).

c. The hypothesis about SMEs

The number of SMEs is  $n$  in the market, and the success probability of all investing projects of enterprises is  $p$ , here  $p$  is in an uniform distribution, whose rang is  $(p_1, p_2)$ . If the project succeed then the enterprise will gain  $I$ , if not, it will gain  $0$ , and the expected income is  $I_0 = I \cdot p$ .

d. The hypothesis about CGOs

First, the hypothesis about policy CGOs.

As the external guarantee body of enterprises, the information between policy CGOs and SMEs is asymmetry, but policy CGOs know the investing success probability distribution  $(p_1, p_2)$  of SMEs. The amount of the guarantee is  $G_g$  and the amount of premium is  $W_g$  policy CGOs' destination is not maximizing their interests, but to help the financing of enterprises, promotes the growth of SMEs. So the sum of the expected return is  $0$ , which is guaranteed by policy CGOs for SMEs. Guarantee fee is paid in the front cover, the government finance has compensation mechanism to policy CGOs.

Second, the hypothesis about commercial CGOs.

Commercial CGOs also do not understand the operation status of SMEs, but they know that the investing success probability distribution is  $(p_1, p_2)$  of SMEs. Due to the motivation of obtaining profit, it can collect information of SMEs as much as possible, so that it can reduce the loss when enterprises break the contract, and the cost for it is  $C_s$ ; the amount of the guarantee is  $G_s$ ; the guarantee rate is  $\alpha$  (it is not fixed, and it varies with the investing risk of the project). Profit maximization is the pursuit of commercial CGOs, so the sum of the expected income is greater than  $0$ , which is got by guarantee for SMEs, that is to say  $E_s > 0$ , the guarantee fee is  $W_s$ , which is paid before guarantee (Lehmann and Rathke 2004)

2. Analysis on the choice of SMEs between policy CGOs and commercial CGOs.

SMEs can make a choice between policy CGOs and the commercial CGOs, and the criteria of selection is guarantee cost minimization.

a. Analysis on the choice of SMEs on policy CGOs

Based on the above assumption, the revenue function of policy CGOs is:

$$E_g = p \cdot W_g + (1 - p)(W_g - G_g) = 0 \quad (20.1)$$

The formula (20.1) shows that policy CGOs determine the guarantee fee, that is  $W_g = (1 - p) \cdot G_g$ , which is based on the investing success probability of the enterprise. At the same time, the guarantee fee of commercial CGOs is  $W_s = \alpha \cdot G_s$ . If the guarantee amount that SMEs need is  $G$ , here we have  $G_g = G_s = G$ . That is to say, the guarantee fee rate of policy CGOs  $(1 - p)$  is equal to the commercial's  $\alpha$ , then SMEs will choose at random, and at the same time the critical value is  $1 - p = \alpha$ . Therefore, at the time of  $p \in (1 - \alpha, p_2)$ , SMEs will select policy CGOs, then the number of SMEs is  $\left[1 - \frac{p_2 - (1 - \alpha)}{p_2 - p_1}\right] \cdot n$ ; While  $p$  belongs to  $(p_1, 1 - \alpha)$ , the SMEs will choose commercial CGOs.

b. Analysis on the choice of SMEs on commercial CGOs

From the above analysis, we can know that, when  $p$  belongs to  $(p_1, 1 - \alpha)$ , SMEs will choose commercial CGOs, and then the benefit of the commercial CGOs is:

$$E_{sn} = \int_{p_1}^{1-\alpha} [p \cdot W_s + (1 - p)(W_s - G_s)] \cdot \frac{\frac{p_2 - [p_2 - (1 - \alpha - p_1)]}{p_2 - p_1} \cdot n}{(1 - \alpha) - p_1} dp \quad (20.2)$$

The goal of commercial CGOs providing guarantee for SMEs is profit maximization, the following conditions should be met:

$$\frac{dE_{sn}(\alpha^*)}{d\alpha^*} = \frac{d\left\{\frac{n}{p_2 - p_1} \cdot \left[-\left[1 - \alpha - p_1 - \frac{(\alpha - 1)^2}{2} + \frac{p_1^2}{2}\right] \cdot G_s + (1 - \alpha - p_1) \cdot W_s\right]\right\}}{d\alpha} = 0 \quad (20.3)$$

$$\frac{d^2 E_{sn}(\alpha)}{d\alpha} = -\frac{n \cdot G}{p_2 - p_1} < 0 \quad (20.4)$$

The rate of premium is :  $\alpha^* = 1 - p_1$ .

While the range of premium rate provided by policy CGOs belongs to  $(1 - p_2, 1 - p_1)$ , which meets the principle of the lowest cost, and at this time SMEs will choose policy CGOs. If policy CGOs could provide any amount of guarantee, then commercial CGOs will exit from the competitive market.

### 20.3.2 The Financing Contributions and Efficiencies Comparison of Policy CGOs and Mutual CGOs

On the financing market, there are objectively mutual CGOs that can provide financing guarantee services for SMEs in the enterprise clusters. Even so, the SMEs in the enterprise clusters still face the choice of three types of CGOs. Here we will compare policy CGOs and mutual CGOs, whose goals are not for profit:

## 1. The assumption of the model

The assumptions about the loan participators are similar to “A Comparison of Financing Contributions and Efficiencies of Policy CGOs and Commercial CGOs”. But among  $n$  SMEs, there is  $m$  SMEs in the enterprise clusters, which can obtain the guarantee from mutual CGOs. The rest is outside enterprise clusters, which can only choose policy CGOs. Therefore, here we will take hypothesis only for two types of CGOs:

### a. The hypothesis about policy CGOs

Because the enterprise clusters are limited in China, so a large number of enterprises are out of the enterprise clusters. As the guarantee ability of mutual CGOs are weak, so parts of guarantee demand of enterprises in the enterprise clusters also can't be met. Policy CGOs increase the supplying ability of market capital and can provide convenience for much more enterprises outside enterprise clusters and ones that are not able or unwilling to get guarantee from mutual CGOs. The rate of guarantee fee of policy CGOs is  $\beta$  and the other assumptions are similar to “A. Comparison of Financing Contributions and Efficiencies of Policy CGOs and Commercial CGOs”.

### b. The hypothesis about mutual CGOs

If mutual CGOs know the success probability and expected return  $I$  of the guarantee. The purpose of mutual guarantee is to promote the development of the enterprise clusters, and mutual CGOs is not for profit and can meet all demands of the enterprises. The amount of mutual guarantee is  $G_c$ , the premium is  $W_c$ , which is paid before guarantee (Tucker and Lean 2003).

## 2. Analysis on the choice of SMEs between policy CGOs and mutual CGOs

According to the hypothesis, when choosing the CGOs, enterprises will seek the purpose of reducing the guarantee cost. If the project succeeds, the CGOs can gain guarantee fee; if not, the loss is equal to the amount of the guarantee deducting guarantee fee.

### a. Analysis on the choice of SMEs between policy CGOs and mutual CGOs in the competitive market

In the competitive market, the choice of SMEs between policy and mutual CGOs is similar to the formula (20.2)–(20.4). Under the assumption that the mutual CGOs can provide any amount of guarantee in the situation, policy CGOs will withdraw from the competitive market and they will provide guarantee only for enterprises outside the enterprise clusters. The guarantee cost that policy CGOs provide for enterprises in clusters is too large that not only it can not make a profit, or even it is difficult to maintain the balance of profit and loss.

- b. Analysis on the choice of SMEs between policy CGOs and mutual CGOs in the monopoly market

Due to financial constraints, mutual CGOs often have no ability to provide security services for all enterprises in the enterprise clusters, then the intervention of policy CGOs is a need and they can create conditions for enterprises' financing.

The revenue function of the enterprise is:

$$E_f = I_0 - p \cdot R \cdot L + (1 - p) \cdot (-A) - \beta \cdot G$$

$$\frac{dp}{d\beta} = -\frac{\partial E_f}{\partial \beta} / \frac{\partial E_f}{\partial p} = \frac{G}{A - R \cdot L} \quad (20.5)$$

The revenue function of policy CGOs to individual enterprise is:  
 $E_g = \beta \cdot G - (1 - p) \cdot G$ .

Policy CGOs refuse to provide guarantee for enterprises whose assets do not meet the requirements. Policy CGOs use the positive income gained by guarantee for the enterprises with low risks to make for the negative ones, which is lost by guarantee for the high risk enterprises, and the total revenue is 0,  $\frac{\partial E_g}{\partial p} = G > 0$ , therefore, policy CGOs can always get more profit from the enterprises with low risks. Enterprises with low risks are preferred for policy CGOs. When  $A > R \cdot L$ , the enterprises are low risk ones, whose incomes exceed the critical revenues. The guarantee fee fixed by policy CGOs can retain the enterprises with low risks and eliminate the ones with high risks.

Based on the above analysis, outside the enterprise clusters there are many enterprises, which are conformed to  $A > R \cdot L$ . According to the stated hypothesis,  $R \cdot L$  are the interests paid by SMEs for loan from the banks (Lei and Xi 2005). In other words, as long as the assets of endowment of SMEs can afford the interest of the banks, it is possible that the SMEs can obtain loan guarantees from policy CGOs. In fact, there are less enterprise clusters in our country due to various reasons, and it leads to the number of enterprises in the enterprise clusters account for only a small fraction of the total SMEs. In this case, we know  $n - m \gg m$ , and the simplification is  $m \ll n/2$ . In conclusion, we can get: the number of SMEs that are provided financing by policy CGOs is much higher than that of mutual CGOs.

### ***20.3.3 Comparison of Financing Contributions and Efficiencies of Commercial CGOs and Mutual CGOs***

If there were only commercial CGOs and mutual CGOs in the market, then the assumptions that are related to the loan participators are similar to that of "A. Comparison of Financing Contributions and Efficiencies of Policy CGOs and Commercial CGOs" and the assumptions that are related to SMEs and mutual

CGOs are similar to that of “B.The financing contributions and efficiencies comparison of policy CGOs and mutual CGOs”.Under the above conditions, the SMEs outside the enterprise clusters will have a different choice.

1. Financing contributions and efficiencies analysis of two types of CGOs in the enterprise clusters

In the enterprises clusters, SMEs seek their finance guarantee basing on the principal of financing cost minimization. When mutual CGOs can provide a sufficient number of securities, the SMEs will give priority to mutual CGOs and do not consider commercial CGOs whose rate of guarantee fee is higher, at this time, commercial CGOs will exit from the enterprise clusters. From the above comparison between policy and mutual CGOs, we know: policy CGOs will eventually exit from the enterprise clusters due to the difficulties of maintaining the balance of profit and loss. By parity of reasoning, in the enterprise clusters, commercial CGOs also can not get profit space during the competition with mutual CGOs. They have not the advantage of information and will eventually choose to quit, too.

2. Financing contributions and efficiencies analysis of two types of CGOs outside the enterprise clusters

From the above assumptions, we can know that mutual CGOs only serve enterprises in the enterprise clusters and ones outside the enterprise clusters do not belong to the secured scope. Therefore, outside the clusters, SMEs will only consider commercial CGOs under the circumstances of only existing commercial CGOs and mutual CGOs.

## 20.4 Conclusion

Through above comparisons of Financing Contributions and Efficiencies of there types of CGOs, the following conclusions can be educed:

1. Policy CGOs should play a leading and persistent role in promoting the financing of SMEs

According to the above analysis it can be concluded: outside the enterprise clusters, most of SMEs will choose policy CGOs. At the same time, due to the characteristics of the asymmetry between the return and the risk of the guarantee, enterprises and the governments being the bear of the external benefit of the guarantee products, so guarantee products are quasi-public goods which have external benefits (Wen et al. 2009). Therefore, the building of policy CGOs funded by government and providing guarantee products in the public way can not only compensate for the efficiency loss caused by the insufficient supply, but also can conform to goals of the improvements of the social welfare of government. It determines that policy CGOs is different from commercial CGOs, whose goals are

profit and it is also different from mutual CGOs, who serve SMEs in the enterprise clusters or in a specific area.

From the above analysis, we know that China's policy CGOs should play a leading role in the financing of SMEs. In practice, as the government gradually increase the funds and policies support to policy CGOs, thus it will promote social capital injection, then the above positive factors will make the leading role of policy CGOs lasting in the future.

## 2. Mutual CGOs support the financing of SMEs in the enterprise clusters

After the comparison of policy CGOs and mutual CGOs we can conclude that: In the enterprise clusters, mutual CGOs is more effective than policy CGOs. What's more, theoretically speaking compared with policy CGOs and commercial CGOs, mutual CGOs have advantages in three aspects: it can effectively weaken the problem of information asymmetry between CGOs and SMEs caused in the process of the guarantee and helps to reduce the cost of transaction and the loan risks of bank. While the social constraint mechanism of mutual CGOs helps to reduce the credit loss (Wang 2005). Under the government support, the advantages contributed to the strong competitiveness and vitality of mutual CGOs in financing guarantee business. In 1983, Levisky and Prasad pointed that we should support the development of mutual CGOs despite the limited number of guarantee for SMEs provided by them, but their efficiencies are high and it is worth developing such mechanism.

The government support is particularly important for the expression of mutual CGOs' advantages, so that it can supply SMEs better services, and the specific measures include fund and policy support. The funding, on one hand, can improve the credit rating of mutual CGOs; on the other hand, it can promote new members' investment to CGOs, which can increase the registered capital and strength of mutual CGOs.

## 3. Commercial CGOs can alleviate the problem of financing of SMEs as a supplement

At present, the financing demand of SMEs in our country is unusually great, but the effective supply is relatively lack. Although some financing guarantee are supported by policy CGOs and mutual CGOs for SMEs, there are still a propitiation of SMEs, which can not obtain financing guarantee. Thus, it will give some certain market to commercial CGOs. Because parts of SMEs are eager for capital, so commercial CGOs are important for SMEs, although the guarantee fee rate is higher. As the complement of policy CGOs, commercial CGOs can alleviate the situations of SMEs' financing problem through secured financing (Wen and Mei 2011). But in the long run, according to the experiences of the United States and Japan whose security system is more mature, for the purpose of the maximization of the profit, when commercial CGOs provide financing guarantee for SMEs, they will also put energy on collaterals, whose developing rates of the profit are higher, such as bid guarantee, performance guarantee, payment guarantee, bond guarantee for large and medium enterprises, bond guarantee for SMEs and so on.

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# Chapter 21

## Study on Financial Reporting Quality Which is Affected by Subordinate Modes of Internal Audit in IPO Companies

Tao-ying Peng and Xin Liu

**Abstract** This paper studies the relations between subordinate modes of internal audit and financial statement quality on the data basis of IPO companies in Shenzhen Stock Exchange from 2007 to 2009. We find that: (1) Those companies who set up internal audit department separately have higher financial statement quality than those who don't; (2) The higher level of internal audit has, the better quality in financial reporting will be, so does the disclosure transparency of this report. Thus, public companies build internal audit branch with a right orientation is helpful to form high-efficient and transparent information transmission mechanics, offer honest and reliable information to investors making them choose rightly. At the same time, the conclusion provides evidence for the action that CSRC (China Securities Regulatory Commission) publishes laws aiming at ordering companies to set up internal audit department.

**Keywords** Financial information • Information disclosure quality • Internal audit • Subordinate modes

### 21.1 Introduction

From the South Sea Bubble in 1917 and the Enron Case in 2001 to the Affairs of China Aviation Oil in 2006, people have come to realize that defects of corporate governance mechanism might breed accounting fraudulent. In 2002, a meeting of IIA (The Institute of Internal Auditors) world forum put forward a theme of 'Challenges of ensuring internal audit quality and improving audit projects'. In July 2005, the 64th forum of IIA international conference worldwide committee

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and leaders also focused on management in internal audit. However, the internal audit of China in early stage was founded aiming at deepening the reform of economic system, maintaining financial regulations service which made it served mainly on traditional fields, lacking experiences in risk management and corporate governance, all of which led it could not play its really role. In theory, internal audit department can balance all parts' rights, monitor firm management activities, enhance internal information transmission mechanics, reduce moral hazard and adverse selection, remit agent conflict as well as prevent and rectify fault financial information by acting as a bridge in corporate governance structure and connecting manager, board and shareholder, so internal audit plays an important part in promoting internal control efficiency and effect, ensuring financial report true and reliable. As the deepening the reform of State-owned enterprises and development of capital market, the quality of financial statement has been placed in more prominent place. In August 2004, SASAC (State-owned Assets Supervision and Administration Commission) issued Interim Measures for Internal Audit Management of Central Enterprises, requiring state-holding companies and state-owned exclusive company should build independent internal audit branch with fulltime staff. In 2007, the Auditing Office of China ordered that public companies should set up internal audit system, disclosure annual self-check report. In 2008, CSRC and other 4 ministries published jointly the Basic Standards for Enterprise Internal Control, formulating that corporate should enhance internal audit work, ensure independences of organization structure, personnel allocation, and work. At the same time, the audit branch must check the effectiveness of internal control on accounting of internal audit investigation. However, related study on the relationship between subordinate modes of internal audit and financial report quality is in shortage. As a result, analyzing the relations of both by using data of companies especially IPO Company's data is helpful for investors to understand the reality of financial report. At the same time, the research is also a supported verification for CSRC's regulations.

## 21.2 Literature Review

Academia's opinions on internal audit function mainly have single-function, two-functions, and several-functions. In fact, we think another methods that is formation purposes, to classify audit functions. This is useful to distinguish different characteristics of internal audit who acts as an important part in corporate governance structure, and analyze the relation between functions and financial report quality. The subordinate modes of internal audit are the external manifestation of their function. When attaching to management layer, the department performs management function, assisting manager to realize goals. While belonging to governance layer, it performs managerial function. Although supervising also, it prefers to focus on evaluations in macroscopic aspect with a higher independence.

Geng et al. (2006) did an empirical study on formation purposes of internal audit department, with a result that internal audit modes had a limit role in improving corporate governance, for it was formed mainly on accounting of management, not to the level of corporate governance. Gu and Zhao (2001) considered that the choices of internal audit department modes were directly influenced by business management concepts, company size, internal management structure and staff quality. In recently 10 years, as the expansion of research field, people gradually paid more attention to the relationship between internal audit and accounting information. Ge and Liu (2003) pointed out that the quality of financial report was firstly depended on the quality of financial information which was covered by financial statement, and then the quality of disclosure off financial statements were other financial reports. When measuring financial information, discretionary accruals (DA) is mostly used. For instance, Cai et al. (2009) used an amendatory Jones model as substitution for earnings management, and thought a relationship existed between high-quality internal audit and low-level earnings management. Wang et al. (2010) made a study on financial statement quality affected by internal audit level, leading a result that there was a obviously negative relationship between internal audit and DA. By using companies in Australia as samples, Davidson et al. (2005) found that building internal audit department could reduce the probability of earnings management.

Although many scholars have studied the relation between internal audit and accounting quality from different prospects, there still has a study vacancy in influences that subordinate modes of internal audit brought to disclosure quality of financial statement. In comparison, related study of our country started lately without a completed system. As an important part of company internal control, the direction of internal audit should be given tremendous attentions. Only by doing this, can this department be ensured in independence to produce its best possible function.

## **21.3 Theoretical Analysis and Hypothesis**

### ***21.3.1 Separately-Building Internal Audit or Not and Financial Statement Quality***

Indomitability, internal audit is a method to economic supervision as well as an important means of self-restricting mechanism. Modern enterprise system calls for a higher requirement for internal audit, only by building a suitable internal audit, can internal auditor be guaranteed in independence and authority, and functions in supervision, evaluation, control and consultation can be fulfilled. Therefore, no matter for what reason to build a department, setting up separately will bring higher independence, which can mend internal control environment, guide control activities, standard internal communication. Consequently, compared with other

auxiliary modes, separately-building mode has many advantages, higher-quality financial report for instances. Based on these above analyze, we put forward the following hypothesis.

H1: Companies who set up internal audit department separately will have higher financial statement quality than those who don't.

### ***21.3.2 Subordinate Modes of Internal Audit and Financial Information Quality***

Different modes of internal audit have direct effects on the independences of internal auditors and the authorities of this branch. Internal audit of China develops later than other countries so it has many disparities. All in all, there are 2 modes in our country: Firstly, non-separately building (Financial department-oriented) mode. This is the original mode of internal audit, focusing on financial revenue and expenditure. The leader manages both audit and financial work, which seems that this mode coordinates operation. However, it forms self-supervision, meaning independence can't be guaranteed. Secondly, separately building modes. There can be classified to manager-oriented, board of supervisors-oriented, board of directors-oriented, dual mode (both board and manager-oriented) according to organization level. When manager controls internal audit, they often authorizes internal audit to check, supervise, and evaluate their subordinate companies. This internal agency relationship could effectively reduce adverse selection and moral hazard, but it hardly helpful in financial information authentication and economic responsibility supervision in themselves, because internal auditors are under the control of manager, which means internal audit performance would be influenced. When supervisor controls, internal audit will have a good independence, but without a management position to supervisor, internal audit can't know operate processes, and is bad to realize its service target. Audit institution who is controlled by board have higher authority and independence for it is led by the supreme decision-making body, which is useful in working. And dual mode makes internal audit on one side under the leadership of managers so as to touch management activities, on the other side led by the board, which independence and authority can be ensured. For this reason, the higher level of internal audit has, the better effects in preventing manager to make financial frauds by insider control or information asymmetry. Based on above analysis, we establish the hypothesis.

H2: The more independent subordinate mode of internal audit is, the higher quality of financial information the companies will have.

### ***21.3.3 Subordinate Modes of Internal Audit and Information Disclosure Quality***

Financial report disclosure quality means the disclosure transparency of financial report. Ge (2009) classified financial information transparency to board and narrow sense. The extended transparency is high quality, including formulation and execution of accounting principle, accounting information quality level, accounting process of financial statements and disclosure. As for narrow transparency, only representing full disclosure. This paper uses the latter definition to measure transparency. Obviously, the higher level of audit department is, the better independence and authority is. During the whole supervision process, it can avoid fraud financial information at the source, guarantee inner financial material honest, fair and just. Thus, good internal supervision could help company get ideal scores when accepting inspection. And we build following hypothesis.

H3: The more independent subordinate mode of internal audit, the higher quality of information disclosure quality

## **21.4 Research Design**

### ***21.4.1 Sample Selection and Data Sources***

This paper gets samples by hands. Because materials of subordinate modes are needed in prospectus, and until 2006 there were regulations ordering public companies must set up internal audit. To assure integrity, firstly, we select IPO companies of Shenzhen Stock Exchange from 2007 to 2009, and get relative materials about internal audit. Secondly, report data and other financial index are received in CSMAR series database. Thirdly, we get data about disclosure quality rating from the website of the Stock Exchange. To sum up, we have 220 samples with the exception of 6 firms who don't offer related data.

### ***21.4.2 Model Specification and Variable Declaration***

At first, to test if build alone internal audit department will do good to financial report quality or not, this paper makes Logistic Regression on the basis of other's experience.

$$\begin{aligned} \text{Logit}(AO) = & \alpha_1 I\text{Asetup} + \alpha_2 \text{LnAssets} \\ & + \alpha_3 \text{ROA} + \alpha_4 \text{Leveage} + \varepsilon \end{aligned} \quad (21.1)$$

In which:

AO refers to audit opinion, replacing financial report quality of firms. Getting standardized auditing opinion represented by the number 1, if not, 0;

IAsetup means set up internal audit branch separately or not, if yes represented by the number 1, if not, 0;

LnAssets represents the complexity of the business, the more complex competition, the more possibilities to occur managerial and audit risks, so there is a negative relation between the two;

ROA represents profitability, when facing pressures of revenue compression and rights issue, companies are motivated to distort financial information; Leverage refers to financial risks, the more risks, the more that financial report cheat, leading lower financial report quality.

Then, in order to research the relations between subordinate modes of internal audit and financial information quality, we build the following multiple linear regression model based on amendatory Jones model.

$$FQ = \beta_1 IA \text{ mod } e + \beta_2 Loss + \beta_3 LnAssets + \beta_4 ROA + \beta_5 Leverage + \beta_6 Age + \beta_7 TA + \varepsilon \quad (21.2)$$

In which: FQ refers to financial information quality, represented by DA. According to Xia (2003), the amendatory Jones model is as follow:

$$\frac{TA_t}{A_{(t-1)}} = \alpha_1 \left( \frac{1}{A_{(t-1)}} \right) + \alpha_2 \left( \frac{\Delta REV_t - \Delta REC_t}{A_{(t-1)}} \right) + \alpha_3 \frac{PPE_t}{A_{(t-1)}} + \varepsilon_t \quad (21.3)$$

$$TA_t = NI - OCF_t \quad (21.4)$$

In which:

$TA_t$  refers to the normal accruals of company in year t;

$A_{(t-1)}$  means total assets in year t-1;

$\Delta REV_t$  stands for the differences of Prime operating revenue between year t and t-1;

$\Delta REC_t$  are the result of Net value of account receivable in year t deduct the number in year t-1;

$PPE_t$  stands for the value of the fixed assets such as property, plant, and equipment of the at the end of year t;

$\varepsilon_t$  is DA that we want;

$\alpha_1, \alpha_2, \alpha_3$  are estimated according to basic Jones model. It is notable that Cai et al. (2005) regressed on the basis of industrial classification; Xia (2003), Zhang and Liu (2000) selected all samples instead of classification. This paper also uses the latter method for small sample numbers won't bring good results if select the former way.

IAmode refers to the establishing modes of internal audit, assignment 1-4 according from low-level to high-level. In the meantime, thinking of the modes are a part of corporate governance mechanism, we add other variables to balance the equation. Loss means if there was a deficit last year or not, if yes, numbered 1;

if not, 0; loss is the motivation of earnings management. So loss of last year will have a direct effect to financial info quality this year; Age stands for the number from establishing to going public. LnAsset1 represents company size. The bigger the size is, the more regulatory loopholes and more chances of earning managements are. A means Total Accruals. Li and Tang (2010) by introducing the opinions of Francis (1996) figured out that external stakeholders can't recognize DA and NDA, so the more TA, the more DA. That is why we introduce TA into regression model as control variable. Other explanations are the same as model 1.

At last, we want to study another component of financial report quality, that is financial report disclosure quality, which is influenced by the subordinate modes of internal audit, so we use information disclosure rating (Scores) as substitution variable and set up multivariate regression models.

$$\begin{aligned} \text{Scores} = & \delta_1 IA \text{ mod } e + \delta_2 \text{Independent} + \delta_3 \text{Lnassets} \\ & + \delta_4 \text{Leverage} + \delta_5 ROA + \varepsilon \end{aligned} \quad (21.5)$$

In which:

Scores stands for Information Disclosure rank, numbered 1 to 4 from excellent to unqualified; the explanations of other variables are as the same with model 2.

## 21.5 Empirical Results and Analysis

### 21.5.1 Statistical Description

Table 21.1 gives the statistical description of subordinate modes of internal audit and their belongings. We can know from the form that there is a decreasing proportion in non-separately establishing modes of internal audit, which is on the contrary comparing with those who set up alone. Furthermore, in those who build separately, affiliation mode of manager-oriented tends to reduce, other 3 modes are up. This means that public company of our country have realized the application mechanism of internal audit in corporate governance, and put it into use, giving it play to promote positive cycle of the enterprises.

**Table 21.1** Statistical description

	2007	%	2008	%	2009	%
Non-separately setting mode	24	25.3	15	22.4	8	11.77
Separately setting	71	74.7	52	77.6	60	88.23
Manager-oriental	33	34.7	14	20.9	13	19.11
Board of supervisor-oriental					4	5.89
Board-oriental	38	40	38	56.7	35	51.47
Dual mode					3	4.41
Total	95	100	67	100	68	100

21.5.2 Empirical Research and Analysis

1. Separately-Building Internal Audit or Not and Financial Statement Quality

According to theoretical analysis, we can figure out that separately-building internal audit have efficient internal control system, perfect internal control environment, wholesome internal communication transmission mechanism, and can improve performance as much as possible. Reflected in financial report means true and reliable financial information. Before regression, relevancy analysis is needed.

Table 21.2 means AO and ISetup has an obvious positive relation, that is setting up internal audit separately can ensure high quality financial material and get standardized auditing opinion, which proves our opinions. At the same time, independent variables have correlativity that less than 0.5, meaning no multicollinearity, which can be brought into the model.

We can know from Table 21.3 that the regression coefficient of ISetup is positive with a number of 3.947, and is remarkable on the level of 0.05. This stands for the whole quality of financial report can be promoted by establishing internal audit separately, corresponding with our estimates. At the same time, the more business, the more complex activities, the lower quality of financial report quality, which proves our support. The possible reason may be the development process of corporate governance. On accounting of that, we can draw a conclusion: building internal audit separately leads higher financial quality, with better managerial methods and efficiency.

2. Separately-Building Mode, the Relations between Coordinate Modes and Financial Information Quality

Firstly, we check the relative variables. Correlation coefficient Table 21.4 tells us that IAmode show a reverse relationship with FQ. That is to say, more independent type will bring less earnings management behavior, which gives proofs to our hypothesis. At the same time, FQ has a positive relation with Loss, TA, which stands for business efficiency of last year and earnings management of this year

Table 21.2 Relevancy between AO and ISetup

	AO	ISetup	LnAssets	ROA	Leverage
Audit opinion	1	0.26**	-0.18*	0.43**	-0.05
ISetup	0.26**	1	-0.07	0.18**	0.01
LnAssets	-0.15*	-0.36	1	0.04	0.02
ROA	0.14*	0.18*	0.01	1	-0.18**
Leverage	-0.01	0.02	0.05	0.04	1

\*\*Obvious relevancy on the level of 0.01

\*Obvious relevancy on the level of 0.05

Note Right corner is Pearson relevancy; left corner is Spearman relevancy

**Table 21.3** Parameter estimation of model 1

Index	Prediction	B	Sig
Constants	?	54.716	0.009
IAsetup	+	3.947	0.047
LnAssets	–	–2.606	0.009
ROA	+	13.340	0.133
Leverage	–	4.342	0.189
N			220
–2Log likelihood			20.581
Adj. R2			25.3 %

has a direct correlation, for stock exchange rules (2008) provides if a company faces loss in serial 2 years, its stock will be suspended, so managers are motivated to change financial information to avoid special treat. Then, more TA will bring more space to manage earnings. In addition, there aren't correlations among other variables. Meanwhile, Var Inflation Factor (VIF) of this model are less than 5 meaning no multicollinearity, so variables are suitable.

Table 21.5 clearly displays the regression result of model 2. Statistics figures out that the negative correlation coefficient is obvious on the level of 5 %, which confirms our suppose on data base, that is, IAmode affects FQ of IPO companies, the more independent, the lower earning management. Those companies with more TA have more complex business types and more motivation to manage earnings. TA in our model is obvious on the level of 0.05 which proves our guess. However, company size is on the opposite with our assume, as with the development of the enterprise internal control basic standard, internal control has become more and more complete, remitting defeats such as internal management confusion, management redundancy, communication efficiency, information lags to a great degree.

### 3. Correlation between IAmode and Scores

Table 21.7 proclaims regression results of model 3. IAmode is –0.169 meaning remarkable at the level of 0.05, which suits our hypothesis, that is, IAmode do have influences to financial report disclosure quality of IPO companies. If a company has a higher-quality internal audit institute, it will get higher score in rating. On the other hand, Leverage also shows an obvious positive relation

**Table 21.4** Correlation between IAmode and FQ

	FQ	IASetup	Loss	LnAssets1	ROA
FQ	1	–0.133*	0.168*	–0.096	–0.045
	Leverage	Age	TA	Scores	
FQ	0.102	0.177*	0.286**	0.083	

\*\*Obvious relevancy on the level of 0.01

\*Obvious relevancy on the level of 0.05

**Table 21.5** MLR between IAmode and FQ

	Prediction	B	Sig	VIF
Constant	?	2.030	0.000	
IAmode	–	–0.093	0.014	1.037
Loss	+	0.196	0.040	1.051
LnAssets1	+	–0.060	0.000	1.218
ROA	–	0.001	0.993	1.049
Leverage	+	0.090	0.485	1.060
Age	+	0.005	0.420	1.020
TA	+	0.000	0.000	1.223

**Table 21.6** Correlation between IAmode and scores

	FQ	IASetup	Loss	LnAssets	ROA	Leverage
Scores	0.1	–0.144*	–0.079	0.086	–0.004	0.134*

\*Obvious relevancy on the level of 0.05

(sig < 0.1) with IAmode. When facing the pressure of high debts, managers want to distort financial report to hold confidences of outer stakeholder, with the improvement of material misstatement risk, which leads a low result for low-quality financial information.

## 21.6 Research Conclusion

From the view of corporate governance, this paper discusses the relationship between subordinate modes of internal audit and quality of financial statement by setting Logistic Regression and MLR. The result shows that companies with a single internal audit department plays a crucial role in improving financial information; the more independent mode, the better quality in financial information and disclosure. This means that independent internal audit can play its oversight mechanism, and improve financial information and disclosure quality. Internal audit is a good medicine to treat agency conflict caused by modern enterprise

**Table 21.7** MLR between IAmode and scores

	Prediction	B	Sig.	VIF
Constant	?	6.041	0.000	
IAmode	–	–0.169	0.000	1.751
Loss	–	0.031	0.611	1.028
Lnassets	+	–0.165	0.616	1.863
ROA	+	–0.284	0.104	1.021
Leverage	–	–0.38	0.085	1.264

system; people should put it on their mind and give it suitable orientation. Only by doing these internal audits fulfill can its service function. Meanwhile, the conclusion also provides theory basis for why CSRC orders public company must set up internal audit department.

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# Chapter 22

## Study on the Traditional Pricing Model of Convertible Bonds

You-zhi Zeng

**Abstract** The convertible bond is a financial derivative with good investment and financing functions and has had a stable and rapid development in China. However, the efficiency of pricing models of convertible bonds is not high, which is not congruous with and conducive to the stable and rapid development. By discussing and deducing traditional pricing models, comparing and analyzing of their advantages and disadvantages, pave the way for the development of pricing models and China convertible bonds.

**Keywords** Convertible bonds · Pricing efficiency · Traditional pricing models · Terms of convertible bonds

### 22.1 Introduction

The convertible bond is a financial derivative with good investment and financing functions and the pricing efficiency of the existed models is generally not high. The earliest scholars to study the pricing of convertible bonds are Brennan and Schwartz (1977) and Ingersoll (1977). Brennan and Schwartz (1977) assumed that the convertible bond value was a function of time and the company value and used the finite difference method to solve the partial differential equation (PDE). McConnell and Schwartz (1986) assumed that the only variable which impacted the value of convertible bonds was company stock price, and company stock price followed a geometric Brownian motion whose volatility was constant. They derived the partial differential equation satisfied by the convertible bond value in the framework of the Black–Scholes pricing model and obtained the convertible bond value by determining the boundary conditions of equation. Wang and Wang

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(2001) using Monte Carlo simulation, got the probability of provisions triggered for redemption and return sale. Using the finite difference method for solving, they pointed out that the contribution of the return sale term on investment was small. Fan and Fang (2001) based on pricing model of corporate convertible bonds with stochastic interest rate and used the finite difference method and the binomial tree model to investigate five factors which impacted the value of convertible bonds. Zhe and Lin (2004) used the basic principles and methods of financial engineering such as BS model to get the conclusion that there was a big difference between the issue price of first day and the theoretical value. Gong and He (2006), using the compound option theory of stock price, built the control equation of convertible bonds pricing and done the numerical simulation with the finite difference method.

## **22.2 Traditional Pricing Models of Convertible Bonds**

### ***22.2.1 Introduction of Traditional Pricing Models***

Before BS model generation, people simply compared the size of the conversion value and the investment value and considered the present value of the larger value as the theoretical price of the convertible bond, which was called the minimum value theorem of convertible bonds and the difference between the theoretical price and the actual price was large. After BS model generation, people began to use this method to price convertible bonds, the accuracy of pricing had some improvement compared to the previous stage. However, due to the terms of the convertible bond could be triggered in advance, at present, often price the convertible bond with numerical methods, which are mainly the Monte Carlo simulation, the binary tree model and the finite difference method.

### ***22.2.2 Derivation of Traditional Pricing Models***

#### **22.2.2.1 The Analytical Method**

The analytical method has a ready-made formula, as long as the estimated parameter contained in the formula can be gotten, we can obtain reliable results. In fact, it is the Black–Scholes pricing model referred to as the BS model. Due to derivative securities are based on underlying assets and therefore we should study the underlying asset price before pricing derivative products. BS model has seven harsh assumptions and no longer repeat it here. Under these assumptions, the movement of stock prices follows the law of geometric Brownian motion which in mathematics was manifested as Ito process:

$$dS = \mu^* S d_t + \sigma S d_z = \left(\mu + \frac{1}{2}\sigma^2\right) S d_t + \sigma S d_z \quad (22.1)$$

$S$  is the price of the underlying stock,  $\mu^*$  is the expected return rate of the stock in unit time,  $\mu$  is the mathematical expectation of the natural logarithm of the stock return in the unit time,  $\sigma$  is the volatility which is the standard deviation of the natural logarithm of the stock return in unit time,  $d_z = \varepsilon\sqrt{d_t}$  is a random process called Wiener process, which meets the standard normal distribution. Based on (22.1), the further study is available to another important mathematical result the Ito lemma:

$$df = \left(\frac{\partial f}{\partial S}\mu^* S + \frac{\partial f}{\partial t} + \frac{1}{2}\frac{\partial^2 f}{\partial S^2}\sigma^2 S^2\right)dt + \frac{\partial f}{\partial S}\sigma S d_z \quad (22.2)$$

$f = (S, t)$  is the price of derivative securities. Take the typical dynamic non-arbitrage equilibrium analysis technology and take a dynamic trading strategy under above assumptions to copy the end cash flow of European call variable. Using Ito process and Ito lemma to eliminate the random, we can get the famous Black-Scholes stochastic differential equation:  $\frac{\partial f}{\partial t} + r_f S \frac{\partial f}{\partial S} + \sigma^2 S^2 \frac{\partial^2 f}{\partial S^2} = r_f f$ , combined with the terminal conditions of the European underlying assets:  $C = \max(S(T) - X, 0)$  or  $P = \max(X - S(T), 0)$ , we can get the Black-Scholes pricing formula:

$$\begin{aligned} c &= S(t)N(d_1) - Xe^{-r_f(T-t)}N(d_2); \\ p &= Xe^{-r_f(T-t)}N(-d_2) - S(t)N(-d_1) \end{aligned}$$

$N(\cdot)$  is the cumulative normal distribution function,  $d_1 = \frac{\ln(S(t)/X) + (r_f + \sigma^2/2)(T-t)}{\sigma\sqrt{T-t}}$ ,  $d_2 = d_1 - \sigma\sqrt{T-t}$ ,  $c$  is the price of the European call variable,  $p$  is the price of the European put variable,  $X$  is the exercise price of variable,  $T$  is the expiration date of variable,  $t$  is on behalf of the present.

## 22.2.2.2 The Numerical Method

### • The Binomial Method

The binomial method is the most popular approximate pricing method of American variable, which is flexible, easy to implement and can handle a variety of pricing issues. In the binomial method, assume that the underlying asset price may rise and reduce at each stage.  $n$  represents the number of time stage,  $\Delta t = T/n$  is the length of each stage;  $u$  is the proportion of the underlying asset price increasing in each stage,  $d$  is the proportion of the underlying asset price declining in each stage,  $p$  is the probability of the underlying asset price increasing in each stage and  $1 - p$  is the probability of decreasing.  $v$  is the degree of the natural logarithm of the underlying asset prices rising in each stage,  $w$  is the degree of the natural logarithm of the underlying asset prices dropping in each stage. We can get one-stage binary tree model diagram:

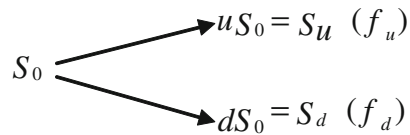
$\ln S_u = \ln u + \ln S_0 = v + \ln S_0$ ;  $\ln S_d = \ln d + \ln S_0 = w + \ln S_0$ . It is easy to get  $\mu = e^v$ ;  $d = e^w$  from the above diagram. The eigenvalues of the binary tree model include size and probability of price changing. Focus on the logarithm price of the underlying asset at the first phase, which is  $\ln S_{\Delta t}$ .  $\ln S_{\Delta t}$  fits the normal distribution whose mean is  $\ln S_0 + \mu_{\Delta t}$  and variance is  $\sigma^2 \Delta t$ . Parameters should ensure that the mean and variance of the discrete binomial distribution are same with the mean and variance of BS model of the consistent normal distribution, in fact when  $\Delta t \rightarrow 0$  the binary tree model is the BS model. With the above tree diagram and mean constraint and variance constraint, if add the parameter imposed by Cox et al. (1979):  $w = -v$ , we can get the model:  $u = e^{\sigma\sqrt{\Delta t}}$ ;  $d = e^{-\sigma\sqrt{\Delta t}}$ ;  $p = \frac{1}{2} + \frac{1}{2}(\frac{b-0.5\sigma^2}{\sigma})\sqrt{\Delta t}$ ; if add the parameter imposed by Jarrow, Ruddy (1983):  $P = 1/2$ , we can get the solution to the model:  $u = e^{(b-\sigma^2/2)\Delta t + \sigma\sqrt{\Delta t}}$ ;  $d = e^{(b-\sigma^2/2)\Delta t - \sigma\sqrt{\Delta t}}$ ;  $p = \frac{1}{2}$ ; with the risk neutral assumption, we can get the solutions to the model:  $u = e^{\sigma\sqrt{\Delta t}}$ ;  $d = e^{-\sigma\sqrt{\Delta t}}$ ;  $p = \frac{e^{r\Delta t} - d}{u - d}$ .

- Monte Carlo Simulation Method

Monte Carlo simulation is also often used to price financial derivatives and the same point between Monte Carlo simulation and the tree diagram method is both required to simulate the path of asset price changing within the validity period. The difference is that the tree diagram method calculates the characteristic values of model and the variable path has been designed firstly, while Monte Carlo simulation is to examine a random sample of price changing in sequence and the variable path is a random. The time  $\Delta t$  corresponds to a value randomly selected and during  $T - t = n\Delta t$ ,  $n$  random values are taken to produce a simulated path with which we can calculate the price of underlying asset and it is called a simulation or an experiment. After many simulations, such as 10,000 simulations, we can get 10,000 the final price of the underlying asset. The final value of the derivative variable can be calculated with the final price of the underlying asset and the arithmetic mean of the derivative variable can be gotten, then using the risk-free rate to discount the arithmetic mean  $E(\bar{P}_t)$ . Finally get the present value of the derivative variable  $f = e^{-rt}E(\bar{P}_t)$ .

- The Finite Difference Method

Object handled by the finite difference method is the partial differential equation of the BS model and the numerical method is used to solve the partial differential equation of the derivatives, and then price the derivative. The finite difference method first divides the partial differential equation into a series of differential equations which are simplified by the iteration method, and then the price of the derivative is calculated. In general, a partial differential equation (PDE) has infinitely many solutions and we are only interested in solutions that meet specific criteria and initial value set. For the finite difference method, it is



necessary to know the provisions of the boundary and initial conditions. The basic idea of the finite difference method is basically same with the tree diagram model.

### 22.3 Advantages and Disadvantages of the Traditional Pricing Models

BS model as the only analytical solution, one of its strengths is to give analytical solutions for risk management and the leverage effect of convertible bonds (Carayannopoulos 1996); However, BS model is only suitable for pricing European variables and American call variables which do not pay dividends. It means BS model is not suitable for pricing convertible bonds (Kwok and Lau 2001; Greiner et al. 2002). This has been confirmed by the empirical research done by Zhe and Lin (2004), the difference between the theoretical price and the actual price is about 10–20 %. The advantage of Monte Carlo simulation is that it can price more complex derivatives. With the use of computer, it can get a more accurate solution by carrying out large-scale computing. The only drawback is that it cannot consider the value of the convertible bond terms which might be implemented in advance and therefore the standard Monte Carlo simulation is not suitable for convertible bond pricing alone. Of course, it does not mean that it cannot be applied to price the convertible bond; with its own unique advantages, Monte Carlo simulation can be applied with other pricing methods and often can improve pricing efficiency, such as Monte Carlo simulation combines with genetic operator method. The finite difference method and the binary tree model can take into account the value of convertible bond terms which might be implemented in advance and therefore they are more appropriate to price convertible bonds. Compared to the finite difference method, a significant advantage of binary tree model is that, because it considers the value of the variable at each node, so it can better deal with the value of complex provisions embedded in convertible bonds. A common drawback of the finite difference method and the binary tree model is that the computational efficiency is not high for pricing the variable value which depends on the historical path of the state variables. Nevertheless, taking into account the embedded terms of the convertible bond, binary tree model is still the optimal choice in the traditional pricing model. Lai et al. (2008) got the difference between the theoretical price and the actual price is much lower than other three traditional models, using TF model (Tsiveriotis and Fernandes 1998) and the binomial model for numerical calculation. However, the binary tree model of convertible bonds pricing still has a large room for improvement, such as its

assumption on the law motion of the underlying stock does not meet China convertible bonds market and will definitely loss its pricing efficiency in China convertible bonds market. Improving these defects is necessary and it is also the direction for us to develop further the pricing models and China convertible bonds.

## 22.4 Conclusions

The convertible bond is a financial derivative with good investment and financing capabilities and excellent security (Paul and Sam 1995; Hull and White 1990). Although it is less than 20 years for the convertible bond introduced into China and its development and advancement is in the twists and turns, the development of China convertible bonds has been on the right track and started its rapid and stable development since the 2008 financial crisis. Until October 10, 2011, the market value of convertible bonds in Shanghai and Shenzhen has reached 117.906 billion Yuan, which is same with B share. Uncoordinated with the rapid and stable development of convertible bonds in recent years, the study on convertible bonds pricing is stagnant. In this paper, we have had an in-depth discussion and comparative analysis about the traditional pricing model of convertible bonds, pointing out their advantages and disadvantages. Improving these defects is necessary and it is also the direction for us to develop further the pricing models and China convertible bonds.

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# Chapter 23

## The Analysis of China's Medium Commercial Bank Financing Activity

Yong-gang Ye and Xi-yu Liu

**Abstract** This paper major research the financing activity of China's medium commercial banks, analyze the data of 8 listed medium commercial Banks, check the result with the peaking order theory, draw the characteristics of medium commercial bank financing activity, analyze the reasons for these characteristics and point out the solution.

**Keywords** Financing activity · Medium commercial bank · Peaking order theory · Equity financing

### 23.1 Introduction

In China, commercial banks are divided into three kinds: large, medium and small. Large commercial bank must have more than 2 trillion total assets; there are five large commercial banks in china: Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, Bank of China, and Bank of Communications. Medium commercial banks are the banks that have total assets more than 300 billion and less than 2 trillion, there are nine medium commercial banks in China: China Everbright Bank, Huaxia Bank Co., Ltd., China Minsheng Banking Corp., Ltd., SPD Bank, Shenzhen Development Bank Co., Ltd., Industrial Bank Co., Ltd., China Citic Bank, China Merchants Bank Co., Ltd. Small commercial banks are the banks have total assets less than 30 million, At present the small commercial banks are the city commercial banks that support local economic development.

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After 30 years running and expansion, Medium commercial Banks in China has achieved great development. 2010, shareholding commercial Banks (1) have the total assets of 14.9037 trillion yuan, a 25.17 % increase from the previous year, gained 135.8 billion yuan net profit.

From Table 23.1, five state-owned commercial Banks occupied the absolute dominant position in the banking industry, in 2010 five large commercial banks’ assets account for 49.2 % of all banking financial institutions. Depending on large distribution networks and huge adequate capital amount, large state-owned commercial Banks always hold the market leading position, on the other hand, “large” means hard to change, in 2010, large commercial bank assets growth rate is 14.93 %, this is not serious in China banking industry, they gained 515 billion yuan profits, that means 2010 is a harvest year.

By contrast, the small city banks gained more than 38 % growth rate both in asset and liability. Although small city banks always face the difficulties that short of capital, expanding market, shackle of zone and etc., they become the fastest growing part in banking industry. Then the medium is a kind of awkward, they want to growing into the large one, but they don’t want to lose the flexibility. In 2010, medium commercial banks gained 128 billion profits, only one fourth of large commercial banks.

23.2 Methodology

This paper selects eight banks that introduced in <Almanac of China’s Finance and Banking> (2011), (because the whole financial statements of Guangdong Development Bank Can not be found, so we exclude the GD Development Bank.) they have the largest market value in December 30, because the whole financial

Table 23.1 2010 China’s banking industry asset and liability data (trillion yuan)

	Large commercial bank	Medium commercial bank	City bank
Total asset	46.89	13.6	7.85
Growth rate (%)	14.93	24.77	38.25
Total liability	44.76	12.87	7.37
Growth rate (%)	29.7	24.47	38.51
Net profit	0.515	0.128	0.077

Data resources <Almanac of China’s Finance and Banking> (2011)

statements of China Life Insurance Company Ltd. Can not be found, the China Unicom fills the vacancy.

According to Myers (1984) models, companies financing needs can be described by following formula:

$$DEF_T = DIV_T + I_T + \Delta W_T - C_T = \Delta D_T + \Delta E_T$$

Which:

- DIV<sub>T</sub> Company dividends
- I<sub>T</sub> Net cash flow from investing activities
- ΔW<sub>T</sub> Liquidity incremental
- C<sub>T</sub> After tax and interest cash flow
- ΔD<sub>T</sub> Net debt issuance
- ΔE<sub>T</sub> Net equity issuance

23.3 Results

23.3.1 Figures and Tables

The result is analysis of the relationship between ΔD<sub>T</sub> and DEF<sub>T</sub>. This paper makes the linear regression with least square method, the result shows in Fig. 23.1.

As shown in Fig. 23.1, ΔD<sub>T</sub> = 30,000,000,000 + 0.2303 DEFT, R- squared is 0.098. From the result of regression analysis, there do not exist significant positive correlation between ΔD<sub>T</sub> and DEF<sub>T</sub>. This result is quite different from peaking order theory, but it is quite similar with the other financing structure testing conclusions for Chinese listed companies. In general, Chinese listed companies

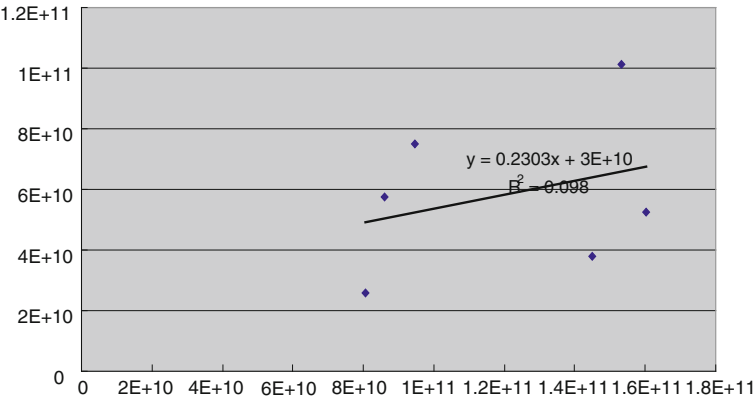


Fig. 23.1 Regression analysis. Data resources from 8 banks financial statement

have strong equity financing preference, while debt financing is not as preferred as in US financial market.

### 23.3.2 References

Modigliani and Miller (1958) opened up the research on the capital structure, Ross (1977) analyzed the decision factors to the capital structure. Diamond (1984), Leland and Pyle (1977) analyzed the impact of financial intermediation in the financing structure. Following, Goswami et al. (1995), Harris and Raviv (1990), Myers and Nicholas (1984) discussed about the relation between information Asymmetries and capital structure. Li and Ma (2004) analyzed the relation between the stock financing preferences and information Asymmetries in China.

Shyam-Sunder and Myers (1999) analyze 157 U.S. listed companies, from 1971 to 1989 data of these companies, U.S. listed companies follow the pecking order theory, this is one of the most powerful empirical test for Pecking Order theory, and the conclusion strongly supports the pecking order theory. Frank and Goyal (2003) also tested the pecking order theory.

Fama and French (1999) found that US listed companies' financing ratio from 1951 to 1996 is: 47.32 % retained earnings, 29.82 % long-term debt financing, 9.23 % short-term debt financing, the financing order of companies are almost following the pecking order theory, that is first internal financing, then external financing, while in external financing, first is debt financing then equity financing.

However, a series empirical test for Chinese listed companies get totally different conclusions. Most of pecking order test in Chinese market found that Chinese listed companies did not follow pecking order theory, they have strong preference for equity financing.

Zhou (2006) studied twenty companies that have biggest and lowest price-earnings ratio in Chinese stock market, analyzed the data from 1999 to 2004 of these companies by least square method, found that the companies' financing order are opposite to the pecking order theory. Then Zhou got the conclusion that Chinese listed companies did not follow the pecking order theory, they have strong equity financing preference. Zhou pointed out the major reason of this opposite, first, Chinese capital market capacity is still in a low level, second, binding mechanism of market is still in establishing, third, bond market development is seriously lagged behind the stock market, and most of listed companies had unusual ownership structure etc.

Pan (2008) further analyzed the negative effect of equity financing preference of Chinese listed companies. The over-reliance on equity financing will lead to the low efficiency in the use of capital, reduce the profitability of the company, then impact the future financing capacity of company. Second, inappropriate equity financing increase the blind propensity of investment, then increase the risk of investment, and lead to capital chain broken and so on. Third, inefficient use of capital and blind investment will lead to unstable return on equity, dampen the

enthusiasm of investors, then affect the development of the equity financing market.

Liu (2002) use the data shows the effect of equity financing preference. By analyzing data of all the listed companies in 2002, Liu found the average idle funds of these companies reached 3.1 hundred million. On contrary, most of small businesses not listed were in the state of extreme shortage of funds.

## 23.4 Discussion

The major reasons would be following:

### ***23.4.1 A Standard Issue Pricing System has not Set Up in China's Stock Market***

In the development, the issuance price is optional in china's stock market, the price always separate from the market price. China's stock issuance price experienced four stages since its beginning, the first stage is CSRC determining the price period, the second is fixed pricing according to relatively p/e ratio period, the third is Accumulated bidding pricing period and the four is controlled P/e ratio pricing period. Although the pricing way went gradually close to actual market conditions and standards, increased the participation of issuing company and market investors, Stock issuance price is still unreasonable. The high issuance price of shares encouraged the equity financing of enterprise.

### ***23.4.2 Return on Equity is not Reasonable***

According to the original intention of stock issuance, investors have faith to the development of enterprise in the future, then they buy the stock of this enterprise, investors Hope to get bonus, send stocks to have a good return on investment. But China's listed enterprise rarely share out bonus to return equity investors, Fu (2009) analyze the cash share out bonus situation of China listed enterprise, in 2008 China enterprise cash dividends rate is 55 %,

only 17 enterprises share out bonus For 7 years, there are only 7.1 % enterprises share the bonus more than ¥0.3 per share. China's stock market attracts more and more Chinese enterprises, because they can a large financing, and do not need to pay reasonable investment returns for financing, this also makes the equity financing preference.

### ***23.4.3 Bond Market is Underdeveloped***

Compare with the rapid development of the stock market, development of the bond market is slow in China, 2007 securities regulatory commission published the pilot provisions of corporate bond issuance, a formal corporate bond market has set up. As a newly established market, bond market has a series of defects: bond price is not decided by the market, there has no authority rating agency in the market, bond varieties is rare, bond exchange is not very convenient. An undeveloped bond market is another reason for equity financing preference.

## **23.5 Conclusion**

Through the analysis of 8 medium commercial banks of China, the result shows that the financing activity of medium commercial banks do not following the peaking order, there is strong equity financing preference in the financing activity. There are three reasons of this situation: first, a standard issue pricing system has not set up in China's stock market, second, return on equity is not reasonable and third, bond market is underdeveloped. To solve the problem, the government should standard issued stock market, establish the company dividends system and develop corporate bond market. A financial market is a health market when investors can get a reasonable return.

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# Chapter 24

## The Balanced Scorecard Application in Performance Evaluation of H Equity Fund Company

Wei Zhang, Yu Zhang and Yong-jun He

**Abstract** This paper, starting from how performance evaluation and strategic management connect to each other, reveals the meaning and importance of building a strategy-oriented performance management, proposing the basic principle and advantage of introducing balanced scorecard in the performance evaluation. The following step is to analyze the company's current situation and strategic target on the H equity fund company, by PEST analysis, Porter five forces analysis and SWOT analysis, to build a 4-areas evaluation method, decide the weights by AHP method in credibility assessment taking the investment operation department's core leaders for instance, finally design a performance evaluation method for H equity fund company by fuzzy evaluation method, which could provide a basis for reward and punishment policy, staff training and promotion in this company.

**Keywords** Balanced scorecard · Strategy · Performance evaluation · Fund company · Fuzzy evaluation

### 24.1 Introduction

The capital market of China, owing to the deeper implementation of socialism market economic system and global economic and trade integration, has been grown fast these years. It is showed that China has become the most active

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investment market in Asia, while the internal and external environment is being through severe changes, and the competition between equity fund companies will be fiercer. So there has been an urgent problem for PE fund companies that, how to optimize the strategy oriented performance evaluation system, hence turn the strategy to quantifiable indicators, dynamically manage the whole process and achieve the strategy targets, to make sure the company is operated steadily. Balanced scorecard is an improved version of evaluation system on financial indicators, is a comprehensive management and evaluation system for company achievements. It is a nice exploration to introduce balanced scorecard into a PE equity fund company for the performance evaluation.

## **24.2 Strategy Oriented Performance Evaluation Theory and Balanced Scorecard Method**

China's economic development has been fast, competition between firms has also been fiercer, to gain the initiative and long-last core competition, the firms will face a transition with development strategy and function orientation. Consequently, strategy oriented performance evaluation management has been an important issue. Balanced scorecard theory shows distinctive advantage in the combination of company strategy and performance evaluation management.

### ***24.2.1 The Relationship Between Strategic Target and Performance Evaluation***

#### **1. Company strategy and strategic target**

Company strategy is a general designation for various strategies for companies, there are many of them, while the basic principles are similar, they are all plans and strategies for the basic issues of the company about integrity and long-term. There are two impact factors for making company strategy; the first one is the goal and planning (Brignall and Ballantine 2004), which contains three contents of goal, core value and willingness. This is also the basic part for a company when it was funded. The second factor is external environment. Company strategy reflects the level that the company is going to reach in a certain time period; it could be qualitative or quantitative. There will be a quantitative benchmark or a time limitation for a strategic target, normally 3–5 years or longer (Freeman and Reed 1983; Bonn 2001; Thomapson et al. 1999), and a strategy will be the actual act for the target.

#### **2. Performance evaluation**

Performance evaluation is a systematic project. With the goal to achieve the early strategic target, the company will evaluate stuffs by performance and

achievement, by using special indicator and appropriate method, and will make positive lead for stuffs future work. It is basically divided into achievement evaluation and behavior evaluation (Gang and Guang-jin 2011).  
Goal of performance evaluation: to make objective evaluation for stuffs, to stimulate the initiation of every stuff, give them the chance to show their talent, improve the cohesion of company, in the same time to improve the quality and efficiency of stuffs, to enhance the whole company’s performance.

24.2.2 Principle and Advantages of Balanced Scorecard Method

1. Definition

The goal of balanced scorecard is to seek for balance, to seek the balance between short-term and long-term targets, financial indicated and non-financial indicated performance, backward and forward indicators, the needs of internal growth and external client. It is the important method for comprehensive evaluation and control of the company strategy (Huang 2007). There are four perspectives for balanced score method, which are financial, customer, internal business processes, learning and growth. The frame is shown in Fig. 24.1.

24.2.3 Advantages of Balanced Scorecard

This paper chooses balanced scorecard method to be the PE equity fund company performance evaluation tool for reason, compared with the traditional method with financial indicator, this method has obvious advantages. Key performance indicator (KPI) method starts with company’s strategic goal, formulate indicators about key perspectives of work and achievements for top to bottom, conform these to be a performance evaluation and management system (Kaplan 1993). Table 24.1 shows the advantages of balanced scorecard.

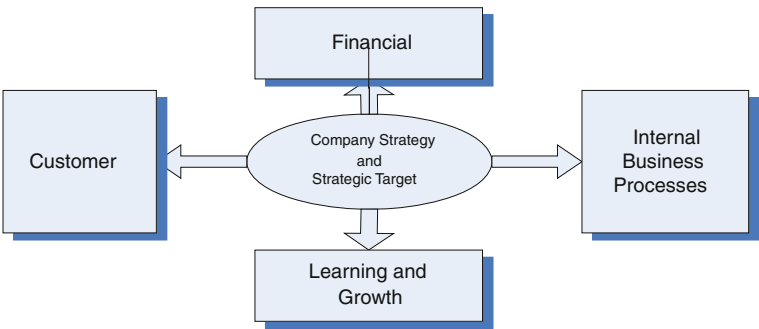


Fig. 24.1 Frame of balanced scorecard

## 24.3 Building Balanced Scorecard Performance Evaluation System in H Equity Fund Company

### 24.3.1 *Brief Introduction for H Company and its Strategic Target*

#### 1. Company overview

H equity investment Fund Company is co-established by A technology investment management Co.LTD and H partner company, contains remarkable numbers of doctors, masters and experienced stuffs with background in project management, capital acquisition and fund raising. This company concentrates on digital media industry in Great China region, with some first-class international enterprises as its strategic investors, such as IBM, McGraw-Hill, Disney and Sierra Ventures. H partner is committed to promote the creative concept of digital innovations, provide values way bigger than money for talented enterprisers. H partner invested several high-tech firms such as Beijing Lingtu, DMG digital group etc.

#### 2. Company strategic target

paper uses PEST analysis to analyze political, economic, social, cultural and technological factor of H company; I also use Porter five forces model on peer competition, threat from new comers, threat from alternatives, provider competition and applier competition; on the other hand, I apply SWOT analysis in company strategy choosing, after analyze the strength, weakness, opportunity and threat (Jian-hua 2007), I conclude the company should have long-term strategy target as below:

1. The framework of human resource: build a framework with matrix flat structure, develop an advanced human resource system of training, management, evaluation and rotation to cater the company's status. Enhance the training efforts, make relationship with performance and rewards, build a team capable to do business, marketing and management, improve both individual and enterprise value.
2. Build reputation and standardize the business: make the business more standard and process, emphasis on high-tech projects with independent intellectual property rights, high market capacity, high industry initiation and capital operation theme, provide professional value-add service, make effort in building reputation and being an industry leader.

### 24.3.2 Application of Balanced Scorecard in H Company Performance Evaluation

#### 1. Definiting the strategy targets

The purpose of balanced scorecard is to combine both the building and implementation of H company strategy, to achieve the target. So the premise should be building clear strategy. The company should first make short-term and long-term goals, then evaluate stuff performance with four perspectives in balanced scorecard method. Concentration and indicators will be different according to different scales and positions.

#### 2. Picking the key indicator-taking investment operation department core leaders as an example

H company is structured with creative investment department, investment operation department, fund business department, management department and financial department, each department contains senior level (president, vice president), middle level (manager for each department) and junior level (senior investment manager, investment manager, investment manager assistant, secretary), which are shown in Table 24.2. Each department has different strategic target, so there are unique 4-perspective indicators for each of them. For example, by propose a full voting in investment operation department's junior level, we have impact factors for those 4 perspectives in Fig. 24.2.

#### 3. Decision of AHP weight on credibility assessment

In fuzzy comprehensive evaluation method, different weights could lead to very different results. This paper decides each weight by AHP method based on credibility assessment to make the result more objective and appropriate.

Reference (Jiao and Zha 2005) uses AHP method to decide matrix weight interval  $w'_j = (w_j - \Delta_1 w_j, w_j + \Delta_2 w_j) = (u_1, u_2)$ . And then according to the principle of fuzzy set-valued statistics processing interval, substitute confidence coefficient of evaluation experts and the indicator interval  $(u_1, u_2)$  into this equation to get indicator weight  $W_i$ 'based on credibility assessment, normalize to be factor indicator weight  $V_i$ .

$$w'_i = \frac{1}{2} \frac{\sum_{k=1}^q r_k [(u_2^k)^2 - (u_1^k)^2]}{\sum_{k=1}^q r_k [(u_2^k) - (u_1^k)]}$$

$$V_i = w'_i / \sum_{i=1}^n w'_i \quad (i = 1, 2, \dots, n)$$

#### 4. Evaluate stuffs by fuzzy evaluation method

From Fig. 24.2 we could know that, the indicator for H company evaluation would be financial X1, customer X2, internal business processes X3, learning and growth X4, financial perspective has impact factor of  $x_{11}, x_{12}, x_{13}$ ; customer perspective has impact factor of  $x_{21}, x_{22}, x_{23}$ ; internal business processes

**Table 24.1** Contradistinctions of 3 different performance evaluation methods

Contradistinctions	Balanced scorecard	KPI	Traditional method
Basic idea	Whole perspectives	Key performance	Financial indicator
Main application objects	Enterprise, departments, teams	Enterprise, departments, teams	Enterprise, departments, teams
Business difficulty	The more complex the better	Relatively independent	Relatively independent
Effect to business	Benefit the value chain building	Make the key point and direction stand out	No obvious effect
Building idea	In the view of strategy, by different perspectives	In the view of strategy, from top to bottom	Totally based on financial indicators
Building method	Goals-perspectives-indicators	List the key indicators	According to the previous year financial statement
Number of indicators	15–20	5–8	3–5
Difficulty	Form hard to simple	Hard	Simple
Effect to the company	To the strategy	To the processes	To the management method
Time response	Target oriented	Target oriented	Previous year performance oriented
Comparability	Vertical	Vertical and partial horizontal	Vertical and horizontal
Side effect	Effect to management system	Let the job not comprehensive	Lead to short-term act
Effect to performance	Help achieve breakthroughs	Improvement in some fields	Just in financial data

perspective has impact factor of  $x_{31}$ ,  $x_{32}$ ,  $x_{33}$ ; learning and growth perspective has impact factor of  $x_{41}$ ,  $x_{42}$ ,  $x_{43}$ . This paper use fuzzy method to evaluate these impact factors (Dongqing and Yuancheng 2009; Qiu 2010). First step is to build a fuzzy evaluation indicator set:  $U = \{u_1, u_2, u_3, \dots, u_q\}$ ; build the set as  $V = \{v_1, v_2, v_3, \dots, v_n\}$ . Then start the single-factor fuzzy evaluation, solve the

fuzzy evaluation matrix FR:  $FR = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ r_{q1} & r_{q2} & \dots & r_{qn} \end{bmatrix}$ ,  $r_{ij}$  are the degrees of

membership of  $u_i$  to  $v_j$ . Decide indicator weights for each fuzzy evaluation,  $A = \{a_1, a_2, a_3, \dots, a_q\}$ , by the AHP method in 3.2.3. In a traditional AHP method, the matrix of determination is  $A = (a_{ij})_{m \times n}$ ; finally we have the comprehensive evaluation:  $B = A \cdot FR = \{b_1, b_2, \dots, b_n\}$ .

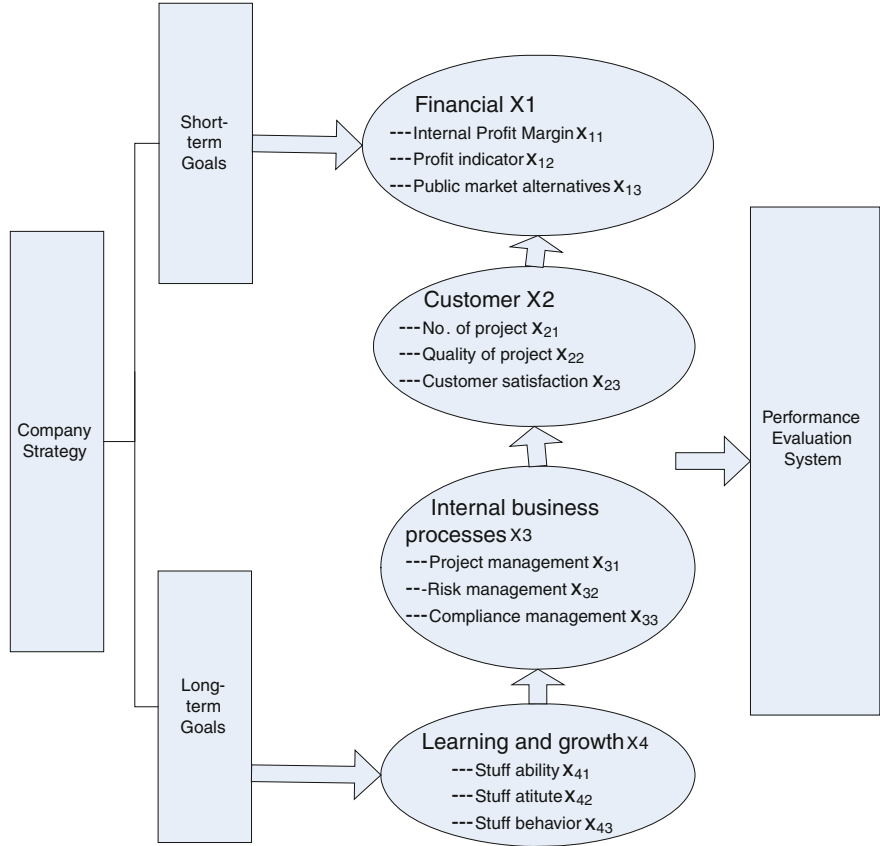


Fig. 24.2 Investment operation department performance evaluation indicators

Table 24.2 Level dividend in H equity investment company

Lv.	Senior		Middle	Junior	
Stuffs of H company	President	Vice president	Manager	Senior investment manager	Creative
				Investment manager Assistant	Investment Dpt.
		Vice president	Manager	Senior investment manager	investment
				Investment manager Assistant	Operation IDpt.
			Manager	Senior investment manager	Fund
				Investment manager Assistant	Business Dpt.
			Manager	Secretary Administrator	Management Dpt.
			Manager	Accountant	Financial
				Cashier	Dpt.

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# Chapter 25

## The Determinants of Shareholder Value Efficiency in Chinese Commercial Banks

Chun-hong Zhao and Yi-yong Xu

**Abstract** This paper introduces comprehensive factors to study their influence on shareholder value efficiency of China's four state-owned commercial banks and 10 joint-stock commercial banks. An empirical analysis found that capacity to expand income, liquidity risk, asset size, loan growth, concentration in the banking industry, GDP per capita significantly enhance the ability to create value for shareholders of the commercial banks, and operational risk, leverage ratio result in significant adverse effects. Finally proposals are offered to enhance shareholder value efficiency of Chinese commercial banks.

**Keywords** Commercial banks • Efficiency • Performance • Shareholder value

### 25.1 Introduction

After joint-stock reform and listing of China's commercial banks, from the creation of shareholder value perspective to study the bank efficiency becomes very necessary, but such research is less, so this paper from the shareholder value perspective study China's commercial banks efficiency in order to promote capability of China's commercial banks in the creation of shareholder value.

Banking efficiency [e.g. Berger (1993), Beccalli (2004), Berger et al. (2009)] and shareholder value [e.g. O'Hanlon and Peasnell (1998), Garvey and Milbourn (2000)], the two research areas have a wealth of research results, there are also a number of studies on shareholder value of banks [e.g. Boyd and Gertler (1994)]

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Heffernan and Fu (2008), Gao and Fan (2003), Zheng and Pan (2006)], but stays at the level of corporate governance and management accounting. This paper attempts to make its own contribution to combination study of bank efficiency and bank shareholder value for commercial banks in China.

With the growing number of commercial banks listed in China, it brings new opportunities to the bank study, namely the introduction of the capital market evaluation for banks to better study of bank performance. The situation in China and Europe is similar in the small number of listed banks relative to unlisted banks, is not conducive to empirical research. To solve this difficulty, (Fiordelisi 2007) uses EVA concepts and methods, so that non-listed banks can refer to the listed bank's capital market evaluation, to address this difficulty in some extent. This paper draws on the research to study factors influencing the shareholder value efficiency of China's commercial banks, to make certain contributions to the introduction of capital market evaluation to studies on bank performance in China.

Foreign banks' performance has focused on the introduction of a variety of influencing factors, in order to do more comprehensive analysis of the impact on bank performance factors and mechanisms, domestic study of banks' performance also pays attention to this trend, but the factors are not relatively comprehensive and systematic (Brissimis et al. 2008; Athanasoglou et al. 2008; Fiordelisi and Molyneux 2010). This paper introduces factors from the bank characteristic factors (including the efficiency factor, risk factors and other factors such as bank size, growth rate of deposits, loan growth, etc.), industry characteristics factors (such as market concentration), macro-economic factors (such as per capita GDP) in order to be more comprehensive and deeper understanding of the impact of these factors on banks for shareholder value creation capacity and their mechanism of action, on this basis to provide the appropriate recommendations to enhance the commercial banks ability to create value for shareholders.

## 25.2 Methodology

Firstly, EVA is used as the measure of a bank shareholder value [see Guo et al. (2010)]. Bank EVA calculation is by the bank's net after-tax operating profit minus the cost of capital, EVA used in shareholder value efficiency research, compared to general financial indicators, an advantage is it better restores the financial position out of the manipulation of accounting profits, another advantage is it puts the opportunity cost of invested capital into the scope of the study will help to examine whether commercial banks given the input and output conditions, create value for the banks' shareholders at the maximum extent. Secondly, using the stochastic frontier approach (SFA), followed by bank shareholder value efficiency measure [see Guo et al. (2010)], the greater the efficiency value of the Bank the stronger capacity of it to create value for its shareholders. Finally, the introduction of more comprehensive factors, empirical research on bank shareholder value efficiency.

## 25.3 Empirical Research

The following will be the empirical analysis on factors influencing bank shareholder value efficiency to examine the actual impact of the factors on shareholder value efficiency of commercial banks in China, and analysis of its impact mechanisms.

### 25.3.1 Model Setting and Indicator Selection

According to China's commercial banks, with reference to previous studies to build shareholder value efficiency of Chinese commercial banks influence factor model (Fiordelisi and Molyneux 2010):

$$\begin{aligned} \psi - eff_{i,t} = & \alpha_0 + \chi x - eff_{i,t} + \delta \tau - eff_{i,t} \\ & + \phi ID_{i,t} + \varphi \ln(CRL)_{i,t} + \eta \ln(OR)_{i,t} + \varpi MR_{i,t} + \lambda LEV_{i,t} \\ & + \theta LIQ_{i,t} + \vartheta \ln(BAS)_{i,t} + \mu ADGR_{i,t} + \nu ALGR_{i,t} \\ & + \rho CONC_{m,t} + \varsigma \ln(GDPP)_{m,t} + \varepsilon_{i,t} \end{aligned}$$

where subscript  $i$  denotes the cross-sectional dimension, the subscript  $t$  denotes the time dimension;  $\psi - eff$  is bank shareholder value efficiency<sup>1</sup>;  $x - eff$  is cost efficiency<sup>2</sup>;  $\tau - eff$  is revenue efficiency;  $\pi - eff$  is profit efficiency;  $ID$  is the measure of income diversification: non-interest income/net operating income;  $CRL$  denotes unexpected credit risk losses: impairment losses on loans/loans;  $OR$  is the measure of operational risk:  $0.15 \times (\text{the banks' total income 3 years before})/3$ ;<sup>3</sup>  $MR$  is market risk indicators: investment in securities/total assets;  $LEV$  is the measure of leverage: total debt/equity capital;  $LIQ$  is the exposure to liquidity risk: deposit to loan ratio = loan/deposit;  $BAS$  is bank size: the total assets;  $ADGRA$ ,  $ALGR$  is respectively the deposit growth rate (the difference between the individual bank deposit growth rates relative to the industry benchmark) and loan growth rate (the difference between the individual bank loan growth rates relative to the industry benchmark);  $CONC$  is the banking sector concentration: the Herfindahl–Hirschman index is that the square of the market share of all bank loans and the smaller the index, loan market more competitive, using the Herfindahl–Hirschman index of loan market is because the loan is China the main business of commercial banks, the field of competition and profit sources;  $GDPP$  is per capita for the year;  $\varepsilon_{i,t}$  is random error.

<sup>1</sup> This paper uses economic value added (EVA) as the measure of value creation by a commercial bank for its shareholders, and the use of the stochastic frontier approach (SFA) measures the shareholder value efficiency of Chinese commercial banks.

<sup>2</sup> In this paper, the SFA method (stochastic frontier approach) estimates of revenue, cost and profit efficiency of Chinese commercial banks.

<sup>3</sup> In accordance with Basel Agreement 2006: operational risk in Basic Indicator Approach.

**Table 25.1** Descriptive statistics of sample data

Variable	Observation	Mean	Standard deviation	Min	Max
$\psi - eff$	184	0.888943	0.125288	0.00000021	0.986778
$x - eff$	184	0.969832	0.020274	0.8799874	0.995021
$\tau - eff$	184	0.908273	0.035142	0.7915303	0.960334
$\pi - eff$	184	0.673545	0.272918	0.0000718	0.957222
<i>ID</i>	184	0.112075	0.108379	-0.0833244	0.531801
<i>CRL</i>	152	0.007241	0.004038	0.0006097	0.024751
<i>OR</i>	139	4,306.362	5,818.85	102.655	29,182.15
<i>MR</i>	184	0.18742	0.084449	0.0022677	0.38761
<i>LEV</i>	184	4.930455	243.6001	-3,267.392	83.64115
<i>LIQ</i>	184	0.654605	0.134741	0.3785732	1.579011
<i>BAS</i>	184	1420,279	1,924,264	12,258.8	9,757,146
<i>ADGR</i>	169	0.079926	0.230898	-0.5420685	1.083957
<i>ALGRA</i>	169	0.08895	0.25898	-0.483898	1.251846
<i>CONC</i>	184	0.2044603	0.0707397	0.1378762	0.442687
<i>GDP</i>	184	11,301.93	5,530.342	5,045.7	23,707.7

The data comes from the Bankscope database, China Financial Yearbook (1994–2008) and annual report of the banks, the sample contains four state-owned commercial banks and 10 joint-stock commercial banks. Including the Agricultural Bank of China, Bank of China, China Construction Bank, Industrial and Commercial Bank of China, Bank of Communications, CITIC Bank, Everbright Bank, China Merchants Bank, Minsheng Bank, Guangdong Development Bank, Huaxia Bank, Industrial Bank, Pudong Development Bank, Shenzhen Development Bank. Table 25.1 shows the descriptive statistics of the variables of the sample.

### 25.3.2 Inspection and Analysis of Empirical Results

Efficiency factors control the unobservable heterogeneity, and so directly using the least squares regression estimation (Xu et al. 2009).

See from the empirical results (see Table 25.2), the significant positive impact on bank shareholder value efficiency are revenue diversification, asset size, the banking industry concentration, per capita GDP, indicating that income expansion capability, interest income expansion, the expansion of asset size, the rise of the banking industry concentration, the per capita GDP growth are significantly in favor of the increment of bank shareholder value efficiency, liquidity risk is also a significant positive impact that the size of China commercial bank credit compared to deposit scale is restrained, so raising the loan-to-deposit ratio will increase bank shareholder value efficiency; operational risk, leverage, loan growth brought more significant negative impact on bank shareholder value efficiency, suggests that increased operational risk caused by business expansion, too fast the development

**Table 25.2** The empirical and robustness results of bank shareholder value efficiency

Variable	(1) $\psi - eff$	(2) $\psi - eff$	(3) $\psi - eff$	(4) Evarate
$x - eff$	-0.199 (0.446)			0.0399 (0.216)
$\tau - eff$	1.048** (0.433)		1.031** (0.441)	0.247*** (0.0928)
<i>ID</i>	0.288** (0.141)	0.210* (0.116)	0.287** (0.130)	0.0333 (0.0288)
$\ln(CRL)$	-0.00857 (0.0130)	-0.0246 (0.0165)		0.00551 (0.00418)
$\ln(OR)$	-0.164*** (0.0343)	-0.138*** (0.0320)	-0.159*** (0.0311)	-0.000639 (0.00916)
<i>MR</i>	0.0181 (0.0906)	-0.0196 (0.107)		-0.0269 (0.0193)
<i>LEV</i>	-2.25e-05*** (6.39e-06)	-2.37e-05*** (6.81e-06)	-2.08e-05*** (5.48e-06)	8.38e-07 (1.29e-06)
<i>LIQ</i>	0.515*** (0.127)	0.512*** (0.132)	0.496*** (0.110)	-0.0487 (0.0352)
$\ln(BAS)$	0.0972*** (0.0336)	0.0844** (0.0325)	0.0931*** (0.0275)	-0.000964 (0.00898)
<i>ADGR</i>	0.0597 (0.0512)	0.0515 (0.0515)		0.0335** (0.0130)
<i>ALGR</i>	-0.108** (0.0492)	-0.100** (0.0496)	-0.0727** (0.0303)	-0.0396** (0.0168)
<i>CONC</i>	2.438** (1.223)	1.807 (1.416)	2.607** (1.153)	-0.0604 (0.301)
$\ln(GDPP)$	0.193* (0.106)	0.149 (0.118)	0.189* (0.100)	-0.0131 (0.0241)
$\pi - eff$		0.109** (0.0475)		
Constant	-2.612** (1.196)	-1.489 (1.396)	-2.694** (1.061)	-0.0444 (0.324)
Observations	125	125	139	125
R-Square	0.605	0.588	0.599	0.160

Note Figures in brackets are robust standard deviation; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ ; evarate is bank shareholder value return on assets; (1) regression results for the original model, (2), (3), (4) for the robustness test model regression results

of liability business, compared to the industry average loans may give the bank more risk of loss; other factors are not significant.

Respectively using profit efficiency to replace revenue efficiency and cost-efficiency, deleting not significant factors and using bank shareholder value return on assets to replace bank shareholder value efficiency for robustness analysis (respectively, are shown at 3, 4, 5 columns in Table 25.2), the empirical result of original model has strong robustness.

## 25.4 Conclusion

By introducing more comprehensive impact factors this paper focus on the empirical analysis of shareholder value efficiency of commercial banks in China, and put forward the following policy recommendations to help Chinese commercial banks to enhance shareholder value efficiency: firstly, enhance the ability to obtain revenue, proper control of operating costs to avoid revenue growth to a lack of stamina; secondly, adjust the income structure, focusing on non-interest income business, appropriate development of the securities investment business, to prevent the market risk arising from participation in market investment; thirdly, control of financial leverage, moderate pursuit of growth in deposits; fourthly, moderate expansion of the scale of assets, strengthen the prevention of operational risk; fifthly, liquidity of commercial banks in China is relatively abundant, but the loan should be moderate growth; sixthly, promote the banking concentration to reduce, prevent banks from by virtue of relative monopolistic market forces to gain higher net interest and other benefits, for the benefits of banks to improve their operation; seventhly, concern about the macroeconomic environment changes, such as the economy for the better may be appropriate to increase the scale of business for our shareholders to profit, on the contrary should be timely to compress the size of credit, to prevent large-scale credit risk.

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# Chapter 26

## The Empirical Research of the Relationship on Underlying Stock Volatility Before and After Convertible Bonds Issue in China

You-zhi Zeng

**Abstract** A common problem of pricing models for the convertible bond is that the pricing efficiency is not high. One of important reasons is that the model parameter estimation is not accurate. At present, the historical volatility of the underlying stock after the convertible bond issue which is suitable for pricing models can't be calculated directly in China. However, the volatility before the convertible bond issue can be calculated accurately. The paper has deduced the relationship between the before volatility and the after volatility, so the after volatility which is suitable for pricing models in China can be calculated directly and accurately.

**Keywords** Convertible bonds issue · Pricing efficiency · The underlying stock volatility · The relationship

### 26.1 Introduction

The convertible bond is an extremely complex financial derivative, whose value depends on the underlying stock price (Brennan and Schwartz 1977; McConnell and Schwartz 1986). A parameter estimate which is extremely necessary and important for almost all convertible bonds pricing models is the volatility estimation of the underlying stock (Paul and Sam 1995; Greiner et al. 2002). It should be implied volatility; however, due to the imperfection of Chinese capital market, implied volatility can't be obtained. Then the historical volatility of the underlying stock after the convertible bond issue (referred to as the after volatility) is used to replace the implied volatility. The convertible bond is a long-term bond, which

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means the pricing volatility should also be a long-term historical volatility. But time after convertible bonds issue is generally short, so the data for the underlying stock volatility estimation are insufficient and a real long-term historical volatility of the underlying stock after convertible bonds issue can't be got directly. While time before convertible bonds issue is so long that there are enough data for the historical volatility of the underlying stock before the convertible bonds issue (referred to as the before volatility). Convertible bonds issue have an impact on the underlying stock volatility and there is a certain relationship between the before volatility and the after volatility. Thus, we can calculate the after volatility, by calculating accurately the before volatility and their relationship. The purpose and significance of this article are:

- The Purpose1: Make sure the average impact which is made by China convertible bonds issue on the volatility of the underlying stock;
- The Purpose2: Calculate the specific relationship  $\sigma_A = f(\sigma_B)$ ,  $\sigma_A$  means the after volatility,  $\sigma_B$  means the before volatility, the same below.

Precisely calculate the after volatility to improve the pricing efficiency of models.

## 26.2 Literature Review

At present, people who research the underlying stock volatility of China convertible bonds are mainly Chinese scholars and therefore the literatures are also limited to Chinese literatures. Existed empirical conclusions for purpose 1 are generally consistent: convertible bonds issue decline the volatility of the underlying stock. Zheng and Lin (2004): Convertible bonds issue had an impact on volatility, reducing the volatility of the underlying stock. Other related research conclusions were similar. There are also exceptions, Wu (2006) researching the closing price of the underlying stock before and after the convertible bond issue, got the conclusion: Convertible bonds issue had no impact on the volatility of the underlying stock. Existed empirical conclusions for purpose 2 are not consistent. Zheng and Lin (2004) further got the relationship between the before volatility and the after volatility is  $\sigma_A = \sigma_B - 5\%$ . (Lai et al. 2008), by researching the impact of 30 Convertible bonds issue on the underlying stock volatility, got the conclusion:  $\sigma_A = \sigma_B - 17.3\%$ . Wu (2006) further get the relationship is  $\sigma_A = \sigma_B$ , which meant the inherent trend of stock volatility did not change with the convertible bond issue and listing. To sum up, the relationship between the before volatility and the after volatility is very inconsistent, which would loss the pricing efficiency of models. Thus, it's very important to deduce the relationship correctly based on the convertible bond market data.

## 26.3 Data and Estimation Method

### 26.3.1 Data Principle and Data Source

In order to estimate the volatility accurately, one of the keys is to find a suitable estimation time period. Too long, the estimation of volatility may be different from the actual situation of volatility; too close, the estimated accuracy is not good. For stock data, it is better to use the time period of 90–180 days (Wang and Wu 2001; Fang and Fan 2001; Gong and He 2006).

Based on the above data principle, the data source is the historical data of the underlying stock of 19 currently listed convertible bonds in Chinese convertible bonds market during three corresponding time periods before and after convertible bonds issue. The three corresponding time periods are 150, 112 and 90 days.

### 26.3.2 Volatility Estimation Method

Actually, the volatility of the underlying stock is the standard deviation of the daily return of the underlying stock in a fixed time period. So we can get the following formula (Tsiveriotis and Fernandes 1998; Ho and Lee 1986; Kwok and Lau 2001):

$$\hat{\sigma} = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (u_i - \bar{u})^2} \times \sqrt{N}, \quad u_i = \ln \frac{S_t}{S_{t-1}}, \quad \bar{u} = \frac{\sum_{i=1}^n u_i}{n}, \quad n \text{ is the sample size, } u_i \text{ is}$$

the logarithm of daily return rate.  $\bar{u}$  is the arithmetic mean of  $u_i$ ,  $S_t$  is the daily closing price of the underlying stock,  $N$  is the number of trading days in one year. In this paper,  $N = 242$ .

## 26.4 Empirical Test and Relationship Deduced

### 26.4.1 Empirical Test

Based on above volatility estimation formula and the original data, following table can be gotten. If the underlying stock data of the corresponding time period are not enough, the corresponding form is vacant (Ke and Li 2012; Zhu and Zhang 2011). In the table, average value means the average volatility of the underlying stock during three corresponding time periods before and after the convertible bond issue. The average difference is the arithmetic mean of the volatility of the underlying stock during three corresponding time periods. The calculation formula of difference is the before volatility minus the after volatility.

**Table 26.1** The volatility summary table

Abbreviation	The before and after Volatility						Average value	
	150 $\sigma_B$	150	112	112	90	90	$\sigma_B$	$\sigma_A$
Xin Gang	0.72	0.66	0.75	0.71	0.67	0.70	0.72	0.69
Bo Hui	0.50	0.40	0.48	0.41	0.50	0.37	0.49	0.39
Shuang Lang	0.48	0.50	0.46	0.49	0.48	0.50	0.48	0.49
Ge Hua	0.34	0.28	0.33	0.24	0.31	0.24	0.32	0.25
Hai Yun	0.32	0.34	0.33	0.32	0.33	0.34	0.33	0.33
Guo Tou	0.32	0.27	0.29	0.24	0.31	0.25	0.31	0.25
Shi Hua	0.26	0.17	0.26	0.16	0.26	0.15	0.26	0.16
Chuan Tou	0.41	0.34	0.35	0.29	0.33	0.30	0.36	0.31
Zhong Hai	0.32		0.32	0.25	0.32	0.26	0.32	0.26
GuoDian	0.21		0.22		0.23	0.20	0.22	0.20
Cheng Xing	0.67	0.59	0.67	0.60	0.69	0.63	0.68	0.61
Zhong Hang	0.20	0.23	0.19	0.23	0.18	0.23	0.19	0.23
Gong Hang	0.18	0.20	0.20	0.24	0.19	0.23	0.19	0.22
ShenJi	0.24		0.26	0.21	0.25	0.20	0.25	0.20
Tang Gang	0.66	0.57	0.65	0.53	0.63	0.50	0.65	0.54
Mei Feng	0.33	0.32	0.33	0.33	0.34	0.35	0.33	0.33
Zhong Ding	0.47	0.45	0.47	0.46	0.47	0.46	0.47	0.46
Yan Jing	0.31	0.25	0.35	0.27	0.33	0.29	0.33	0.27
JunLun2	0.54		0.50	0.45	0.52	0.46	0.52	0.45
The average difference	0.041		0.043		0.036		0.040	

Primary data source DaZhiHui software

From the above table, the purpose 1 is achieved. Impact made by China convertible bonds issue on the volatility of the underlying stock is about 3.5–4.5 %, which can be gotten from the last line of the Table 26.1.

**26.4.2 Relationship Derivation**

The data for the relationship derivation are the last two row data in Table 26.1. Based on the data and Eviews 7.0, the scatterplot can be gotten. In Fig. 26.1, “BEFORE” means  $\sigma_B$ , “AFTER” means  $\sigma_A$ . the same below.

The before volatility and the after volatility show good linear relationship in the scatter plot and next is regression analysis.

In Table 26.2, the coefficient of determination is 0.92332 and the F-distribution value is 204.6995 which is significantly greater than the critical value  $F_{0.05}(1, 17) = 4.45$ , Which mean the overall regression equation is a linear significance. The t- distribution value is 14.30732 which is significantly greater than the critical value  $t_{0.025}(17) = 2.110$ , Which means regression equation coefficient is significant. Next, test whether residuals meet the regression assumptions. First, test residuals independence with D-W statistic. In Table 26.2, DW statistic is

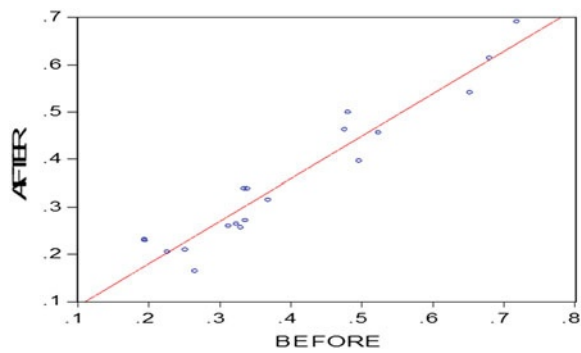


Fig. 26.1 Volatility scatterplot

Table 26.2 Regression analysis table

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000989	0.026628	0.037160	0.9708
Before	0.896495	0.062660	14.30732	0.0000
R-squared	0.923320	Mean dependent var		0.355103
Adjusted R-squared	0.918809	S.D. dependent var		0.150247
S.E. of regression	0.042811	Akaike info criterion		−3.364721
Sum squared resid	0.031158	Schwarz criterion		−3.265306
Log likelihood	33.96485	Prob(F-statistic)		0.000000
F-statistic	204.6995	Durbin-Watson stat		2.269457

Dependent Variable: AFTER

Method: Least Squares

Date: 05/23/12 Time: 20:24

Sample: 1 19

Included observations: 19

2.269457 and  $d_u = 1.28$ ,  $4 - d_u = 2.72$ , so residuals are independent. Second, test heteroscedasticity with White statistic Table 26.3.

Judging from the accompanying probability of white statistic, in the 5 % significance level, accept the null assumption: the same variance. Last, test residuals normality with residuals histogram and Jarque–Bera statistic (Fig. 26.2).

Although residuals histogram is not very standard for the bell-shaped, Judging from the accompanying probability of Jarque–Bera statistic which is 0.580659, in the 5 % significance level, accept the null assumption: residuals fit the normal distribution.

Table 26.3 White heteroskedasticity test

F-statistic	0.188948	Prob. F(2,16)	0.8296
Obs*R-squared	0.438398	Prob. Chi Square(2)	0.8032

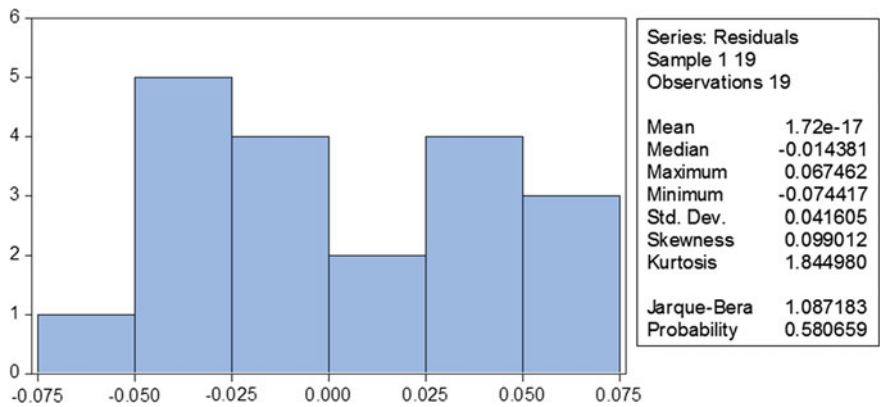


Fig. 26.2 Residuals normality test

In summary, the purpose 2 is achieved, which means the relationship between the after volatility and the before volatility is  $\sigma_A = 0.8965 \sigma_B + 0.001$ .

26.5 Conclusions

By researching the historical volatility of the underlying stock during three corresponding time periods before and after China convertible bonds issue, get the following two conclusions:

- The average impact made by China convertible bonds issue on the historical volatility of the underlying stock is decreasing volatility by 3.5–4.5 %;
- The relationship between the after volatility and the before volatility is  $\sigma_A = 0.8965 \sigma_B + 0.001$ .

**Acknowledgments** This work is supported by the study fund of the Philosophy and Social Science Project in Beijing, NO: sz201210037024.

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# Chapter 27

## The Empirical Study on the Correlation between Equity Incentive and Enterprise Performance for Listed Companies

Xiao-feng Hui and Shan-shan Zou

**Abstract** In order to study the correlation between equity incentive and enterprise performance, the listed companies which executed equity incentives from 2009 to 2010, are taken as samples in this essay. After taking stock prices and macro-economic factors into consideration, the correlation between stock option incentive and enterprise performance is researched by analysis of principal component and multiple regression. The result shows that there is no significant correlation between equity incentive and enterprise performance.

**Keywords** Enterprise performance · Equity incentive · Executive · Stock price

### 27.1 Introduction

As the equity of company is changing scattered and the technology of management becomes increasingly complex, companies carry out equity incentive in ways of stock options, in order to incite the management personnel and innovate on incentives. Equity incentive has been thought as the “Golden Key” in solving the principle-agent problems of companies in the late 20th century. It makes great efforts to improve the performance of companies and the working efficiency of management. As equity incentive was introduced late in china, lots of methods have been proposed to improve the effect of Stock option incentive plan in listed

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companies. Because of financial crisis in 2008, the share price fell in the listed companies, which made the market value of the shareholders' equity shrink dramatically. The public, including shareholders, began to call incentives of high salary and high equity into question. To managers, the executive price was higher than share price for some parts of the Stock options. Some companies announced to terminate the projects of equity incentive which were implemented before. Taking WANGKE as an example, there was some relation between equity incentive and share price, which resulted in two failures during 3 years.

It is different from previous studies that this essay takes the market factors into consideration. As the change of share price, which can affect the equity incentive, cannot be separated from the studies, the available remuneration for executives, which benefits from equity incentive, is made as explanatory variable in this essay.

Different from previous studies, this paper discusses whether equity incentive can make efforts in firm performance or not by adopting the changes of the share price, which makes the research more practicable.

## 27.2 Investigatory State

The study of Hall and Liebman (1998) has showed that there is a positive correlation between the remuneration of the executives and firm performance by analyzing relational data from 475 companies between 1980 and 1994 in the USA. W-type relationship is revealed between managerial holdings and the value of the enterprise by Huimin and Mak (2002), which is deeply influenced by industry-factor. The research by (Davies et al. 2005) has indicated that there is non-linear relationship between the value of the enterprise and managerial holdings.

The related research in china began at the end of the 1990s. As is shown by the paper of Li (2000), there is no obvious positive correlation between the shareholding proportion of senior managers and the performance of the companies. The result studied by (Gu and Zhou 2007) showed that no obvious effect is made by introducing equity incentive. The research by Xiang and Wen (2010) has meant that human capital property ought to be conferred on the managers and benefits should be given to them if the company wished to improve the efficiency.

From what has been discussed above, there are considerable differences between equity incentive and enterprise performance from domestic and foreign researches. The result which was studied before held the opinion that there was positive correlation between equity incentive and enterprise performance, while the recent research holds the opposite view that there is no obvious correlation or non-linear relationship between the two factors, particularly after the split share structure reform was executed in china.

27.3 Sample Selection and Data Sources

27.3.1 Sample Selection

The sample data of this paper is selected from the listed companies with the implementation of China’s equity incentive plan between 2009 and 2010. The companies mentioned in the essay are the implemented China A-share listed ones, which has already been approved by the SFC after the implementation plan (draft) of equity incentive was announced between 2006 and 2008 (China Securities Regulatory Commission 2006). The listed company, which has suspended or cancelled the original incentive plan, are not included in the range mentioned in the paper, though the companies have already published the implementation plan or been proved by SFC before. Neither of those whose equity incentive plans were asked to revises after SFC announced ≪ Listed company equity incentive memorandum 1, 2, 3 ≫ ; (China Securities Regulatory Commission 2008). That leads to the rejection against the ones of ST and PT. Consequently, the number of the sample about China A-share listed companies selected by this paper is 30 in the total.

The Sample data comes from RESSET financial researching database of Juyuan Royce and Data Technology Co. Ltd, information of listed companies assigned by SFC and “CNINFO” which uses in publishing announcement and annual report.

27.3.2 Variable Design

1. Dependent Variable

The performance of the management is comprehensively evaluated by four aspects in this paper, which includes investment and profit, profitability, debt paying ability, and growing capability. Then, nine specific indicators in Table 27.1 are selected from the four aspects.

2. Independent Variable

When market factors are considered, the changes of share price have an influence upon the effect of equity incentive. The Earnings generated by equity incentive (SY) is regarded as equity incentive effect in this paper, which is used in studying the influence that the equity incentive has exerted on the performance of the listed companies.

Table 27.1 Dependent variable

Investment and profit	Profitability	Debt paying ability	Growing capability
Earnings per share $X_1$	Earnings ratio on equity (weight) $X_3$	Current ratio $X_6$	Growth rate of earnings per share $X_8$
Equity per share $X_2$	Return rate of assets $X_4$ Net interest of assets $X_5$	Quick ratio $X_7$	Growth rate of operating earnings $X_9$

**Table 27.2** Control variable

	Variable symbol	Variable name
Control Variable	GDP	Regional GDP growing rate
	MAR	Marketization degree Fan et al. 2006
	GQ5	Share ratio of the top five shareholders
	SIZE	The natural logarithm of the sample companies' assets
	DE	Assets debt ratio

### 3. Control Variable

The five targets in Table 27.2 are selected as control variable.

## 27.4 Model Construct

### 27.4.1 Composite Scoring Model of Enterprise Performance

The nine targets mentioned above are analyzed though principal component analysis.

$$p_1 = a_{11}X_1 + a_{12}X_2 + \cdots a_{1n}X_n \quad (27.1)$$

$$p_2 = a_{21}X_1 + a_{22}X_2 + \cdots a_{2n}X_n$$

...

$$p_m = a_{m1}X_1 + a_{m2}X_2 + \cdots a_{mn}X_n$$

$$P = \delta_1 p_1 + \delta_2 p_2 + \cdots + \delta_t p_t$$

Variable definitions:

- $p_i$ : The  $i$  principal component
- $a_{ij}$ : Standardized eigenvector
- $X_j$ : Standard normal random variable of the  $j$  financial indicators
- $\delta_i$ : Weights of the variable contribution rate about every principal component
- $P$ : Comprehensive evaluation of the enterprise performance

### 27.4.2 Performance Evaluation Model of Equity Incentive

The empirical model of performance evaluation about equity incentive

$$P = \alpha + \beta_1 SY + \beta_2 DDBL + \beta_3 GDP + \beta_4 MAR + \beta_5 DE + \beta_6 GQ5 + \beta_7 SIZE + \varepsilon \quad (27.2)$$

- $\alpha$ : Constant term
- $\beta_i$ : Coefficient of regression
- $\varepsilon$ : Stochastic error

## 27.5 Empirical Model

### 27.5.1 Descriptive Statistics

The statistical data below in Table 27.3 are managerial ownership ratio, the size of the company, growth rate of regional GDP in the sample.

The data in Table 27.3 shows that, the total assets of the enterprise manifested an increasing trend. However, with the size of the business expanding, the growth rate of regional GDP reduced by a small margin firstly, and rose up in 2010. The stock-keeping ratio of managers reduced in 2009, while the ratio rebounded in less amplitude in 2010. The maximum of the ratio was 57.364 %, while the minimum was 0.0001 %, with a great disparity among the proportion of shareholding. Moreover, the ownership ratio was pretty low, with the ones below 1 % occupying the most, the ones below 5 % standing more than half, and the ones overtopping 5 % holding less than 30 %. The reasons may be as follows: firstly, managerial ownership ratio is limited by relevant provisions. In china the ratio is 10 %. Secondly, Equity incentive plan of listed companies is circumspectly designed, resulting in weak intensity.

### 27.5.2 Analysis on Principal Component

The analysis on principal component is as follows:

Three principal components, whose accumulative contribution rate is up to 72.728 %, are extracted in the study. What is shown in the list reveals that the information of each variable can be well explained by the principal components.

The entrepreneurial integrated performance can be obtained through principal component.

$$P = 43.626P_1 + 15.646P_2 + 13.455P_3 \quad (27.3)$$

**Table 27.3** Descriptive statistical results

	Share proportion for senior executive					Total assets of the business	Growth rate of regional GDP
	Mean	Maximum (%)	Minimum (%)	Below 1 %	1–5 %		
2008	0.085	57.364	0.001	56.7	16.7	6293702217	0.114
2009	0.076	57.364	0.001	53.3	20	8465475666	0.113
2010	0.082	54.421	0.0001	46.7	16.7	9459194604	0.129

**Table 27.4** Anova

Model	Sum of squares	df	Mean square	F	Sig.
Regression	934749.030	6	155791.505	7.419	.000
Residual	1742920.401	83	20999.041	—	—
Total	2677669.431	89	—	—	—

### 27.5.3 Multivariate Regression Analysis

Regression analysis is carried out based on the result above and the model.

The simulation degree of the model in Table 27.4 is 34.9 %, while test value Sig. of F is 0.000, which is less than significance level 0.05. The regression equation is remarkable through significance test.

The result shows in Table 27.5 that the VIF of explanatory variables is below 1.5, which reveals that multicollinearity problems among explanatory variables are well solved.

Taking significant level of 0.05 into consideration, the *t* test value of assets debt ratio is Sig. = 0.00 < 0.05, with a negative coefficient, which indicates that assets debt ratio has a negatively correlation with enterprise performance. The Sig. of firm size is equal to 0.01(<0.05), with a coefficient of 46.316, which demonstrates that positive relation exists between firm size and enterprise performance, that is to say, a larger firm size makes the enterprise performance much better. The profit generated by equity incentive, ownership concentration and macroeconomic factors do not pass through significance test, with the Sig. being greater than 0.05, which demonstrates that there is no significant linear relation among the three factor above and the enterprise performance. Although the GDP growth of macroeconomic factors has no effect on the growth of enterprise performance, the regression coefficient of MAR is positive. Furthermore, Sig. is close to 0.05, which manifests that a higher degree of regional market-oriented helps to promote the Enterprise Performance more effectively.

**Table 27.5** Coefficients

Model	Unstandardized coefficients		Standardized coefficients		t	Sig.	Collinearity statistics	
	B	Std. error	Beta				Tolerance	VIF
(Constant)	−869.13	346.190	—		−2.51	0.014	—	—
GDP	−127.75	818.336	−0.016		−0.16	0.876	0.788	1.270
MAR	25.514	13.233	0.188		1.928	0.057	0.828	1.207
DE	−699.30	123.026	−0.649		−5.68	0.000	0.682	1.461
SIZE	45.430	16.8745	0.302		2.692	0.009	0.699	1.401
GQ5	67.545	119.209	0.059		0.567	0.573	0.725	1.379
SY	4.54E−9	0.000	0.014		0.145	0.885	0.878	1.138

Equity incentive, whose regression coefficient is positive, does not pass the significance test. That is to say, there is no significant linear correlation, but slightly positive effect, between equity incentive and enterprise performance.

## 27.6 Conclusion

As is shown by the result of regression testing in the paper, when the effect of stock price is considered, there is no obvious positive correlation between equity incentive and enterprise performance. In other words, equity incentive which is directed to the management personnel makes less effect on enterprise performance. Simultaneously, there is no obvious correlation between macroeconomic factors and enterprise performance. Nevertheless, it is shown by regression results that high market-oriented degree helps improving the enterprise performance. In addition, the larger the scale of the company is, the better the enterprise performance can be.

## 27.7 Analysis and Suggest

The reasons why the equity incentive has no obvious correlation with enterprise performance are as follows:

Firstly, imperfect markets of securities weaken the correlation between stock prices and enterprise performance.

The validity of the securities market is the theoretical premise of the full utility about the equity incentive. There is high correlation between the effect of equity incentives and share price. As the securities market is not standardized, the change of the share price is influenced and restricted by many factors, such as macroeconomic element, political environment, government policies, and so on (Chen 2003). The Operating conditions of the company go against the market prices of the secondary Securities. That is to say, good business performance may lead to a fall in stock, while poor business performance could have a rise in stock (Lasfer and Faccio 1999). The capital market is difficult to be seen as a barometer of corporate performance in terms of low quality of listed companies, lack of independence and transparency in intermediaries and government intervention in the stock market (Holdemess et al. 1999). Moreover, it is full of difficulty for capital market to monitor the enterprise. Equity incentive is hard to play a role without the change of this condition. Even though the share reform solves a major institutional problem on the development of China's capital market, the low efficiency of the Chinese stock market has still weakened the association between stock prices and corporate performance, which makes equity incentive go far away from its proper role.

Secondly, the managers' self-serving behavior

Many factors are taken by share manipulating in management hierarchy for personal gain, (Himmelberg et al. 1999) such as imperfect mechanism of market supervision, and serious asymmetry of information. Moreover, the management hierarchy gains higher income from exercise price difference in the way of raising the exercise stock of the company in the capital markets by non-normal means, which leads to difficulty in achieving the original intention on equity incentive.

Thirdly, it will take several periods for the economy to recover after financial crisis. Although the economy during the period of financial crisis in China was also suffered a strike, GDP growth remained at a relatively high level. However, the performance of listed companies did not show a high growth, and some even lost. What is discussed above leads to the result that the macroeconomic variables do not pass the significant test.

So, the capital markets in china, especially the stock market, should be improved constantly, which is the premise for the effective implementation of equity incentive. Only in the standard stock market can the investor have a place for the smooth flow of equity, which can also keep the capital flowing freely between investors.

And, a perfect structure should be built for corporate governance. The structure for corporate governance is the internal assurance for the implementation of equity incentive (Wang and Cheng 2009). A perfect structure for corporate governance is able to restrict the right belonging to senior executives, which keeps the equity incentive far away from being the benefit tool for the senior executives.

Finally, the listed companies ought to establish a scientific and efficient system for performance evaluation. During the period of performance evaluation, a variety of financial indicators should be taken synthetically (Yu 2006). Not only the profitability of the company ought to be examined, but the development and the Operation Capability of the company should also be considered. Only in this way can the executives be guided on long-term profits, and ensure the availability of effective incentive for listed companies.

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# Chapter 28

## The Impact of Information Asymmetry on Liquidity Basing on the MEM Model

Hua Guo and Yang Liu

**Abstract** Considering the characteristic of China stock market, we use the order imbalance index to measure the level of market's information asymmetry, and apply the MEM model to depict the dynamic of liquidity. Basing on the SSE constituent index from 2010 high-frequency tick by tick transaction data, we research the impact of order imbalance; trading volume and volatility on liquidity from the perspectives of relative spread and market ask and bid depth. The result shows that market liquidity exhibits the feature of intensive aggregation, and is negatively correlated with market's information asymmetry and volatility, but in positive correlation to trading volume.

**Keywords** Aggregation · Liquidity · MEM · Order imbalance

### 28.1 Introduction

Liquidity is concerned to the efficiency and stability of financial market, it could ensure a smooth transaction and achieving the function of price discovery. The reason changing the level of liquidity is always the significant point in microfinance area, and current research shows that liquidity is effected by the macro-economic, middle and microcosmic factor, including policy change, company attribute, market microstructure and investor behavior respectively. And the impact of microcosmic factor is the most direct and fundamental among them,

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so we can explore the mechanism of liquidity movement from the point of microcosmic factor. The essence of microcosmic factor is to reveal the information in the incomplete market. Because the purpose of setting the market microstructure is to promote the melt of information into price, and to improve information transparency, besides in order to reduce the influence of information asymmetry and to estimate the value of property, the investors update their information all the time by learning, and the results of the game would be reflected in the price behavior directly. So we take the information asymmetry of financial market as the fundamental reason that affects the level of liquidity. At present lots of research prove that information is concerned with market liquidity. Admati (1998) finds that liquidity traders would reduce trading with informed traders so as to avoid the losses of adverse selection, which cause a big change of liquidity. Manganelli (2005) and Dufour and Engle (2000) are unanimous that the increase of trade intensity is related to the informed trade. Easley and Hara (1992), Easley et al. (1996) finds that the change of trade volume contains information, the increase of volume indicates the existence of informed trade, and the level of volume is positively related to the probability of informed trade. Lin (1995), Madhavan (1997) and Huang (1997) extract the cost of adverse selection by decomposing spread from the point of trade cost, which prove that liquidity is affected by market information. Mu et al. (2004) shows that the spread in Shanghai stock market have a high degree of cost of adverse selection. Yang et al. (2002) uses the cost of adverse selection as the index of information asymmetry and finds market depth is negatively correlated with market's information asymmetry.

The research above certify the market information have influence on liquidity, but never consider the feature of nonlinear autocorrelation caused by the aggregation of liquidity which will interfere the explanatory ability of exogenous variables. Therefore, in order to investigate the impact of information on liquidity exactly, we make a difference from the previous studies, taking the order imbalance index as the measure of Information symmetry, and using multiplicative error model (MEM) constructed by Engle (2002) to model the intraday spread and market ask and bid depth so as to depict the aggregation of liquidity.

## 28.2 Econometric Models

### 28.2.1 Basic Model

MEM is introduced by Engle (2002) who discusses this approach as a general framework based on GARCH Bollerslev (1986) type models to model any kind of non-negative series with the feature of aggregation. The key of the model is that the inter-temporal dependence of variables can be described by their conditional mean. Let  $\{x_t\}$  denote a non-negative time series. Then, the MEM for  $x_t$  is given by

$$x_t = \mu_t \varepsilon_t \quad (28.1)$$

$$\mu_t = E(x_t | F_{t-1}), \quad (28.2)$$

where  $F_{t-1}$  denotes the information set up to  $t-1$ ,  $\mu_t$  is the conditional mean of  $x_t$ , and  $\varepsilon_t$  is error term, which is a unit mean, i.i.d. variable process defined on non-negative support with the density function written as  $f(\varepsilon_t)$ .

The MEMs vary with different conditional means and density functions. Basic MEM( $p, q$ ) specification is given by

$$\mu_t = \omega + \sum_{i=1}^p \alpha_i x_{t-i} + \sum_{j=1}^q \beta_j \mu_{t-j}, \quad (28.3)$$

where

$$\omega > 0; \alpha_i \geq 0 (i = 1, \dots, p); \beta_j \geq 0 (j = 1, \dots, q).$$

Moreover, MEM( $p, q$ ) depends on distribution of  $\varepsilon_t$ . If letting  $\varepsilon_t$  follows exponential, Weibull and Gamma distribution, we can get EMEM( $p, q$ ), WMEM( $p, q$ ) and GMEM( $p, q$ ) respectively. Also the parameters in MEM can be estimated by MLE method (maximum likelihood estimation) based on the distribution of  $\varepsilon_t$ .

## 28.2.2 Argument Model

Market liquidity always exhibits the feature of aggregation by the reason of separating big orders, herd behavior of investors. In order to investigate the impact of intraday information asymmetry on liquidity, we apply order imbalance to measure the level of information asymmetry, then use MEM to model the aggregation of relative spread, ask and bid depth. Considering liquidity is also influenced by trading activity and market risk, we introduce trading volume and realized volatility Anderson and Bollerslev (1998) (RV), together with order imbalance(OI) into Eq. 28.3 as exogenous variables. Because liquidity has a strong intraday periodicity, we firstly apply smoothing spline Engle and Russell (1998) method to remove the intraday periodicity of relative spread and market's depth series denoted by  $x_t$ , moreover get the periodic factor denoted by  $d_t$  and the adjusted series  $x_t/d_t$ . Letting  $p = q = 1$ , the model is:

$$\tilde{x}_t = x_t/d_t \quad (28.4)$$

$$\tilde{x}_t = \mu_t \varepsilon_t \quad (28.5)$$

$$\mu_t = \omega + \alpha \tilde{x}_{t-1} + \beta \mu_{t-1} + \theta_1 Vol_{t-1} + \theta_2 RV_{t-1} + \theta_3 OI_{t-1}. \quad (28.6)$$

Assuming  $\varepsilon_t$  follows a Weibull (1,  $\gamma$ ) Zhang et al. (2011) distribution, the density function is given by

$$f(x) = \begin{cases} \gamma(\Gamma(1 + 1/\gamma)x)^{\gamma-1}e^{-(\Gamma(1+1/\gamma)x)^\gamma}, & x \geq 0 \\ 0 & x < 0 \end{cases}, \quad (28.7)$$

where  $\Gamma(\bullet)$  is the Gamma function. Furthermore the associated logarithm likelihood function is given by

$$L = \sum_{t=1}^N \left[ \ln\left(\frac{\gamma}{\tilde{x}_t}\right) + \gamma \ln\left(\frac{\Gamma(1 + 1/\gamma)\tilde{x}_t}{\mu_t}\right) - \left(\frac{\Gamma(1 + 1/\gamma)\tilde{x}_t}{\mu_t}\right)^\gamma \right]. \quad (28.8)$$

## 28.3 Empirical Results

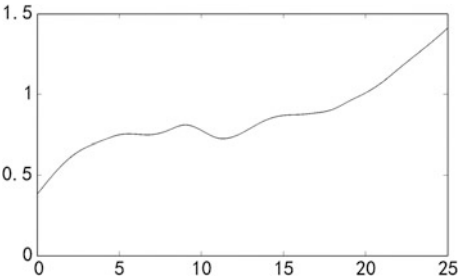
### 28.3.1 Data

The econometric model discussed in the previous section is tested on a sample of SSE constituent index. The data are taken from the CSMAR tick-data database and cover the period from Jan. 4, 2010 to Oct. 12, 2010. Picking off the adjusted and data missing stocks, there are 141 stocks left. The relative spread and depth of each stock are first diurnally adjusted to take out the intraday periodicity. This is accomplished by using a smoothing spline to regress the relative spread, bid and ask depth on the time of day. The spline has 24 knots corresponding to each 10 min of the trading time, which refer to 9:30, 9:40, 9:50, ..., 14:50, 15:00. The order imbalance, trade volume and RV in each 10 min are also counted. Then we average the whole sample's adjusted relative spread and depth, order imbalance, trade volume and RV of each knot respectively to get the market level of these variables, the descriptive statistic of which is showed in Table 28.1. The Figs. 28.1, 28.2, 28.3 exhibit intraday pattern of relative spread, ask and bid depth of stock 600,029.

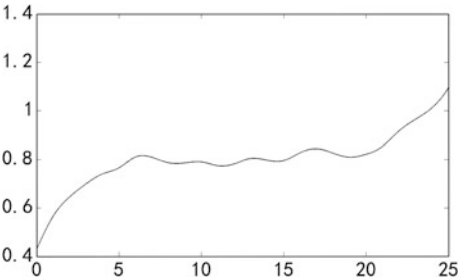
**Table 28.1** Descriptive statistic of each variable

	Mean	Standard deviation	Skewness	Kurtosis
Order imbalance	19.2820	15.0238	1.0420	3.9306
Volume( $\times 10^6$ )	1.7530	1.8199	4.8355	48.7121
RV	0.0045	0.0027	7.7253	115.5617
Adjusted spread	0.9822	0.1308	0.1142	2.8643
Adjusted bid depth	0.9756	0.7649	2.1845	9.7565
Adjusted ask depth	0.9615	0.5446	1.6550	7.6173

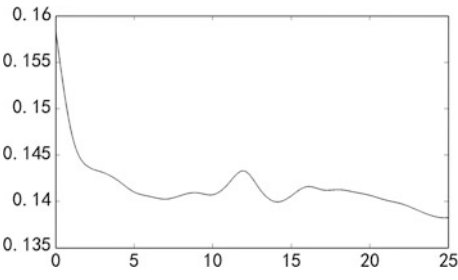
**Fig. 28.1** Intraday pattern of bid depth



**Fig. 28.2** Intraday pattern of ask depth



**Fig. 28.3** Intraday pattern of relative spread



**28.3.2 Results**

On the basis of data preprocessing above, this section further investigates the effect of market information asymmetry on the liquidity by using MEM to model the dynamic of relative spread, ask and bid depth respectively, and then estimates the parameters in Eqs. 28.4 28.5, 28.6 by MLE method with chaos algorithm. The parameter estimates are presented in Table 28.2.

$\alpha + \beta > 0.85$  in Table 28.2 indicate that the aggregation of the relative spread and the ask and bid depth in China stock market are strong, and the MEM model can well capture the characteristics of liquidity aggregation. The parameter estimates mostly have a significant positive and negative on the 1 % confidence level, which indicate that the order imbalance, trading volume and realized volatility have crucial and dynamic impacts on the market liquidity at intraday 10 min level. The result that the relative spread increases and the ask and bid depth reduce when

**Table 28.2** Argumed mem parameter estimates

	Relative spread	Bid depth	Ask depth
$\omega_0$	-0.5948***	0.1073***	0.0950***
$\alpha$	0.6419***	0.6553***	0.6502***
$\beta$	0.3258***	0.2080***	0.2021***
$\theta_1$	-0.0162**	0.1481***	0.1654***
$\theta_2$	2.5232**	-2.0067***	-5.3219***
$\theta_3$	0.1205***	-0.0158**	-0.0746***
$\gamma$	9.9961***	2.7810***	3.0670***
$L$	-4,641.7953	-884.2886	-1,051.2158

*Note* \*\*\*, \*\*, \* are significant on the 1, 5, 10 % confidence level

the previous order imbalance increase, shows the rational uninformed traders in China Stock market are able to judge the informed traders' behavior, and then take action to raise the ask price and reduce the bid price, revoke or limit no orders, in order to refuse supplying free option for informed traders and avoid adverse selection losses. For the controlled variables such as trading volume and RV, when the level of trading volume in the previous period raise, the relative spread decreases and the ask and bid depth increase, which indicate a positive correlation relationship between trading activity and liquidity. These may be due to behavior of retail investors who are irrational and playing a dominant role in China stock market always represents obvious herding effect, which cause the raise of liquidity when market transactions become active and more traders are involved in the transactions. When the previous market volatility raise, the relative spread increases and the ask and bid depth reduce, which show a negative correlation between the level of market liquidity and volatility. The reason may be that the risk-averse investors will reduce the level of liquidity supply at market risk rising period for reducing risk exposure and losses which result in the decrease of market depth, or they raise ask price and reduce the bid price to get amount of risk compensation causing the relative spread increased.

## 28.4 Conclusion

This paper has presented the MEM to model the dynamic of relative spread, ask and bid depth for the first time, and finds that liquidity in China stock market has exhibited the feature of aggregation intensely. Based on this finding, we take order imbalance index, which is used to measure the level of information asymmetry timely, together with trading volume, RV as exogenous variables to study how liquidity is influenced by information asymmetry, and finds that information asymmetry factor is negative related to liquidity, while trading volume and RV are in positive correlation to liquidity remarkably. It thence appears that strengthening

the information disclosure mechanism and reducing the level of information asymmetric are effective ways to improve market liquidity, which also provides some reference to the regulatory authorities.

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# Chapter 29

## The Implied Cost of Capital: Based on Chinese Listed Companies

Hui-guo Sun

**Abstract** This paper estimates the implied cost of capital inferred from a valuation model of Chinese A-share listed companies and also considers its validity. The implied cost of capital is “expected returns on capital investment” from the shareholders’ point of view, and it has the advantage of revealing more information and mitigating measurement error from the firm level. This paper assesses the quality of alternative ICC estimates and finds that GGM and CT reflect risk more appropriately.

**Keywords** Multivariate analysis • Pooled regression • Risk factors • The implied cost of capital

### 29.1 Introduction

In recent years, the implied cost of capital (ICC) offers an alternative for estimating a company’s cost of capital and a proxy for expected returns. ICC has the advantage of avoiding noise in realized returns. Traditional approaches to inferring the cost of capital, such as capital asset pricing model(CAPM) or a three-factor model of Fama and French (1992, 1993), use realized returns to estimate the cost of capital, and are “unavoidably imprecise” summarized by Fama and French (1993). Accounting researchers have developed many different ICC models in the literature and have used these models to assess the effects of disclosure quality, earnings quality on the cost of equity capital and so on. However, how to evaluate

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the quality of the measures is still a question, especially in China. Some researchers have only used one of the methods. For example, Li and Hui (2008) study the relationship between the firms' information publishing and the cost of capital. But in China. But researchers seldom declare why they choose the method and illustrate its validity.

Since there are alternative models to estimate the implied cost of capital which are various assumptions. I am interested in which of them is the most appropriate to estimate a cost of capital. This paper compares the following major eight models, which are labeled GLS, CT, GGM, OJN, EP, PEG, MPEG and AGR. (1) GLS is a model described in Gebhardt et al. (2001); (2) CT is a model proposed by Claus and Thomas (2001); (3) GGM is a model based on a Gordon Growth Model by Gordon and Gordon (1997); (4) OJN is a model suggested by Ohlson and Juettner-Nauroth (2005); (5) EP, PEG, MPEG and AGR are based on an abnormal earnings capitalization model proposed by Easton (2004).

Lee et al. (2010) evaluate seven models of implied cost of capital, and they find that there are two approaches to evaluating the quality of ICC estimates: one can compare the ICC estimates' correlation with perceived risk proxies, such as beta, leverage, B/M, volatility, or size, and they are superior if they have a significant correlation with the risk factors consistent with expected signs. This paper focuses on the implied cost of capital of Chinese A-share listed companies and uses the approach to evaluating its validity. Kitagawa and Goto (2011) and Botosan and Plumlee (2011) also use the methods.

## 29.2 The Implied Cost of Capital

The implied cost of capital is the internal rate of return that makes an asset's market value equal the present value of its expected future cash flows. And the methods are all from dividend discount formula (the Eq. 29.1). With various assumptions, the eight models have yield different results.

$$p_0 = \sum_{i=1}^{\infty} \frac{E_0(dps_i)}{(1+r)^i} \quad (29.1)$$

These models are divided into two categories: residual income models, and abnormal earnings growth models. GLS, CT and GGM are residual income models, while OJN, EP, PEG, MPEG and AGR are abnormal earnings growth models.

### 29.2.1 GLS Model

The Eq. (29.2) expresses GLS model.

$$\begin{aligned}
p_0 = b_0 + \sum_{i=1}^3 \frac{eps_i - r_{GLS}b_{i-1}}{(1 + r_{GLS})^i} \\
+ \sum_{i=4}^{11} \frac{E_0(roe_i - r_{GLS})b_{i-1}}{(1 + r_{GLS})^i} + \frac{E_0(roe_{12} - r_{GLS})b_{11}}{r_{GLS}(1 + r_{GLS})^{11}}
\end{aligned} \quad (29.2)$$

$p_0$  is the stock price at time 0,  $b_i$  is the book value at time  $i$ ,  $roe_i$  is forecasted roe at period  $i$ ,  $eps_i$  is forecasted earnings per share at period  $i$  and  $r_{GLS}$  means the implied cost of capital. In the first three years, forecasted earnings are used, while from 4 to 12 year, each firm's forecasted roe is defined as industry median or industry average. This paper uses industry average as forecasted roe from 4 year. This model is used in many literature, such as Easton and Monahan (2005), Guay et al. (2011).

### 29.2.2 CT Model

CT is a model proposed by Claus and Thomas (2001) and can be represented by Eq. (29.3).

$$p_0 = b_0 + \sum_{i=1}^T \frac{ae_i}{(1 + r_{CT})^i} + \frac{ae_T(1 + g)}{(r_{CT} - g)(1 + r_{CT})^T} \quad (29.3)$$

$$\begin{aligned}
ae_i &= eps_i - b_{i-1} * r_{CT} \\
g &= r_f - 3\% \\
T &= 4
\end{aligned} \quad (29.4)$$

$r_{CT}$  is the implied cost of capital.  $r_f$  is the risk-free rate. And the others are same as GLS model. A few researchers use this model, for example, Easton and Monahan (2005) use it.

### 29.2.3 GGM Model

GGM is a model based on a Gordon Growth Model by Gordon and Gordon (1997). It can be expressed by Eq. (29.5).

$$p_t = \sum_{i=1}^{T-1} \frac{dps_{t+i}}{(1 + r_{GGM})^i} + \frac{eps_{t+T}}{r_{GGM}(1 + r_{GGM})^{T-1}} \quad (29.5)$$

$r_{GGM}$  is the implied cost of capital and  $T = 5$ . Generally, this model belongs to residual income models, however, Lee et al. (2010) think it's a Gordon growth model. This paper follows the majority.

### 29.2.4 OJN Model

This model is developed by Ohlson and Juttner-Nauroth (2005) and also implemented in Gode and Mohanram (2003). The Eq. (29.6) represents this.

$$r_{OJN} = A + \sqrt{A^2 + \frac{eps_1}{p_0}[g - (\gamma - 1)]} \quad (29.6)$$

Now,  $g = \frac{eps_2 - eps_1}{eps_1}$ ,  $A = \frac{1}{2} \left[ (\gamma - 1) + \frac{dps_1}{p_0} \right]$  and  $\gamma$  the long-term growth rate defined as the current period's risk-free rate minus 3 %.  $r_{OJN}$  is the implied cost of capital.

### 29.2.5 AGR, EP, MPEG and PEG Model

These models have the same sources from Easton (2004).

AGR model is like Eq. (29.7).

$$p_0 = \frac{eps_1}{r_{AGR}} + \frac{agr_1}{r_{AGR}^*(r_{AGR} - \delta agr)} \quad (29.7)$$

where,  $agr_1 = eps_2 + r_{AGR}^*dps_1 - (1 + r_{AGR})^*eps_1$ ,  $agr_2 = eps_3 + r_{AGR}^*dps_2 - (1 + r_{AGR})^*eps_2$ , and  $\Delta agr = \frac{agr_{t+1}}{agr_t} - 1$ .  $r_{AGR}$  is the implied cost of capital.

In Eq. (29.7), if  $\Delta agr = 0$ , then we get MPEG model:

$$r_{MPEG} = \sqrt{\frac{eps_2 + r_{MPEG}^*dps_1 - eps_1}{p_0}} \quad (29.8)$$

$r_{MPEG}$  is the implied cost of capital.

If we get  $dps$  equal to zero, then the Eq. (29.9) expresses PEG model.

$$r_{PEG} = \sqrt{\frac{eps_2 - eps_1}{p_0}} \quad (29.9)$$

**Table 29.1** Descriptive statistics

	N	Mean	Median	S.D.
AGR	3,207	0.0575	0.0353	0.0767
EP	5,866	0.0425	0.0336	0.0368
MPEG	2,726	0.137	0.1167	0.0885
PEG	3,599	0.1337	0.1116	0.0952
OJN	2,766	0.1489	0.1277	0.0909
GGM	3,736	0.0954	0.0664	0.1081
GLS	2,058	0.1436	0.047	0.2077

$r_{PEG}$  is the implied cost of capital. However, some researchers like Botosan and Plumlee (2005) estimate  $r_{PEG}$  with Eq. (29.10). This paper uses Eq. (29.9) to estimate it.

$$r_{PEG} = \sqrt{\frac{eps_5 - eps_4}{p_0}} \tag{29.10}$$

Then if  $agr = 0$ , then  $r_{EP}$  is given by Eq. (29.11).

$$r_{EP} = \frac{eps_1}{p_0} \tag{29.11}$$

The models mentioned above are used in this paper to estimate the implied cost of capital of Chinese A-share listed companies and also to consider their validity.

## 29.3 Results

### 29.3.1 Descriptive Statistics

Table 29.1 displays the descriptive statistics of the sample firms. The sample is Chinese A-share listed companies, which are nonfinancial companies and non-ST listed companies. All data of this paper are from RESSET Database, CSMAR Database of China.

As for the implied cost of capital in AGR, the mean and median which are 5.75 and 3.53 %, are almost equal to that of EP model, which are 4.25 and 3.36 %. GGM mode has higher values which are 9.54 and 6.64 %. The other models, including PEG, MPEG, OJN and GLS, have close mean values. But their median values are not close.

**Table 29.2** Multiple regressions

	AGR	EP	MPEG	PEG
bm	0.0081	−0.0033	−0.0085	−0.0142 <sup>a</sup>
(+)	(1.17)	(−1.46)	(−0.97)	(−1.77)
lev	0.0336 <sup>c</sup>	−0.00006	0.0768 <sup>c</sup>	0.0931 <sup>c</sup>
(+)	(4.05)	(−1.62)	(7.47)	(11.61)
Size	0.0017	0.0056 <sup>c</sup>	−0.0016	−0.0038 <sup>b</sup>
(−)	(1.17)	(11.03)	(−0.88)	(−2.19)
Beta	0.0014	−0.0117 <sup>c</sup>	−0.0038	−0.0213 <sup>c</sup>
(+)	(0.21)	(−5.08)	(−0.45)	(−2.79)
Adj	0.256	0.221	0.197	0.167
R2				

a, b, c indicate significance at the 1, 5, and 10 % level

**Table 29.3** Multiple regressions

	OJN	GGM	GLS	CT
bm	−0.0049	0.0407 <sup>c</sup>	0.113 <sup>c</sup>	0.0096
(+)	(−0.54)	(4.18)	(4.52)	(1.05)
lev	0.0931 <sup>c</sup>	0.0642 <sup>c</sup>	−0.0935 <sup>c</sup>	0.0914 <sup>c</sup>
(+)	(8.88)	(5.58)	(−3.33)	(8.76)
Size	−0.0023	−0.0106 <sup>c</sup>	0.0062	−0.0104 <sup>c</sup>
(−)	(−1.21)	(−5.33)	(1.27)	(−5.48)
beta	−0.0048	−0.0098	0.0370	−0.0143
(+)	(−0.56)	(−1.05)	(1.63)	(−1.61)
Adj	0.182	0.115	0.192	0.072
R2				

a, b, c indicate significance at the 1, 5, and 10 % level

### 29.3.2 Multivariate Analysis

As stated in the previous section, I compare the implied cost of capital using the following methods. I compare the signs of coefficients and explanatory power of the models by estimating a multiple regression. Tables 29.2 and 29.3 report the results. Table 29.2 reports the results of AGR, EP, MPEG and PEG, and Table 29.3 reports the results of OJN, GGM, GLS and CT.

Here, I choose risk factors below: market beta (beta), leverage, book-to-market ratio (bm) and size. Prior studies shows beta, bm and leverage are expected to have positive sign, while size with negative sign.

Tables 29.2 and 29.3 show that the adjusted-R square (AdjR2) of AGR is the highest, 25.6 %. However, only coefficients of leverage have expected signs and significant values. As for OJN and MPEG, also only one risk factor has expected signs and significant values, respectively. The result also shows two risk factors have significant values for CT, GLS and EP, but only that of CT have expected signs. This means that CT is the best of the three. According to the result, three

risk factors, including bm, leverage and size have expected signs and significant values. And for GGM, the adjusted-R square is only 11.5 %, which is higher than that of CT. So GGM and CT appear to be advantageous, and GGM is the best if we take the adjusted-R square into account. However, this is different from other studies. Kitagawa and Goto (2011) find that the PEG ratio and the modified PEG ratio show a significant correlation in consistency with the expected sign.

## 29.4 Conclusion

In this paper, I estimate the implied cost of capital of Chinese A-share listed companies. Many models have been proposed to estimate the implied cost of capital. However, there is little consensus on which models performs best (Chen et al. 2011), so this paper introduces the models and evaluates them.

One criteria to evaluate the models is that variables have the expected signs and the R-square is high in the multiple regression model. This paper uses four risk factors including beta, leverage, size and book-market-ratio as independent variables, ICC as dependent variable. This paper finds that GGM and CT reflect risk factors most appropriately.

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# Chapter 30

## The Influence of Corporate Governance and Independent Audit on the Cost of Debt

Biao Yu, Tao-ying Peng and Xin Liu

**Abstract** Using a sample of non-financial A-share listed companies in Shenzhen and Shanghai stock exchange between 2008 and 2010, this paper empirically analyzes the influence of corporate governance and independent audit on the cost of debt. The research found that both high-level of corporate governance and high-quality audit supervision can significantly reduce the cost of debt. And there exists a substitution effect between corporate governance and independent audit in affecting debt costs, that is to say, improve the level of corporate governance to reduce the cost of debt only established when audit quality is low, and does not hold in high audit quality. The research show that improves the level of corporate governance and audit quality is of great significance in solving financing difficulties for the enterprise.

**Keywords** Audit quality · Corporate governance · Substitution effect · The cost of debt

### 30.1 Introduction

The level debt cost is an important factor that affect the feasibility of external financing, higher cost will not only decrease financing and profit ability of the company, but also affect its growth performance and long-term development. In modern enterprises, the conflict of interests and information asymmetry among share holders, managements and creditors, caused by the separation of ownership and management, make creditors facing non- diversifiable systemic risks. To avoid loss, they often make adverse selections, leading companies have difficulty in

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financing by the way of debt, or ask for higher return on debt investment to make a huge increase in financing costs. Being the crucial parts of internal and external governance mechanism, foreign scholars conducted a large number of in-depth researches on the effects that corporate governance and independent audit on debt costs. These studies show that high-level corporate governance and high-quality audit supervision can significantly reduce debt costs. However, because of the differences in social, economic and legal system between China and western countries, there may exist some diversity in the influence mechanisms of debt costs. Therefore, in such a flourish development conditions in China's capital market, we research the influences of corporate governance and independent audit on debt costs, can not only guide creditors to make more rational decisions to protect their interests, but also is good for companies to perfect their governance mechanism and for accounting firm to improve their audit quality, realizing the sound developments of capital markets.

## 30.2 Literature Review

The influencing factors of debt costs have been one of the most important research areas of accounting and finances in recent years. Overseas scholars have discussed the influences of debt costs caused by the various elements of corporate governance from different angles. Bhojraj and Sengupta (2003) found that the improvement of board independence could decrease debt costs, and the increase of ownership concentration could increase debt costs. Ashbaugh-Skaife et al. (2006) made the same results, they approved that the increase in board independence and shareholding were helpful to improve credit rating of bonds, while the increase of large shareholders would decrease the rating. Anderson et al. (2004) found that debt costs is inversely proportional to not only the independence of the company's board of directors and the scale, but also the independence of the audit committee, size and meeting frequency by tracking S&P 500 index companies. In our country, Cui (2008) showed that the proportion of largest shareholders, board independence would obviously affect total debt costs and bank loan debt costs. Jiang (2009) found that the improvement of governance is conducive to reducing the cost of debt. Wu (2009) also thought that high-level of company governance can markedly reduce debt costs.

As for the influences of debt cost that independent audit brings, there are many research achievements. Blackwell et al. (1998) found that when debt financing, subject to audit or not would have significant impacts on the level of interests rates. Mansi (2004) found that Big 6 could decrease company debt financing costs the same results were seen on (Pittman and Fortin 2004). Kim et al. (2007) found that those companies who were audited by Big 4 would have a lower debt costs in comparison with those who hadn't. Moreover, when auditors change from Big 4 to non-Big 4, the bank would increase loan interest rate. Domestically, the relevant literature is not such many. Yiming and Songlian (2007) found that both long and

short term loan interest rates are relevant to the audit characteristics of loan companies. Haiyan and Funing (2008) found that non-clean audit opinion and interest expense rate is positively correlated, this shows that the creditor may use the information conveyed by the audit opinion to take some self-protection measures Xu et al. (2011) found that non-state-owned enterprises to employ high reputation auditors can significantly reduce the cost of debt, but not set up for state-owned enterprises.

Unlike the above literatures, corporate governance and independent audit, as important parts of internal and external governance mechanism, are unified organic entirety, so this paper considering to examine the two mechanisms' impact on debt cost. By using principal component analysis, we build an index to reflect corporate governance level, not only investigated the influences of governance and independent audit on debt costs, but also examined if there is a substitute effect between corporate governance and independent audit in affecting debt cost.

### 30.3 Hypotheses Development

Debt contract is one of the most important contracts in companies. Creditors are rarely involved in enterprise management, and mainly through debt covenants to identify debtor—creditor relationship for self-protection. So, there are information asymmetry and agent problems. In the case of symmetrical information, creditors may make reverse choices for lacking of the knowledge of the true value of the enterprise, namely, they will require the appropriate risk premium to make up their information risks. Corporate governance, as a way to ensure investors to get the desired return, can enhance information transparency and alleviate information symmetry between managements and creditors, reduce information risks of creditors so as to release firm's debt costs. In addition, by reasonably arranging control rights and consummating incentive and restrain mechanisms, good corporate governance can not only increase decision level and efficiency, but also unite benefits between managements and investors, reduce agency costs, ensure operate performances and values, lessen default risks to reduce their debt costs. Based on the above analyses, we give the following hypotheses:

H1: On the basis of the same conditions, higher level corporate governance will bring lower debt costs.

The independent audit system is one of the important contents in the modern exterior governance mechanism. As an third party who is independent between management and outside investors of the company, the auditor can reduce the information asymmetry and agency cost between creditor and the management by attesting accounting information. During the decision-making process, the creditor often requires the company to provide audited financial reports in recent years, and some even put forward certain requirements on the auditor's qualification, such as

sizes, abilities, experiences (Yiming and songlian 2007). This indicates that creditors will take into account the audit factors when deciding debt investments. Reputation Theory thinks that if accounting firms of large-scale are destroyed their reputation by low audit quality, they will lose more chances of getting quasi-rent in the future DeAngelo (1981). So they are more motivated to provide high quality audit service to hold their brand reputation. Otherwise, big firms can invest more in knowledge for holding more resources, at the same time, are easy to attract high quality talents, making them well-qualified to offer high quality audit services. Those companies who hire accounting firms of large-scale (high quality auditor) can enhance their trustworthiness of accounting information; reduce information asymmetry between managements and creditors, so as to decrease debt costs of the companies. Based on the above analysis, we put forward the following hypothesis:

H2: On the basis of the same conditions, companies audited by large-scale accounting firm (high quality auditor) will have lower debt costs.

## 30.4 Research Design

### 30.4.1 Sample Selection and Data Resource

We use all the A-share public companies in Shanghai and Shenzhen stock exchange from 2008 to 2010 for the initial sample, and get 2,889 samples after deleting the finance and insurance companies as well as companies that don't offer information. The data of 'So-top1' are from CCER database, and other data come from CSMAR database. In addition, the rank of Big 10 is from [www.cicpa.org.cn](http://www.cicpa.org.cn). The software used is SPSS17.0.

### 30.4.2 Model Specification and Variable Declaration

To test H1 and H2, we posit the following regression model:

$$\text{Debtcost} = \alpha_0 + \alpha_1 \text{CGI} + \alpha_2 \text{Big10} + \alpha_3 \text{Op} + \alpha_4 \text{Lev} + \alpha_5 \text{Growth} + \alpha_6 \text{Fixass} + \alpha_7 \text{Size} + \alpha_8 \text{Current} + \alpha_9 \text{ROA} + \alpha_{10} \text{Intcov} + \alpha_{11} \text{LTRatio} + \alpha_{12} \text{ST} + \mu$$

Each variable in the model are defined as follows:

The dependent variable Debtcost is measured as interest expenses divided by the average of interest-bearing debt at the beginning and end of the year. To reject the influences of extreme value, we give the data (3 %, 97 %) winsorization process. Interest-bearing debt includes short-term borrowings, long-term liabilities due within 1 year, long-term loans, and bonds payable, long-term payable and other long-term liabilities.

**Table 30.1** Definition of corporate governance indicators

Indicators	Specific definition
ceo_topdir	Settings of chairman and general manager. When 1 people hold the 2 posts, numbered by 1; otherwise, 0
out_ratio	Proportion of independent board, numbers of independent board divides total numbers
top	Proportion of MBO
so_top1	State-controlled is numbered by 1, otherwise 0
top1	Proportion of the first majority shareholder
cstr2-10	The logarithm of Sum of Squares showing proportion of the 2nd to 10th shareholder(cstr2-10)
Parent	Have parent company is numbered by 1, otherwise, 0
hbshare	Public on other market is numbered by 1, otherwise, 0

The main test variables are CGI which represent corporate governance level and Big10 which represent audit quality. Learning from Bai Chongen's literature (2005), we select a series of indicators, including the settings of chairman and general manager (ceo\_topdir), the proportion of independent board (out\_ratio), the proportion of MBO (top), State controlled (so\_top1), the proportion of the first majority of shareholder (top1), the logarithm of Sum of Squares showing proportion of the 2nd to 10th shareholder (cstr2-10), parent company (parent), public on other market (hbshare), and use principal component analysis to extract six factors (accumulative contribution rate up to 85.014 %) to build the corporate governance index. The selected eight indicators (specific definition is present in Table 30.1) related to board governance, executives pay and incentives, ownership structure, financial information disclosure and transparency, can reflect the level of corporate governance to some extents. Big10 is a dummy variable that equals 1 for the firms audited by the first 10th big accounting firms, and 0 otherwise.

We also include a set of control variables in the model to disentangle the effects of corporate governance and audit quality on debt cost from firm-specific credit risk factors. First, we include a dummy variable Op, which equals 1 for the company gets modified audit opinion and 0 otherwise. The modified audit opinion means low quality information, making a higher level information asymmetry between managements and creditors. Rational creditor will ask for higher risk compensations, thus increasing debt costs. To control for the profit ability, we include ROA showed by return on assets. The stronger ability of profiting means more ability to repay capital with interest and lower debt costs. To control for the repayment ability we include Current, defined as liquidity assets divides liquidity debt, and Intcov, defined as EBIT divides financial costs. Fixass defined as fixed assets scaled by total assets, as a control for the collateral value. More fixed assets ensure the probabilities of repaying debt, so there is a lower debt costs. As a control for the firm size, we include Size defined as the natural logarithm of total assets. Bigger size means good ability to resist risks to have a lower debt costs. To control for the financial leverage and leverage maturity structure, we include Lev, defined as total debt divide total assets, and LTRatio, defined as long-term debt to

total debt. In addition, we also include a dummy variable ST, ST companies are predicted to have a higher debt costs for high risks. Other variable being included is Growth, defined as the growth rate of gross operating income, those companies who grow well face higher pressure making increasing debt risks and higher debt costs.

## 30.5 Empirical Results

### 30.5.1 Descriptive Statistics

Table 30.2 present the descriptive statistics results of all the variables. The maximum and minimum of Debtcost are 0.142 and 0.013 respectively, indicating that some companies have low costs compared with others, and there are huge differences in debt costs among different companies. And the maximum and minimum of CGI refer to 1.585 and  $-1.110$  respectively, showing that there exists gap in different companies. The descriptive statistics on auditing also indicate that in the samples companies, only 34.9 % employ the Big10 firm to do annual report audit work, as for the number of clients, the market share of ‘Big10’ only close to 35 %, showing that nowadays China’s audit market competition is very intense.

### 30.5.2 Univariate Analysis

In Table 30.3, we divide the overall sample into 5 groups on the basis of CGI from high to low, and select the highest and the lowest group as our sub-samples; and

**Table 30.2** Descriptive statistics of variables

Variables	Mean	Median	Standard deviation	Min	Max
Debtcost	0.059	0.056	0.027	0.013	0.142
CGI	0.000	$-0.048$	0.486	$-1.110$	1.585
Big10	0.349	0.000	0.477	0.000	1.000
Op	0.065	0.000	0.247	0.000	1.000
Lev	0.743	0.546	3.591	0.012	142.718
Growth	1.047	0.155	29.052	$-1.000$	1497.156
Fixass	0.288	0.263	0.188	0.000	0.916
Size	21.789	21.672	1.383	10.842	28.136
Current	1.335	1.143	1.009	0.002	20.106
ROA	0.032	0.033	0.212	$-6.764$	5.074
Intcov	20.999	4.075	168.494	241.740	5358.160
LTRatio	0.193	0.131	0.193	0.000	0.902
ST	0.086	0.000	0.281	0.000	1.000

**Table 30.3** Univariate analysis

Variables	Mean (Median)		
	Highest of CGI	Lowest of CGI	T-stats (Z-stats)
Debtcost	0.057 (0.052) Big10 = 1	0.060 (0.056) Big10 = 0	−0.003 <sup>a</sup> (−2.461 <sup>b</sup> )
Debtcost	0.055 (0.053)	0.062 (0.057)	−0.007 <sup>c</sup> (−5.888 <sup>c</sup> )

Note <sup>a,b,</sup> and <sup>c</sup> denote statistical significance at the 10, 5, and 1 confidence levels, respectively

we also classify the overall sample based on the Big10. As shown in Table 30.3, the mean and median of debt cost are significantly lower for the firm with the highest CGI than with the lowest CGI. The results also indicate that firms which hire the Big10 to do the audit work are often with lower debt cost than those which don’t hire the Big10. These univariate differences are consistent with our hypothesized associations between the test variables and the cost of debt.

30.5.3 Multiple Regression Analysis

Table 30.4 presents the result of multiple regression analysis. In model 1 and 2, we examine the impact of corporate governance and audit quality on the cost of debt respectively, and in model 3, we examines the two mechanisms’ impact on the cost of debt comprehensively. As shown in Table 30.4, in model 1, the coefficient on CGI is significant and with a negative sign, the significant coefficient obtained for CGI are consistent with H1 and imply that higher governance can lead a lower debt cost. In model 2, the coefficient on Big 10 is also significant and with a negative sign, this is consistent with H2 and implies that Big10 can provide high quality audit service to protect the interests of creditors and to reduce debt cost. In model 3, the coefficient of CGI and Big10 are consist with model 1 and 2, which means that both high level corporate governance and Big10 can reduce debt costs and our hypothesizes are proved.

In addition, we can also see from Table 30.4 in these three models. The coefficients on Size and LTratio are significant and with negative sign. In contrast, the coefficients on OP and ST are significant and with positive sign. Those are consistent with our prediction. However, the coefficients on Lev, Growth and ROA are insignificant

**Table 30.4** Multiple regression analysis

Variables	Modle1	Modle2	Modle3	Big10 = 1	Big10 = 0
Constant	0.125 <sup>c</sup> (14.231)	0.121 <sup>c</sup> (13.533)	0.121 <sup>c</sup> (13.554)	0.101 <sup>c</sup> (8.598)	0.142 <sup>c</sup> (10.464)
CGI	-0.003 <sup>c</sup> (-2.722)		-0.002 <sup>b</sup> (-2.507)	-0.001 (-0.841)	-0.004 <sup>a</sup> (-2.912)
Big10		-0.003 <sup>b</sup> (-2.539)	-0.002 <sup>b</sup> (-2.307)		
Op	0.017 <sup>c</sup> (7.289)	0.016 <sup>c</sup> (7.264)	0.017 <sup>c</sup> (7.334)	0.012 <sup>x</sup> (3.002)	0.018 <sup>x</sup> (6.398)
Lev	0.000 (-0.489)	0.000 (-0.419)	0.000 (-0.356)	0.000 (-0.228)	0.000 (-0.904)
Growth	0.000 (0.631)	0.000 (0.583)	0.000 (0.589)	-0.002 (-1.617)	0.000 (0.625)
Fixass	0.014 <sup>c</sup> (5.061)	0.014 <sup>c</sup> (5.214)	0.014 <sup>c</sup> (5.153)	0.013 <sup>c</sup> (3.322)	0.013 <sup>c</sup> (3.668)
Size	-0.003 <sup>c</sup> (-7.382)	-0.003 <sup>c</sup> (-6.639)	-0.003 <sup>c</sup> (-6.677)	-0.002 <sup>c</sup> (-3.664)	-0.004 <sup>c</sup> (-5.891)
Current	-0.001 (-1.589)	-0.001 <sup>a</sup> (-1.89)	-0.001 (-1.590)	0.000 (0.002)	-0.001 (-1.198)
ROA	0.001 (0.501)	0.001 (0.550)	0.001 (0.577)	0.007 (0.790)	0.000 (-0.025)
Intcov	0.000 <sup>a</sup> (-1.935)	0.000 <sup>b</sup> (-2.069)	0.000 <sup>b</sup> (-2.020)	0.000 <sup>c</sup> (-4.297)	0.000 (-1.370)
LTRatio	-0.036 <sup>c*</sup> (-13.411)	-0.036 <sup>c</sup> (-13.341)	-0.036 <sup>c</sup> (-13.429)	-0.034 <sup>c</sup> (-8.608)	-0.037 <sup>c</sup> (-10.515)
ST	0.010 <sup>c</sup> (5.000)	0.010 <sup>c</sup> (4.965)	0.010 <sup>c</sup> (5.001)	0.012 <sup>c</sup> (3.268)	0.009 <sup>c</sup> (3.672)
Adj. R <sup>2</sup>	0.200	0.200	0.201	0.205	0.193
F-value	66.682 <sup>c</sup>	66.573 <sup>c</sup>	61.661 <sup>c</sup>	24.665 <sup>c</sup>	41.862 <sup>c</sup>
N	2,889	2,889	2,889	1,008	1,881

*Note* The *t*-statistics are reported in parentheses. <sup>a</sup>, <sup>b</sup>, and <sup>c</sup> denote statistical significance at the 10, 5, and 1 % confidence levels, respectively

### 30.5.4 Further Analyses

In order to test the influence of corporate governance on debt cost in different audit quality, we classify the overall sample into 2 groups to do regression analysis. From Table 30.4, we can see that in sample of 'Big10 = 1', the coefficient of CGI is insignificant, which implies that when the audit quality is high, the improvement of corporate governance can't reduce the cost of debt. However, in the sample of 'Big10 = 0', the coefficient of CGI is significant and with a negative sign. This is means that when the audit quality is relatively low, the enhancement of corporate governance level can obviously lead a lower cost of debt. Therefore, we believe

that there exists substitution effect between corporate governance and independent audit in affecting debt cost.

### 30.6 Conclusion

The purpose of this paper is to examine the impacts of corporate governance and independent audit on the cost of debt by using a sample of nonfinancial A-share public companies in Shanghai and Shenzhen from 2008 to 2010. The results shows that firms with high level of corporate governance and audited by Big10 auditors (high quality audit supervision) have significantly lower debt cost than other firms. Additionally, there exists a substitution effect between corporate governance and independent audit in affecting debt costs, namely, improving the level of corporate governance to reduce the cost of debt only established when audit quality is low, and does not hold in high audit quality.

This study has the follow meanings. Firstly, deepen the reform of corporate governance mechanisms to improve the level of corporate governance is not only beneficial to reduce its debt costs and increase its debt financing efficiency for the company, but also helpful for the creditors to reduce their risks and protect their interests. Secondly, high-quality audit supervision can reduce the information asymmetry between managements and creditors, reducing debt costs while protecting their rights, to meet debt financing demand, to improve optimal allocation of debt capital. Finally, there is substitution effect in the influences of debt costs caused by corporate governance and independent audit. Given the existing system can't ensure the demand for high quality audit service, it is very important to enhance corporate governance and in the process of deepening the reform of corporate governance, supervisors should pay more attention to those companies with a relatively low audit quality so as to protect creditors' rights and interests.

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# Chapter 31

## The Engineering of Mechanism Between China's Economic Transformation and Capital Market Development

Mao-wei Xu

**Abstract** Since the development of capital markets have the extremely vital role on industrial structure transformation, capital market can be regarded as the input of industrial structure transformation. The industrial structure transformation can be regarded as the output of the capital market. Hence, capital market and industry structure transformation can be regarded as an input–output system. Also, visual capital market can regarded as the input of the economic transformation; economic transformation can be regarded as the output of capital market. We can explore the circulation of capital market among different areas and the transmission effects of capital market in promoting the economic transformation. Unfortunately, the effect of capital market development on economic transformation does not turn better in recent years.

**Keywords** Capital market • Economic transformation • Financial engineering • Mechanism

Economic transformation is generally the change of resources disposition and the way of economic development, including the change of development model, development elements, and development path and so on. For the understanding of the essence about economic transformation, currently, there are narrow definition and broad definition, and narrow economic transformation refers to the transformation from one economic system to another, which is also called system transformation. Therefore, in China, the economic transformation means the transformation from high concentration of planned economy to the market economy system, of the purpose of the transformation is in a period of time to complete system innovation, and more effectively serve the economy. The broad definition

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of economic transformation refers to the fundamental change of a country or a region's economic structure and economic system in a certain period. Concretely speaking, economic transformation is the update of economic system, is the transformation of economic growth mode, is the ascension of economic structure, is the replacement of pillar industries, and is the process from quantitative change to qualitative change of national economic system and structure. Therefore, the broad economic transformation not only includes system transformation but also includes economic structure transformation (Wang 2008). The so-called economic structure transformation is the transformation from agriculture, rural finger of the traditional society, close to the industry, urban, open modern society. The aim of structural transformation is to realize the transformation of economic growth mode, thus in the transition process to change the status of a regional economic system of countries and regions in the world.

## **31.1 The Analysis About the Impact of Capital Market's Development on Economic Transformation**

### ***31.1.1 Economic Transformation Connotation and Evaluation Index***

As China's sustained economic development and the continuous promotion of socialist market economy system, some factors that hinder sustainable development of economy exposed continually, they are mainly embodied in the economic growth still depends on "increasing investment, expanding the plant, increasing labor input, so as to increase production", which is called the extensive style of economic growth with the pursuit of high consumption and high cost; agricultural and low-end industry primarily constitute the Industrial structure, this kind of industrial has relatively low value and poor market competition ability. These problems are due to China's economic structure. Therefore, for current situation in China, system transformation is no longer the important problem. The implementation and realization of economic structure's transformation is the key to solve current problems of economic development.

So, according to China's realistic need of current economic development, economic transformation should focus on the structural transformation emphatically, namely: firstly, the focus of development evolves from the first industry to the second industry, and then to the third industry, realizing the upgrading of the industrial structure; secondly, improving the technical content of product, reducing energy consumption and realizing intensive industrial structure. Therefore, the measurement of transformation of China's current economic structure can be evaluated by the following several indicators:

1. Energy consumption of per unit GDP. Energy consumption of per unit GDP is also called energy consumption of ten thousand GDP (Cohen et al. 2001); it is

the energy consumption for producing every ten thousand GDP. Energy consumption of per unit GDP is the major index of reflecting the energy consumption level and the status of saving energy and reducing consumption, is a ratio between total energy supply and gross domestic product (GDP). This index shows the energy utilization degree of a country in economic activities, reflects the change of the economic structure and energy utilization efficiency

2. Industry upgrading degrees. The focus of economic development shifts from the first industry to the second industry, and then to the third industry, which is called the upgrading of the industrial structure, therefore, the ratio of the added value of second industry and the third industry can be used to measure the industrial structure updating status of an economy, the former is called the second industrial upgrading degrees, the latter is called the third industrial upgrading degrees, type (31.3) measure the total industrial upgrading degrees which synthesizes the both above.

The second industry upgrading degree = the added value of the second industry/GDP  
(31.1)

The third industry upgrading degree = the added value of the third industry/GDP  
(31.2)

Industrial structure upgrading degrees = (the added value of the second industry + the added value of the third industry) / GDP  
(31.3)

3. Contribution degree of technology. Improving the technical content of product is an important way to improve its value; improving the technical content of process is the important pattern of enhancing its production efficiency. So, in the process of economic structure transformation, technology plays an important role, and also be the important index which reflects the transformation of economic structure. So, the contribution degree of technological input in economic development can measure the contribution degree of technology and reflect the status of the transformation from the economic structure to high-tech.

### ***31.1.2 The Development of Capital Market and Evaluation Index***

Capital market refers to the borrowing funds market with the period of 1 year or more, including not only the stock market, but also the bank credit market, bond market and fund market, etc. that have a financing term of 1 year or more. As an important channel of raising fund and the effective place for the reasonable

distribution of resource, capital market plays an important role in economic and social development; it is helpful for enterprise restructuring and promoting industrial structure to high-grade. So, for the economic transformation, the development of capital market has the vital significance. In order to measure the development status of capital market, such indexes as capital market financing amount, bond terms, stock terms, middle and long-term loan development in bank can present the situation.

### 31.2 The Effective Mechanism of Capital Market's Development on Economic Transformation

The DEA (Data Envelopment Analysis) is put forward by Charnes, Cooper and Rhodes in 1978, the principle of the method is mainly by keeping input or output of the Decision unit (DMU, Decision Making Units), changeless, determining relatively effective production frontier by mathematical program and, statistic data, and value their relative effectiveness by comparing the deviation degree of each decision unit onto the DEA production frontier face. Based on the relative efficiency concept, DEA is a kind of evaluation method with the tool of convex analysis and linear program. It calculates and compares the relative efficiency of different decision units with the application of mathematical programming model and makes comment on evaluation objects. It will give full consideration about the optimal input–output scheme for each decision unit itself, and thus be able to reflect the information and characteristics of evaluation objects themselves much more ideal. In addition, it shows its unique characteristics about more output analysis of complex system.

Since the development of capital markets has the extremely vital role on industrial structure transformation, capital market can be regarded as the input of industrial structure transformation. The industrial structure transformation can be regarded as the output of the capital market. Hence, capital market and industry structure transformation can be regarded as an input–output system.

We suppose there are  $m$  decision units, its input shows such as type (31.4).  $x_{ji}$  ( $i = 1, 2, 3, 4$ ) presents respectively the capital market financing amount, bond terms, stock terms and bank's middle-long term loan of the  $j$  ( $j = 1, 2, \dots, m$ ) decision unit.  $v_i$  ( $i = 1, 2, 3, 4$ ) presents respectively the weight of capital market financing amount, bond terms, stock terms and bank's middle-long term loan. We suppose that the output of the  $m$  decision unit be shown as type (31.5). In type (31.5),  $y_{kj}$  ( $k = 1, 2, 3$ ) presents respectively the energy consumption of per unit GDP, the upgrading degree (Lipsev et al. 2005) of the industrial structure and scientific and technological contribution degree of the  $j$  ( $j = 1, 2, \dots, m$ ) decision unit.  $\mu_k$  ( $k = 1, 2, 3$ ) presents respectively the weight of the energy consumption of per unit GDP, the upgrading degree of the industrial structure and scientific and technological contribution degree.

$$\begin{array}{cccc}
& 1 & 2 & \cdots & m \\
v_1 & x_{11} & x_{12} & \cdots & x_{1m} \\
v_2 & x_{21} & x_{22} & \cdots & x_{2m} \\
v_3 & x_{31} & x_{32} & \cdots & x_{3m} \\
v_4 & x_{41} & x_{42} & \cdots & x_{4m}
\end{array} \quad (31.4)$$

$$\begin{array}{cccc}
& 1 & 2 & \cdots & m \\
y_{11} & y_{12} & \cdots & y_{1m} & \mu_1 \\
y_{21} & y_{22} & \cdots & y_{2m} & \mu_2 \\
y_{31} & y_{32} & \cdots & y_{3m} & \mu_3
\end{array} \quad (31.5)$$

Then, according to the principle of DEA model, for each decision unit  $DMU_j$ , there is corresponding efficiency evaluation index such as type (31.6) below

$$h_j = \frac{u^T y_j}{v^T x_j} = \frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}}, \quad j = 1, 2, \dots, n \quad (31.6)$$

For the decision unit  $DMU_{j_0}$  of  $j_0$ , the bigger  $h_{j_0}$  is,  $DMU_{j_0}$  can consume relatively less input and get relatively more output. So, with the efficiency index of the  $j_0$  decision unit as the goal, take all the efficiency index of decision units constraints, CCR( $C^2R$ ) model can be constructed below:

$$\begin{aligned}
\max h_{j_0} &= \frac{\sum_{r=1}^s u_r y_{rj_0}}{\sum_{i=1}^m v_i x_{ij_0}} \\
s.t. \quad &\frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1, \quad j = 1, 2, \dots, n \\
&u \geq 0, v \geq 0
\end{aligned} \quad (31.7)$$

Type (31.7) can be transformed into type (31.8):

$$\begin{aligned}
&\min \theta \\
&s.t. \quad \sum_{j=1}^n \lambda_j x_j + s^+ = \theta x_0 \\
&\quad \sum_{j=1}^n \lambda_j y_j - s^- = 0 \\
&\quad \lambda_j \geq 0, j = 1, 2, \dots, n \\
&\quad \theta, s^+ \geq 0, s^- \leq 0
\end{aligned} \quad (31.8)$$

$\theta$  is unconstrained

According to type (31.8),  $\theta$ ,  $s^+$ , and  $s^-$  of any decision unit can be solved.

### 31.2.1 The “State” Analysis for the Effect of Capital Market Development on Economic Transformation

The economic transformation and the development of capital markets is related, and the capital market development is helpful for the economic transformation, so, visual capital market can be regarded as the input of the economic transformation; economic transformation can be regarded as the output of capital market (International Banks for Reconstruction and Development 2003). Based on this, when the decision units in type (31.4) and type (31.5) are some economic entity’s annual data, there is only one evaluation objects, that is the economic entity; we Assume that there are data of  $m$  years about this economic entities, and regard these data as the decision units, then, using the DEA model shown in type (31.7) or (31.8), we can calculate  $\theta$ ,  $s^+$  and  $s^-$  of each year, which reflects the efficiency promoted on economic transformation by the development of capital markets.

1. When  $\theta^* = 1$  and  $s^{*+} = s^{*-} = 0$ , decision unit  $j_0$  is effective, namely, the capital market of the  $j_0$  year is effective on promoting the economic transformation, whether by technology or scale.
2. When  $\theta^* = 1$  and  $s^{*+} \neq 0$  or  $s^{*-} \neq 0$ , decision unit  $j_0$  is weak effective, the capital market of the  $j_0$  year is effective on promoting the economic transformation, technology and scale are not effective at the same time, namely, either the best technological efficiency or the best scale efficiency
3. When  $\theta^* < 1$ , decision unit  $j_0$  is not effective, the capital market of the  $j_0$  year is neither technology effective nor scale effective on promoting the economic transformation (Atkinson 2005).

Therefore, with the annual data, the promoting efficiency of capital market on economic transformation can be assessed by DEA model, and the result can be reflected by indexes such as  $\theta$ ,  $s^+$ ,  $s^-$  and so on.

Based on these conclusion, we assume that the DEA evaluation index of the  $j$  year is  $\theta_j$ , then, we can draw a  $j - \theta_j$  curve with  $j$  as Abscissa denotes and  $\theta_j$  as y-coordinate. This a curve will reflect from different Angle of capital market economic transformation promotes the efficiency of the development trend.

In order to test the principal above, we use the sample data in Table 31.1 to demonstrate

We use DEA to transform the data in Table 31.1; the result is shown in Table 31.2

According to the result in Table 31.2, the curve of  $j - \theta_j$  can be drawn, which is shown in Fig. 31.1. Figure 31.1 tells us that in recent years, the promoting effectiveness of capital market development on economic transformation dose not turn better (Banker et al. 1984).

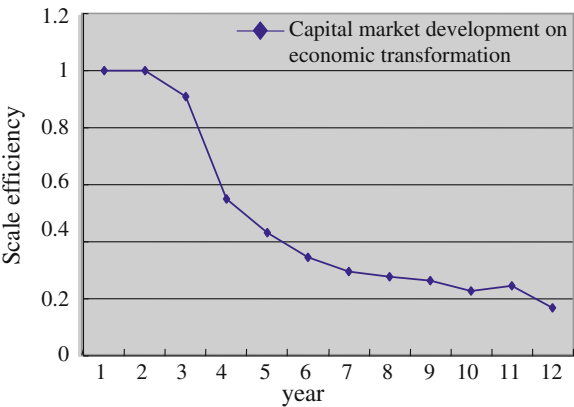
Table 31.1 Sample data

Years	$y_2$	$x_1$	$x_2$	$x_3$	$x_4$
1994	1	1	1	1	1
1995	0.9985	1.337799	1.329177	0.460004	1.376133
1996	1.001769	1.618381	1.629100	1.300814	1.629937
1997	1.019769	2.066757	2.052659	3.959299	1.989569
1998	1.029019	2.714183	3.045224	2.575188	2.664703
1999	1.042666	3.112568	3.346671	2.890507	3.082779
2000	1.59968	3.699006	3.648118	6.435767	3.592484
2001	1.068465	4.851775	3.872085	3.832364	5.058342
2002	1.07662	5.942258	4.81744	2.943112	6.256286
2003	1.08817	7.594660	5.108982	4.154936	8.154626
2004	1.081441	9.091046	5.580620	4.623722	9.865452
2005	1.088415	10.47033	6.994920	5.760787	11.24907

Table 31.2 The result of DEA

year $j$	Technical efficiency	Scale efficiency $\theta_j$
1994	1.000	1.000
1995	1.000	1.000
1996	0.737	0.910
1997	0.932	0.550
1998	0.905	0.433
1999	1.000	0.347
2000	1.000	0.295
2001	1.000	0.277
2002	1.000	0.262
2003	1.000	0.229
2004	0.849	0.244
2005	1.000	0.167

Fig. 31.1 The curve about the promoting effectiveness of capital market development on economic transformation



### 31.2.2 “Potential” Analyses About the Effect of Capital Market Development on Economic Transformation

Vernon (1966) Economic transformation is related with capital market development, the development of capital market is helpful to economic transformation, therefore, capital market can be regarded as the input of economic transformation; economic transformation can be regarded as the output of capital market. Based on the principal, when the decision unit are the annual data of some area, the evaluation objective are multiple areas; assuming that there are  $m$  areas, and the data of the same year in  $m$  areas are decision unit, we can calculate  $\theta_j$  of every areas  $j(j = 1, 2, \dots, m)$  by the DEA model shown in type (31.7) or type (31.8). When  $\theta_j = 1$ , it indicates that the promoting effectiveness of capital market on economic transformation shows he best in  $j$  area this year. But, when  $\theta_j \neq 1$ ,  $\theta_j$  can not give the best measurement about the promoting effectiveness of the capital market on economic transformation in  $j$  area. So, it is necessary to improve the traditional DEA model (CCR model):

1. Firstly, the first DEA evaluation should be made for all areas (namely, the decision unit  $DMU_j$  ( $j = 1, 2, \dots, m$ )), when the evaluation result shows that  $\theta_j = 1$  ( $j = 1, 2, \dots, m_1$ ) in  $m_1$  ( $m_1 \leq m$ ) decision unit (area), these areas will be definite as high effectiveness area where capital market development promotes economic transformation (Jing 2005).
2. Then, the decision unit(area) with  $\theta_j = 1$  in the first DEA evaluation will be removed, and make the second DEA evaluation for the rest  $m - m_1$  decision unit, if the result shows that there are  $\theta_j = 1$  ( $j = 1, 2, \dots, m_2$ ) in other  $m_2$  ( $m_2 \leq m - m_1$ ) decision areas, then these areas will be definite as less effective area where capital market promotes economic transformation.
3. Finally, the decision unit (area) with  $\theta_j = 1$  in the first and the second DEA evaluation will be removed and definite the rest  $m - m_1 - m_2$  decision unit (area) as the low efficiency area where capital market promotes economic transformation.

Therefore, regarding the data of the same year in multiple areas as decision unit, we can evaluate the promoting effectiveness of capital market development on economic transformation (Dow 1998). The result of evaluation can judge the promotion potential of the capital market development on economic transformation, and can map out the level figure. Apparently, by the figure, we can explore the circulation of capital market among different areas and the transmission effects of capital market in promoting the economic transformation. In order to test the principal above, we use the sample data in Table 31.3 to demonstrate

Table 31.3 DEA sample data

Area	$y_2$	$x_1$	$x_2$	$x_3$	$x_4$
A	1	1	1	1	1
B	0.9985	1.337799	1.329177	0.460004	1.376133
C	1.001769	1.618381	1.629100	1.300814	1.629937
D	1.019769	2.066757	2.052659	3.959299	1.989569
E	1.029019	2.714183	3.045224	2.575188	2.664703
F	1.042666	3.112568	3.346671	2.890507	3.082779
G	1.059968	3.699006	3.648118	6.435767	3.592484
H	1.068465	4.851775	3.872085	3.832364	5.058342
I	1.07662	5.942258	4.81744	2.943112	6.256286
J	1.08817	7.594660	5.108982	4.154936	8.154626
K	1.081441	9.091046	5.580620	4.623722	9.865452
L	1.088415	10.47033	6.994920	5.760787	11.24907

Table 31.4 The first result of DEA evaluation

Area $j$	Scale efficiency $\theta_j$	Judgment
A	1.000	Effective
B	1.000	Effective
C	0.910	
D	0.550	
E	0.433	
F	0.347	
G	0.295	
H	0.277	
I	0.262	
J	0.229	
K	0.244	
L	0.167	

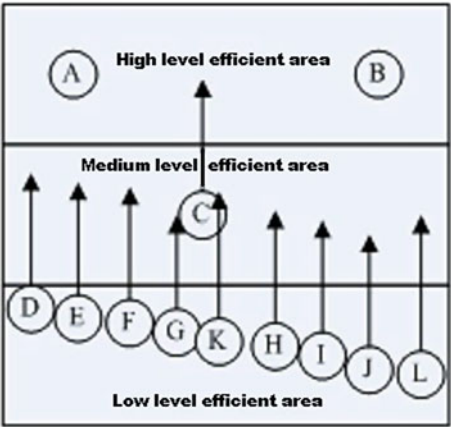
We make the first DEA evaluation with the data in Table 31.3, the result is shown in Table 31.4. It shows that area A and area B are high effectiveness area where capital market development promotes economic transformation (Glosten and Milgrom 1985).

Then, the data in area A and area B will be removed, and make the second DEA evaluation for the rest ten decision units, the result is shown in Table 31.5 (Green and Porter 1984). It indicates that area C is the less effective area where capital market promotes economic transformation; then, the rest areas D, E, F, G, H, I, J, K, L are low efficiency areas where capital market promotes economic transformation. The level figure can be mapped out as Fig. 31.2:

**Table 31.5** The result of second EDA evaluation

Area $j$	Scale efficiency $\theta_j$	Judgment
C	1.000	Effective
D	0.834	
E	0.649	
F	0.550	
G	0.480	
H	0.449	
I	0.475	
J	0.346	
K	0.371	
L	0.253	

**Fig. 31.2** Level figure for the promoting effectiveness of capital market development on economic transformation



**31.3 Conclusions**

According to China’s realistic need of current economic development, economic transformation should focus on the structural transformation emphatically, namely; first, the focus of development evolves from the first industry to the second industry, and then to the third industry, realizing the upgrading of the industrial structure; second, improving the technical content of product, reducing energy consumption and realizing intensive industrial structure. Since the development of capital markets have the extremely vital role on industrial structure transformation, capital market can be regarded as the input of industrial structure transformation. The industrial structure transformation can be regarded as the output of the capital market. Hence, capital market and industry structure transformation can be regarded as an input–output system.

Also, visual capital market can regarded as the input of the economic transformation and, at the same time, economic transformation can be regarded as the output of capital market. Economic transformation is related with capital market

development, the development of capital market is helpful to economic transformation, therefore, capital market can be regarded as the input of economic transformation; economic transformation can be regarded as the output of capital market. We can explore the circulation of capital market among different areas and the transmission effects of capital market in promoting the economic transformation. Unfortunately, the effect of capital market development on economic transformation does not turn better in recent years.

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# Chapter 32

## The Reform of IPO Bookbuilding Mechanism and IPO Anomalies in China Stock Market: Evidence from the Bidding of Institutional Investors

Hong-hai Yu

**Abstract** After the reform of IPO bookbuilding mechanism in China stock market at 2009, the IPO anomalies called “3-high”, including high issuing price, high PE, and high funding, are very serious, and wealth allocation is unfair during this procedure. This paper studies such problems from the perspective of institutional investors’ biddings during IPO bookbuilding. We find that after the reform, unreasonable arrangement of IPO bookbuilding mechanism results to the over-competition among institutional investors, which further causes to IPO overpricing and the problem of “3-high”. This research opens the “black box” of IPO bookbuilding and IPO pricing procedure to some extent. Based on this research, we suggest optimizing the incentive and constraint mechanism of institutional investors further to make the competition more reasonable, to improve the IPO pricing efficiency and the fairness during wealth allocation.

**Keywords** IPO bookbuilding reform • IPO “3-high” • Bidding of institutional investor • Over-competition • Wealth allocation

### 32.1 Introduction

In 2005, the CSRC (SEC of China) adopted IPO bookbuilding mechanism with Chinese characteristics to replace the fixed PE pricing mechanism during new security issuing procedure, to improve the pricing efficiency. But there are various IPO anomalies and the efficiency seems to still low after that. At the first stage from 2005 to 2008 before the reform of bookbuilding mechanism, the average initial return reaches to 155 %, which is too high to explain by traditional theory. In order to handle this problem, the CSRC adopted the reform of IPO

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bookbuilding. After that, though the phenomenon of high initial return disappears, some new anomalies called “3-high” start to emerge, including high issuing price, high PE and high extra funding. Why the reform removes the problem of high initial return, but causes new problem of “3-high”? What are the effects of IPO bookbuilding reform to the stakeholders among IPO procedure? How should we push the reform to go ahead to improve pricing efficiency? The researches of these problems are not only essential to the direction and steps of further reform of IPO bookbuilding, but also relevant to the fairness and efficiency of social wealth distribution.

When we look back related literatures about IPO bookbuilding mechanism, we could see that current research mainly focuses on the new shares allocation by underwriter since (Benveniste and Spindt 1989). Some researches (Sherman and Titman 2002; Sherman 2005; Aggarwal et al. 2002; Chemmanur et al. 2010) find that the underwriter provides incentives to the institutional investor to provide private information; while some other researches (Reuter 2006; Ritter and Zhang 2007; Jenkinson and Jones 2009; Liu and Ritter 2010) find that the underwriter transfers the benefits to related stakeholders. While in China stock market, different from standard bookbuilding mechanism, the underwriter has no rights of new share allocation, so the above researches could not provide reasonable explains to “3-high” problem. Most researches about China IPO market mainly use the close price of first day as the benchmark of efficiency price, and explain why there’s “IPO discount” (Jiang et al. 2006; Yang and Zhao 2006; Zhou et al. 2006; Chen et al. 2011; Tian 2011). But because of the serious speculation during new stock trading procedure, the use of first day’s close price as the benchmark of intrinsic value is doubtful. Besides, Shao and Wu (2009) and Liu et al. (2011) try to study the role of institutional investors during IPO book-building and get some interesting results. But because of the data constraints about biddings, these researchers could not tell us how the issuing price set up, and also could not provide reasonable explains to the anomalies of “3-high”.

In this paper, based on the methodology of Purnanandam and Swaminathan (2004), we use the method of data matching in the same industry to identify the benchmark of intrinsic value to analyze the pricing efficiency, and for the first time we use the particular bidding data of institutional investors to analyze the efficiency of pricing and why the problem of “3-high” appear. We find that after the reform of IPO bookbuilding, compared to the intrinsic value, IPO pricing is too high, and correspondingly the problems of “3-high” appear. Further research shows that the unreasonable arrangement of IPO bookbuilding in China stock market results to the over-competitions among institutional investors, which further results to the problem of over-pricing and IPO “3-high”. During this process, the wealth distribution is leaned towards issuers and underwriters.

Our paper contributes to the current literature in the following ways: Firstly, we manually collect the bidding data of institutional investors since 2010, and for the first time we analyze the bidding strategies of institutional investors, and open the “black box” of pricing during IPO bookbuilding mechanism to some extent; Secondly, we use a new method to select the benchmark to analyze the IPO pricing

efficiency, and based on that, we provide new explain to the problem of IPO “3-high” after the reform of IPO book-building.

The rest of our paper is organized as follows: Sect. 32.2 is the methodology; Sect. 32.3 is the research design; Sect. 32.4 is the empirical results; Sect. 32.5 concludes the paper.

## 32.2 Methodology

### 32.2.1 Theoretical Analysis

The bookbuilding mechanism in China stock market is different from standard bookbuilding in American stock market, and the main difference is the new share allocation. In China stock market, there are two channels for share allocation, one is called “off-line market”, which is only for some certificated institutional investors who participate in the bookbuilding process and determine the issuing price together; another one is called “on-line market”, which is for the individual investors and general institutional investors, and they just provide the quantity of demand, but not price. At the first stage before IPO bookbuilding reform, the certificated institutional investors could participate in both off-line and on-line market at the same time; but at the second stage after IPO book-building reform, all the institutional investors could only participate in one market, on-line or off-line. Besides, no matter at the off-line or at the on-line market, the investors will basically over subscribe, and when the bidding is above one level, then the corresponding investors has the same chances to get allocation (Degeorge et al. 2010).

Based on this institution background, we set up basic model as follows.

We assume the intrinsic value of IPO stock is  $V$ , the institutional investor's signal about IPO value is  $S_i$ . We assume that  $S_i$  satisfies normal distribution. Besides, because IPO stock is scarce resources in China stock market, there's some resale option value during IPO pricing, which we use  $M$  to measure.

Before the reform of IPO bookbuilding mechanism, the institutional investors could participate in both on-line and off-line markets and provide their demands, we assume the demand of off-line market is  $Q_{1,i}$ , the demand of on-line market is  $Q_{2,i}$ .  $S_i + \theta_i$  is the bidding of institutional investor at the off-line market. The institutional investors select  $\theta_i$ , and then the decision function is as (32.1).

$$Max_{\theta_i} F = Max_{\theta_i} [(V + M) - P(S_i + \theta_i)] * [Q_{1,i}(S_i + \theta_i) + Q_{2,i}] \quad (32.1)$$

When all the institutional investors provide their biddings, then

$$P = \frac{1}{N} \sum (S_i + \theta_i) = V + \bar{\theta} \quad (32.2)$$

Equation (32.2) means how the biddings determine the IPO pricing, since now in China stock market IPO price is determined by the average of biddings. When  $Q_{2,i}$  is high, it is optimal for the institutional investor to choose a negative  $\theta_i$ , which will have chances to make the issuing price low to increase the total profit. Even if  $\theta_i$  is too low and make the investor to lose chances to get allocation in the off-line market, he could still get allocation through the on-line market.

When all institutional investors take the similar strategy, from (32.2) we could see that  $\bar{\theta}$  will be negative and the IPO price will lower than its intrinsic value, which means underpricing.

While at the second stage after the reform, the institutional investor could not participate in both off-line and on-line market at the same time. Because there is less competition in the off-line market, plus some constraints of the on-line market, the institutional investors will prefer to participate in the off-line market. The decision function is as follows.

$$\underset{\theta_i}{Max} F = \underset{\theta_i}{Max} [(V + M) - P(S_i + \theta_i)] * [Q_{1,i}(S_i + \theta_i)] \quad (32.3)$$

Now the institutional investors will be punished for bidding with a low price by not getting allocation. To mitigate this drawback, institutional investors will have to choose a positive  $\theta_i$  to increase the odd of being selected, which means the over-competition among institutional investors. At optimal,  $\theta_i$  will be positive, which leads to overpricing.

### 32.2.2 Main Hypothesis

Based on the above analysis, we provide the following hypothesis:

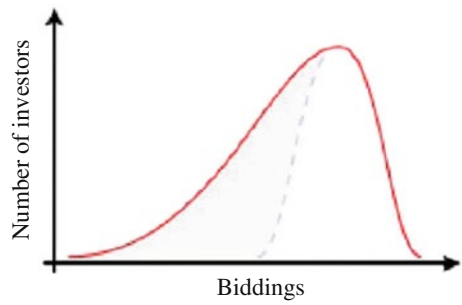
- H1 After the reform of IPO book-building mechanism, the over-competition among institutional investors results to the problem of IPO over-pricing. The more aggressively they compete, the higher the IPO issuing price.
- H2 After the reform of IPO book-building mechanism, the over-competition among institutional investors results to the problem of “3-high”. The more aggressively they compete, the server the “3-high” problems.

## 32.3 Research Design

### 32.3.1 Sample Selection and Data Source

The second reform of IPO book-building in 2010 requires the underwriter and issuer to provide institutional investors' bidding information, which provides us opportunities to study the intrinsic mechanism of IPO pricing. We manually collect the biddings from 2010.10 to 2011.12. Totally there are 280 samples.

**Fig. 32.1** Over-competition results to negative skewness of biddings



Besides, the other data including IPO price, issuing date, issuing PE, IPO funding etc. are from Wind database, and other data of financial report are from CCER database.

**32.3.2 Variable Definition**

The variables include dependent variables, explanatory variables and control variables. The dependent variables include IPO pricing efficiency or relative price, and IPO “3-high”. We follow the method used in Purnanandam and Swaminathan (2004) to select the benchmark through using the price of control firms in the same industry.

The explanatory variable is how to measure institutional investors’ competition. Similar to Roll and Subrahmanyam (2010), we use skewness to measure competition. From Fig. 32.1 we could see that in order to get the allocations, the investors’ biddings will focus on the right part, which will result to negative skewness. So skewness is a good proxy variable for competition.

Besides, we also use the number of institutional investors and extra subscription as proxy variables of competition.

The control variables include firm size, leverage, ROA, the type of controlling shareholder. The definitions are in Table 32.1.

**32.4 Results**

**32.4.1 Main Results**

Table 32.2 shows the relationship between IPO relative price through the method of Purnanandam and Swaminathan (2004) and IPO “3-high”. From Table 32.2 we could see that compared to the intrinsic value, the IPO stock is over-priced, and the mean and median levels are 1.4434 and 1.2087 correspondingly, which provide

**Table 32.1** Variable Definition

Variable name	Variable definition
Price_r1	The ratio of IPO price to the matching sample's price. The selection of matching sample is based on sales, net profit and earning per share in the same industry
Price_r2	The ratio of IPO price to the average close prices of the same industry, deleting the samples which go public in 3 years and ST stocks
Fund_extra	(The actual fund-the predicted fund)/the predicted fund
Skewness	The bidding skewness among institutional investor in the off-line market, which is the proxy variables of institutional investors
Number	The number of institutional investors in the off-line market, divided by IPO scale to control size effect, as another proxy variable of competition
Size	The natural log of total asset, using the average of 3 years before listing
EPS	Total earning/total shares, using the average of 3 years before listing
BPS	Total net asset/total shares, using the average of 3 years before listing
Leverage	Total liability/total asset, using the average of 3 years before listing
GEM_dummy	If the company belongs to Growth Enterprise Board, we take "1"; else take "0"

**Table 32.2** IPO relative price and the relationship with IPO "3-High"*Panel A: IPO relative price*

	Mean	Median
Price_r1	1.4434	1.2087
IPO over price	0.4434*** (<0.0001)	0.2087

*Panel B: the relationship between IPO relative price and IPO "3-high"*

	Issue price	PE	Fund_extra
Coefficient	0.4539*** (<0.0001)	0.1908*** (0.002)	0.4539*** (<0.0001)

Note \*, \*\* and \*\*\* indicate 10, 5 and 1 % levels of significance, respectively

basic evidence to hypothesis H1. Besides, we consider further the relationship between relative price and "3-high", from Panel B we could see that the higher of relative price, the higher of absolute price, PE and funding level.

We consider further the impact of institutional investors' competition to the IPO price efficiency. From Table 32.3, we could see that after controlling the related variables, the competition has significant positive effect to pricing. Here we use bidding skewness and number of institutional investors as the proxy of competition, the skewness is more negative, the number is bigger, then the competition is more. The results in Table 32.3 support our hypothesis H1, and are similar to the research of Christise and Schultz (1813) and Christise et al. (1994).

We consider further the impact of competition to IPO "3-high". From Table 32.4 we could see that after controlling related variables, when the competition is more serious, then the extra funding level is higher, the IPO PE is

**Table 32.3** Competition and price efficiency

	Model 1	Model 2	Model 3	Model 4
Skewness	−0.1769** (−2.03)	−0.1765** (−2.01)		
Number			1.0997** (2.06)	1.4984** (2.30)
Size		−0.0203 (−0.20)		0.1354 (1.03)
Leverage		0.5951 (1.14)		0.4008 (0.70)
EPS		0.1532 (0.72)		0.1784 (0.78)
BPS		−0.0277 (−0.32)		−0.0542 (−0.57)
GEM_dummy		0.0894 (0.67)		0.1091 (0.81)
Intercept	1.4229*** (25.45)	1.4297 (0.77)	1.2187*** (11.35)	−1.7705 (−0.72)
R-sq	0.012	0.025	0.024	0.045

Note \*, \*\* and \*\*\* indicate 10, 5 and 1 % levels of significance, respectively

**Table 32.4** Competition of institutional investor and IPO “3-High”

	Fund_extra	PE	Issuing price
Skewness	−0.3659*** (−3.34)	−9.4151*** (−4.40)	−3.7841*** (−3.14)
Size	0.0634 (0.58)	−7.8945*** (−3.19)	0.2608 (0.16)
Leverage	−0.6613 (−1.33)	17.5881* (1.93)	7.5388 (0.99)
EPS	0.5927** (2.10)	−3.4829 (−0.95)	10.1869*** (2.73)
BPS	−0.2481*** (−2.57)	2.0941 (0.95)	−1.1301 (−0.78)
GEM_dummy	0.2879** (2.18)	4.5851* (1.71)	3.6073** (2.09)
Intercept	0.4382 (0.22)	191.5802*** (4.28)	10.9991 (0.37)
Adj. R-sq	0.115	0.121	0.200

Note \*, \*\* and \*\*\* indicate 10, 5 and 1 % levels of significance, respectively

bigger, and the price level is higher, which supports our hypothesis H2. We also use the number of institutional investors as the proxy variable of competition, and the results are similar.

### 32.4.2 Robustness Check

How to measure the pricing efficiency is one critical problem in this paper. Here we further use the industrial average close price at IPO issuing date as the benchmark of IPO price. The results are similar to Table 32.2, means that the competition is more serious, the pricing is higher.

How to measure the competition among institutional investor is another critical problem. We use the extra subscription from institutional investor at the off-line market as the proxy variable of competition, and the results are similar to Table 32.4.

## 32.5 Conclusion

After the reform of IPO book-building mechanism in 2009, the phenomenon of high initial return disappears, but the phenomenon of “3-high”, including high IPO price, high PE and high funding emerges. We study this problem based on the perspective of biddings of institutional investors after the reform. The results show that after the reform the IPO price is too high compared to its intrinsic value, which results to “3-high” problem correspondingly. The further research shows that the over-competition among institutional investors coming from the unreasonable institution arrangement result to over pricing and “3-high” problem. During this process the wealth distribution is leaned towards issuers and the underwriter.

Based on our research, we suggest optimizing the incentive and constraint mechanism of institutional investors further to make the competition more reasonable, to improve the IPO pricing efficiency and the fairness during wealth allocation.

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# Chapter 33

## The Relation Between Earnings Management and Internal Control Information Disclosure: Evidences from Listed Companies in China

Jing-ri He and Jia Wang

**Abstract** We conduct an empirical research to examine the relation between earnings management and the disclosure of internal control through setting up internal control information disclosure index (CIDI) and using 1090 firms that disclosed information about internal control in 2010. We find that firms with higher internal control information disclosure expose to lower level of earnings management. This result not only has examined the implementation effects of new internal control information disclosure system, helping build and improve related laws and regulations, but also has a referenced significance for the further restrain of earnings management, the improvement of realness and reliability of financial reporting and the stimulation of healthy development of the capital market.

**Keywords** CIDI · Disclosure · Earnings management · Internal control

### 33.1 Introduction

In recent years, internal control, as an important measure to establish and develop corporation governance, has aroused wide concern in the whole country. The promulgation of “Enterprise Internal Control Standards” in August, 2008 converted the internal information disclosure institution as directed and general rules into mandatory and detailed requirements. Theoretically, specific internal control information disclosure would increase the credibility of financial report of firms

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and decrease, in a manner, cheating behaviors, thus effectively restraining earnings management.

In China, with the booming of capital market, enterprises earnings management has become increasingly influential, even a potential hazard to the social and economic development, especially the development of stock market, and significantly prevents the capital market to allocate resources rationally. On one hand, due to the accounting information distortion caused by earnings management, many listed companies that lacks of competence appear to be as good as those highly profitable firms, which misleads investors' investment decisions, harming the interests of medium and small investors (Hamersley et al. 2002). On the other hand, if the equity price of firms with earnings management but lack of support from profitability is high, market risk will increase, endangering the stability and development of stock market or even the whole capital market. Therefore, how to contain earning management efficiently and how to enhance the authenticity and reliability of accounting information now are urgent issues to be solved (Beneish et al. 2008). Many scholars already proposed that corporation governance is the fundamental way to constrain earnings management (Doyle et al. 2007). Since internal control is an important way to improve corporation governance, and new promulgated "Enterprise Internal Control Standards" proposed mandatory requirements on internal control information system, this paper, from the perspective of listed companies, discussed the relationship between internal control information disclosure and earnings management, investigated whether comprehensive and formal internal control information disclosure can reduce earnings management.

As a series of scandals in accounting industry have been disclosed recently, internal information disclosure issue becomes a hot topic all over the world. Gleason et al. (2011) found that the disclosure and remediation of tax-related internal control weaknesses has the effect of constraining earnings management through the income tax accrual. Chan et al. (2008) indicate that companies who had not disclosed internal control weaknesses information, compared with companies who did so, have higher earnings management level. Hermanson (2000) claimed that reporting internal control is an effective way to inhibit malpractices. After the publication and implementation of "Enterprise Internal Control Standards", the correlation between internal control information disclosure and earnings management becomes a nationwide hot topic. Hanwen (2011) displayed that enhancing enterprise internal control will improve earning quality. Sun and Mo (2012) found that establish and development of internal control increased the reliability of financial reports of listing companies. Fang and Jin (2011) discovered that better internal control resulted in either less real earning management activities or weaker preference on earning management by accountants; companies publicizing assurance report on internal control, particularly those whose reports were guaranteed, expose to lower earning management. Lv and Cai (2010) found that internal control information disclosed by most companies didn't satisfy the requirements.

Given all that, although now plenty researchers explored the correlation between internal control and earnings management, their results are not accordant. In addition, current research mainly focus on a certain type of internal control information disclosure, such as deficiencies of internal control, internal control self-assessment report or internal control assurance report and use the disclosure of one specific type to represent and evaluate the overall internal control quality or the degree of internal control information disclosure, without investigating if and how the overall internal control information disclosure will affect the financial information quality and lack of empirical research about the implementation of new internal control information institution. Hence, this paper, based on previous research, from the perspective of internal control information disclosure, explored for companies listed in either Shanghai Stock Market or Shenzhen Stock Market and from different industries, whether earning management can be restrained by comprehensive and detailed internal control information disclosure; Moreover, this project, using data from the annual report of each company in 2010, the second year after the Standards has been formally implemented, conducted initial examine and analysis about the effects of the new implemented policies through empirical research, and offered suggestions and advices on the management and development of further establishing enterprise internal control system.

### 33.2 Theoretical Analysis and Hypotheses

The general phenomenon that earnings management is among accounting practices in modern corporations can be well illustrated by contract theory and asymmetric information theory. (1) Contract theory: due to the fact that different community of interest droved by different interests' factors, owners care more about the appreciation of their original capital while the business operators pay more attention to whether an outstanding performance could bring them an extra income. Therefore, the economical conflicts between the principals and the agents will motivate the agents to conduct earnings management. (2) Asymmetric information theory: as is known to all, investors have less useful information related to the profitability and developmental level of a company than the administrative staff. Therefore, the administrators would intend to conduct earnings management in order to mislead investors' decisions. Arya et al. (1998), Dechow et al. (2003) and Ducharme et al. (2004) have proved that enterprises exactly have motivations to misguide investors through earnings management. Wang and Gan (2009) found that listed companies in China have significant downward earnings management in the year of re-issuing new shares. It is not hard to find out that earnings management has serious negative impact on the normalization of capital market. Therefore, in order to eliminate the distortion of accounting information and to promote the healthy development of the capital market, we have to launch an in-depth research and analysis of restraining earnings management. Goh (2007) found that the level of corporate governance and earnings management are negatively correlated. That is

to say, the high level of corporate governance could effectively supervise and efficiently restrain the earnings management while the low level of corporate governance provides opportunities and environments for the earnings management. To a certain extent, the normalization and effectiveness of internal control information disclosure could reflect the level of corporate governance. Meanwhile, internal control information disclosure could also improve the reliability of financial reports and reduce the level of asymmetric information. Therefore, Effective internal control information disclosure should be able to inhibit earnings management. Accordingly, we put forward the following hypothesis:

Hypothesis H: firms with higher internal control information disclosure expose to lower level of earnings management.

### **33.3 Data Sources and Research Design**

#### ***33.3.1 Sample Selection***

Due to the fact that the “Enterprise Internal Control Standards” has been conducted since July 1, 2009, we select 2010 annual report of listed companies issuing A-shares on Shanghai and Shenzhen Stock Exchanges as the research sample. The reason for this selection is that 2010 is the second year after the Standards has been formally implemented and the examination and analysis about the effects of the new implemented policies through empirical research could be more representative and persuasive in offering suggestions and advices on the management and development of further establishing enterprise internal control system. The sample selection procedure is on the basis of the following facts:

1. Exclude finance and insurance enterprises which have the particularity in accrued profits.
2. Exclude ST and ST\* companies.
3. Exclude the company listed in 2010 which have no complete data in two consecutive years.
4. Exclude cultural industry who has less than 30 samples and that will affect the regression results.
5. Exclude the companies with incomplete or abnormal data.

After selection, 1090 observations remain. Sample distribution in industry and each industry code can be seen in Table [33.1](#).

**Table 33.1** Industry distribution and codes

industry name	Codes	Sample distribution
Agriculture	A	36
Excavating	B	63
Manufacturing	C	549
Electric, gas and water supply	D	60
Transportation and warehousing	F	80
Information and technology	G	49
Wholesale and retail trade	H	82
Realty	J	114
Social services	K	57

**33.3.2 Measurements of Earnings Management**

Modified Jones model is chosen to estimate the extent of earnings management. This model, effectively overcoming the shortage that the sample size is too small and used to test an enterprise with relatively short history, is especially suitable for China’s listed companies.

**33.3.3 Measurements of the Level of Internal Control Information Disclosure**

Using content analysis method, we establish a series of index to measure the level of internal control information disclosure. Every primary index and secondary index are set according to the “Enterprise Internal Control Standards”, “Enterprise Internal Control guidelines”, “Internal Control guidelines of Shanghai Stock Exchange listed companies”, “Internal Control guidelines of Shenzhen Stock Exchange listed companies” and the five elements of internal control. This internal control information disclosure index system includes 9 primary indexes and 27 relevant secondary indexes (Table 33.2) and we equally evaluate every index-if one is disclosed in the annual financial report, it will be account 1 point, otherwise 0 point-instead of endowing different weight coefficient according to its importance. Through a comprehensive evaluation of various standards of the disclosure, we can calculate the internal control information disclosure index by the following equation:

$$CIDI = ICD/MICD$$

where *CIDI* is the internal control information disclosure index; *ICD* is the sum of points that each sample gains; *MICD* is the maximum value of the sum of points that each sample could gain.

**Table 33.2** Comprehensive evaluation system of internal control information disclosure lever

Primary index	Secondary index	Evaluation rules
Weaknesses and deficiencies	Weaknesses	Disclosed account 1 point, otherwise 0
	Corrective suggestion	Ditto
Building goals	Overall target	Ditto
	Analysis of reasonability	Ditto
Subsequent work	Overall target	Ditto
	Tasks Arrangement	Ditto
Evaluation report	Self evaluation report	Ditto
	Verification report of audit agency	Ditto
Internal control environment	Corporate governance structure	Ditto
	Organizational structure and distribution of responsibility	Ditto
	Enterprise culture and human resources policy)	Ditto
	Internal audit organization	Ditto
	Anti-corruption mechanism	Ditto
Internal control risk assessment	Targets of risk assessment	Ditto
	Risk identification process	Ditto
	Risk analysis progress	Ditto
	Risk response	Ditto
Internal control activities	Information technology control	Ditto
	Performance evaluation	Ditto
	Accounting system	Ditto
	Daily control activities of the board	Ditto
Information and communication	Communication mechanism to get internal information	Ditto
	Communication mechanism to get external information	Ditto
Inspection and supervision	Consecutive supervision and inspection	Ditto
	Special supervision and inspection	Ditto
	Inspection report	Ditto
	Specific measures for improvement	Ditto

### 33.3.4 Empirical Model

According to verify the hypothesis H, we create the following linear regression model:

$$|DA| = \beta_0 + \beta_1 * CIDI + \beta_2 * SIZE + \beta_3 * TOPF + \beta_4 * ROE + \varepsilon$$

where  $|DA|$  is absolute value of earnings management level;  $CIDI$  is the internal control information disclosure level;  $SIZE$  is firm size;  $TOPF$  is the ownership concentration, equaling the sum of proportion of the top five shareholders;  $ROE$  is the ratio of net profit to net assets. Moreover,  $SIZE$ ,  $TOPF$  and  $ROE$  are the control variables we chose.

## 33.4 Empirical Results

### 33.4.1 Descriptive Statistics

The descriptive statistics of each variable as Table 33.3 presents.

### 33.4.2 Correlation Test

Comparing the Pearson correlation coefficient between each variable indicates that significant correlation exists between the earnings management and internal control information disclosure level; the different extent of correlation among earnings management and firm size, ownership concentration and the rate of return on net assets respectively implies that control variables are appropriately selected; Explanatory variables and control variables, as well as control variables and control variables, have little correlation, informing us that multicollinearity problems can be controlled to a certain extent.

### 33.4.3 Regression Analysis

The results of the multiple linear regression of the model can be illustrated in Table 33.4. We could find that significant negative correlation exists between the earnings management and internal control information disclosure level in various industries. That is to say, firms with higher internal control information disclosure expose to lower level of earnings management. This result provides a strong evidence for hypothesis H.

**Table 33.3** The descriptive statistics of variables

Variables	Min	Mean	Median	Maxi	S. D
IDA1	0.0002	0.0869	0.0456	2.1998	0.1432
CIDI	0.03562	0.2751	0.2632	0.6316	0.0634
TOPF	10.19	49.5158	49.415	100	16.972
ROE	-0.9811	0.10321	0.0854	2.9187	0.1771
SIZE	0.65818	9.53892	9.5296	12.452	0.7389

Table 33.4 The results of regression

Variable	A	B	C	D	F	G	H	J	K
Inter	0.429 1.654	-1.724 -2.905***	0.142 3.022***	0.232 3.535***	0.506 4.476***	5.883 3.164***	-0.047 -0.359	-0.500 -1.559	0.089 0.710
CIDI	-0.884 -2.988***	-1.611 -2.533**	-0.085 -2.134**	-0.222 -2.910***	-0.402 -2.572**	-5.835 -2.438**	-0.738 -5.000***	-0.901 -2.117**	-0.350 -2.178**
TOPF	0.001 1.524	0.008 2.552**	0.000 -1.476	0.000 -1.204	0.001 2.189**	0.008 1.444	0.000 0.979	-0.002 -1.291	0.000 -1.121
ROE	-0.106 -1.455	0.259 1.275	0.099 5.320***	-0.062 1.423	0.018 0.184	-0.361 -0.233	0.059 2.187**	0.035 0.466	0.136 1.705*
SIZE	-0.016 -0.600	0.212 3.980***	-0.006 -1.275	-0.013 -1.966*	-0.041 -3.920***	-0.423 -2.338**	0.035 2.516**	0.102 3.165***	-0.010 0.715
Adj R <sup>2</sup>	0.159	0.273	0.050	0.211	0.243	0.151	0.288	0.091	0.114
F	2.659*	6.842***	8.230***	4.942***	7.346***	3.129**	9.178***	3.832***	2.794***

Note \*\*\*, \*\*, \* mean statically significant at the 1, 5, 10 % level

### 33.5 Conclusion

The empirical results of this research show that the higher the internal control information disclosure level is, the lower the enterprise earnings management extent is. This conclusion is helpful to explain the rationality and necessity of strengthening and improving enterprise internal control information disclosure system in our country. However, most of the domestic listed companies did not properly report internal control information in their annual financial report. Even if they do, many of them did not completely in accordance with the standard implementation. This trend undoubtedly will throw a huge obstacle to improve enterprise's internal governance structure, strengthen internal control level and develop excellent internal control system, thus negatively influencing the administrative level and the further healthy development of Chinese enterprise. Therefore, we consider that there is still a long way to realize that all the listed companies would voluntarily disclose internal control information according to the related regulations and requirements.

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# Chapter 34

## The Requirements of Fair Value Measurement on Market Environment

Fang Liu

**Abstract** The market environment in which fair value is applied is seldom touched upon by relevant researches of fair value. From three perspectives of value goal, definition and value evaluation, this paper analyzes the requirements imposed on market environment by fair value. Taking the market environment in emerging nation and the financial crisis environment as analysis models, this paper makes a deeper discussion and gets some enlightenment for the measuring of our country's fair value. Therefore, this analysis is of some practical meaning for institutionalizing the framework of fair value measurement with Chinese characteristics.

**Keywords** Fair value • Market environment • The fair value hierarchy • Valuation techniques

### 34.1 Introduction

No matter what situation the market is in, the judgment of market environment in fair value measurement is indispensable, and the differences of market environments would cause the differences of the implementing results of fair value standards by different countries. However, currently, both at home and abroad, the research has rarely touched the field of the market environment in which fair value applies. The theory of fair value research which takes IFRS 13 and the modified ASU NO.2011-4 of Topic 820 (the latest accomplishments of the joint program of IASB and FASB on fair value measurement) as representative has not made a systematic study on its market environment. Therefore, unfolding the research of fair value from the aspect of market environment, does not only perfect the theory

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of fair value measurement which taking our country's market environment as background, but also be beneficial for the reporting entity to deal with the problems of fair value measurement caused by the changing of marketing conditions, and also be helpful to resolve the shared and unique problems existed in the markets of various districts.

## **34.2 Requirements on Market Environment Imposed by Fair Value Measurement**

### ***34.2.1 Requirements on Market Environment Imposed by the Goal of Fair Value Measurement***

Firstly, William R. Scott summarized value obtaining into two means: the evaluation of value by discounting the future cash flow (direct method), and the evaluation of value by market value (indirect method) (Scott 2006). Under the ideal circumstances, the results of the two methods are the same. In realistic circumstances, due to the considerations of the uncertainty and the principle of cost-benefit, the evaluation of value often adopts the methods in which the price information is easy to get, namely the indirect method. When the reliable price information could not be obtained, the other value evaluation methods would be used, such as the income approach. IFRS13 has made clear that fair value measurement under the income approach is based on the current expected market value of the future amount (IASB 2011), and this is the direct embodiment of present value thought. Fair value contains the thoughts of present value and market price measuring (Xie 2008), and includes the two methods of price measuring in value evaluation in theory. To be precise, it realizes the process of dynamic similarity-approaching to value through the evaluation of price.

The constant pursuit of value measurement does not impose requirement of market environment on the fair value measurement. On the contrary, the diversified market environments become the backdrop of the fair value measurement. The selection of direct method or indirect method in the fair value measurement depends on the specific situation of market environment, thus leaving an extensive applicable market scope to fair value objectively.

### ***34.2.2 Requirements on Market Environment Imposed by the Definition of Fair Value***

Both IFRS13 and FAS157 define fair value as the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date (FASP 2006). This kind of definition

emphasizes the concepts of market orientation, exit price and orderly transaction. Orderly transaction assumes exposure to the market for a period before the measurement date to allow for marketing activities that are usual and customary for transactions involving such assets or liabilities; it is not a forced transaction. Compared with fair transaction, orderly transaction emphasizes that the transaction is customary, the fairness of transaction and the accessibility of transaction information, and its requirements is higher than fair transaction. In other words, if transaction is orderly, then fairness is the prerequisite. Compared with active transaction, the definition of active market requires that the active transaction must be consistent and its frequency as well as volume can provide enough price information (IASB 2009). The requirements of orderly transaction on transaction frequency and volume are lower than active transaction obviously, and the overall requirements are lower than active transaction. The orderly transaction which meets certain of conditions could become active transaction. However, the reduction of activity volume or level (the market is not active yet) does not anticipate that the transaction of market is not orderly (FASB 2009). Therefore, orderly transaction does not only exist in active market, but also exist in inactive market. Judging from the definition, the vocabularies such as measuring date, market participant and exit price generate accompanying with market transaction, and it is more suitable that these vocabularies are regarded as the limited conditions when the fair value is estimated, and it would not influence the fair value measurement realistically. What's more, orderly transaction and fair value come together. To be objective, as long as the orderly transaction exists, then the soil of fair value measurement exists.

Apart from the situation that the market environment is divided into active market and inactive market according to the activeness of the market, there are the concepts of principle market and the most advantageous market in the fair value measurement. The principles of principle market and the most advantageous market are used in the selection of the market in which exists many transactions of asset and liability, and do not raise new requirement on the market environment in which fair value is applied. Active market and inactive market, principle market and advantageous market are two set of parallel concepts, and there does not exist the relationship of containing and being contained between them. They categorize the markets of fair value measurement according to the different standards. Fair value is compatible with the different situations of the two sets of markets, and does not exclude the specific market type. From the micro-prospect, if there orderly transaction exists, then the prerequisite for measuring the fair value of asset and liability on measuring days exists. From the macro-prospect, active market and inactive market, principle market and the most advantageous markets are only the different types of market environments for the fair value measurement, and the market in which the orderly transaction of asset and liability takes place could be the market in which fair value is measured.

### ***34.2.3 Requirements of the Valuation of Fair Value on Market Environment***

1. *The influence on valuation of fair value by market environment.* Analyzing the market environment required by fair value measurement from the aspect of value evaluation, the influence on evaluation of fair value by market environment must be clarified firstly. The influence on evaluation of fair value by market environment could be analyzed from the inputs and valuation techniques. On the aspect of inputs, the situation of market environment can influence the accessibility of market data, and then influence the assumptions (inputs) that market participants would use when the price of asset and liability is confirmed. According to the accessibility of market data, the inputs could be categorized as observable value and unobservable value, and then be classified into the three levels of the fair value measurement (Bi-rong 2010). Among them, the inputs based on the market data, which could be regarded as observable, and could be used for the measurement of the Level 1 and Level 2 of the fair value hierarchy; the inputs based on the best information which could be obtained by the entity could be used for Level 3 measuring. Besides, the changing of market conditions can stir the transfer of the levels of fair value. On the aspect of valuation techniques, the situations of market environment always influence the selection and changing of valuation techniques directly and indirectly. The typical situation of indirect influencing is the degree of the accessibility of the inputs of market environment influencing, and then the degree of accessibility of inputs and the relative subjectivity become the important factor that influence the selection and changing of valuation techniques. For instance, the selection of the single valuation technology or multiple valuation techniques could not be separated from the analysis of market environment; the formation of new market and the changing of market condition are the important factors that push the adjustment and changing of value valuation techniques. Therefore, no matter analyzes from the aspect of inputs or the aspect of valuation techniques, the procedure of fair value valuation could not be independent from the judgment of market environment (Fig. 34.1).
2. *Requirements on market environment by valuation of fair value.* Seeing from the fair value hierarchy, fair value takes the assumed transaction as its basement firstly (Shi-chi 2010), releasing the market participant from the transferring of asset and debt service obligation. The subject must enter the market and it is unnecessary to engage in real transaction. This makes the fair value measurement apply in extensive market space possible. Secondly, the process of value evaluation could not be separated from the judgment of market environment. However, it does not exclude the specific market type. When the enough information of the market is accessible, and the entity or the third party could make the reasonable evaluation based on the perspective of market participant, combining the data obtained and applying the professional judgment, then the fair value measurement could take place. Finally, the influence of market

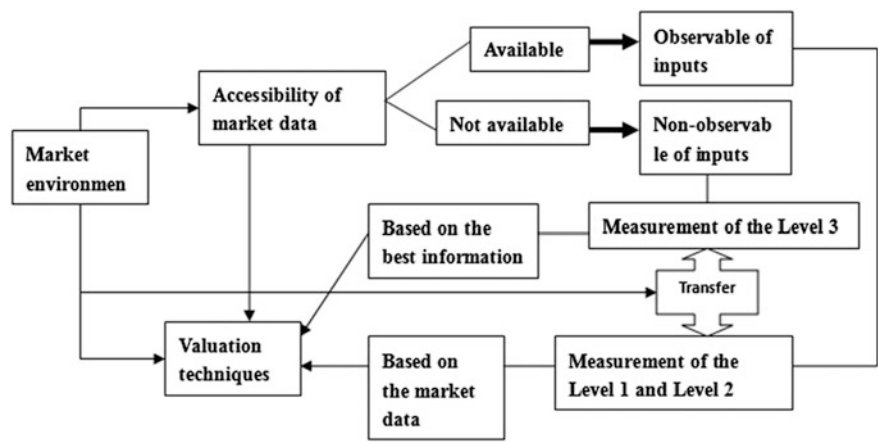


Fig. 34.1 The influence on valuation of fair value by market environment

environment on the valuation of fair value, no matter it is direct or indirect; its final resort is the application of valuation techniques. The development of valuation techniques, which takes present value as representative will make the indirect method for value measurement more feasible, and then reduce the dependence of market's quoted price. Therefore, fair value is of good market compatibility, and the requirement of it on market environment is low in fact. During the process of valuation, we shall not be limited to the judgment of market activeness. The key of whether the fair value measurement could be carried out depends on whether the information obtained could represent fair value. Take this as the standard, and the phenomenon that the measuring process stops when the market is inactive or the market quoted price could not be obtained directly could be avoided, and the misunderstanding that the fair value measurement is not suitable for the emerging country or the country in the process of economic transformation.

34.2.4 Summary

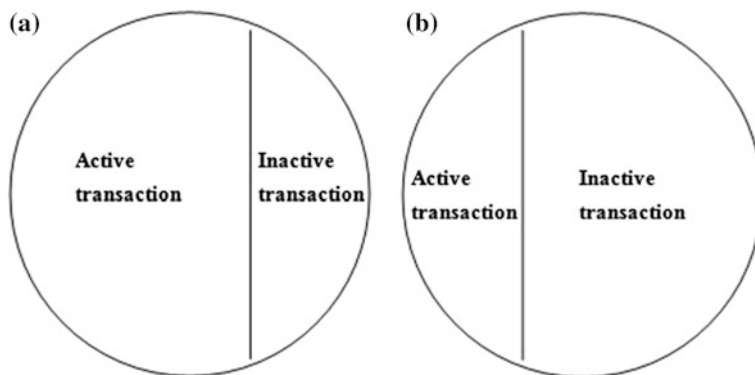
The various differences exist in the specific market in different phases (such as financial crisis period and financial flourishing period) or the different markets (such as the market environments of developed countries or regions, market environments of emerging countries) in the same period, so the market environments show the feature of diversification. The fair value measurement takes the diversified market environments as background, trying to reflect the real situation of economy. The goal of value measurement and the basement of virtual transaction provide extensive market space for the fair value measurement. The fair value measurement, which imposes little requirement on market environment

(Xie 2001) and has good compatibility, exists parallelly in active market and inactive market, principle market and the most advantageous market, does not exclude a specific market type. The market in which the orderly transaction of asset and liability takes place could become the market in which the fair value measurement takes place, and the key point whether the fair value measurement could be adopted depends on that if the information obtained represents fair value.

### **34.3 Analysis on the Two Typical Situation of the Market Environment in Which Fair Value is Applied**

#### ***34.3.1 Market Environment of Emerging Market Economy Country***

Due to the differences of economy, politics and consumer's preference, the differences and unevenness of accounting environment exist indeed (Barth 2008), and the activeness which the same asset (liability) shows is of great difference. From macro-prospect, the grand market environment in which the transaction of all the types of asset and liability are active does not exist. Under the active market environment, the active transaction prevails, making the overall situation of the market active, or vice versa. As for the emerging market economy country, compared with developed country, the activeness of its market environment is relative. In the market environment of emerging market economy country, the situation that the overall market activeness of some asset or liability is lower than developed country must exist, and the contrary situation also exists. However, both the two situations need the three level measurement of the fair value hierarchy unavoidably, and only the measuring scope is different. Due to the strict definition of active market, the common market environment could not meet the definition generally. As for our country, the percentage of the situation in which the active market price of the same asset or liability is adopted makes up about 30 % (Min et al. 2011). What we face up more is the fair value measurement under the situation of inactive market or even the much extremer situation (such as financial crisis). In other words, the chances of the fair value measurement on the Level 2 and Level 3 would be more. From the above, as for the emerging economy market country, the three-level fair value measurement in its market environment exists surely, and the situations which are relevant to the Level 2 and Level 3 measuring are more relatively. Therefore, improving the accessibility of market data and perfecting the valuation techniques of fair value under the inactive market environment are essential to resolve the problem of fair value measurement (Fig. 34.2).



**Fig. 34.2** Two situations of macro-market environment. *Note* Active market environment (a), inactive market environment (b)

### 34.3.2 *Environment of Financial Crisis*

1. *Positioning of financial crisis environment.* In the development of human beings' economy, the occurrence of financial crisis has never been rare. As the high-speed development of global financial industry, the frequency of financial crisis becomes higher and the infectiveness becomes stronger, showing the characteristic of diversification. Since the financial crisis of this time began to take shape on 9th Aug 2007, it has swept across the world overwhelmingly, the debt that whether fair value shall be preserved stirred by the financial crisis has caught the concern of accounting community. Indeed, the action of "killing messenger" is naive. However, the fact that the bursting of financial crisis reveals the defect of fair value's theory could not be denied. Therefore, to study the financial crisis environment may fill the blank space of the theory on the fair value measurement.

In the environment of financial crisis, the balance of money market is been disproportionate, then the financial products of stock market, bond market and the other capital markets taking a nosedive sharply, temporally or in extensive-period, and the capital feeing, the normal bank credit relations collapsing, making many financial establishments closed. Under such circumstances, compared with the measuring in normal market period, the fair value measurement would be more strict and harsh. Seeing from the rules of economic development, although modern financial crisis shows certain of precedence and period extension, its generation is always indispensable with the periodic fluctuation of economy.

However, as the periodic fluctuation of economy, the specific market will show a relative active or inactive status. The overall activeness of macro-market touches the lowest point during financial crisis, and touches the peak during the flourishing time of economy. The fair value measurement covers different market period and does not exclude specific market type. The positioning of crisis environment in the measuring environment of fair value shall be objective, or not excluding it from the fair value measurement when many measuring problems are faced up.

The financial crisis environment, which is a special situation for the fair value measurement, could be confirmed as the extreme situation of inactive market environment (Ting-qing and Shi-fen 2011). The occurrence of financial crisis could not be the reason that rejects the fair value measurement (Xie et al. 2010). On the contrary, it will become the most preferential material to enrich the theoretical system of fair value.

2. *Problems of fair value valuation under the circumstance of financial crisis.* Financial crisis is the extreme situation of market environment of fair value measurement, and its phenomenon in the market environment of fair value measurement are: market tends to be irrational on the whole; the volume and level of activity descends outstandingly; the fluidity lacks; amount of active transaction decrease sharply; the fairness of transaction and publicness of transaction information is ruined; inactive transaction or even the transaction which is not orderly is full of market; little information could be accessed publicly; There is a wide bid-ask spread or significant increase in the bid-ask spread; transaction price could not represent fair value; and the market price quotation shows an outstanding difference and so on. Under such market environment, the accessibility of market data becomes the first problem imposed on fair value measurement. The data mastered by the report entity and the subjective speculation are applied more, so the regulation on operation and more forcible supervision is needed, and also the reporting subject's professional capability faces a great challenge. What's more, the problem of risk mitigation reasonableness under the circumstances that the fluidity risk and credit risk shot up (Barth et al. 2008), the judgment of orderly transaction and the applicable problem of the valuation techniques and its environment, the reasonableness of the fair value measurement when multiple valuation techniques for value evaluation is adopted and the problem that lacks systematic guidance, all of these have raised a great challenge for the professional judging ability of the reporting subject. Therefore, the fair value measurement under crisis environment becomes very knotty. The fair value measurement under inactive market especially the extreme market environment still needs more detailed and more feasible guidance.

### **34.4 Inspiration for Our Country's Fair Value Measurement**

Our country is a representative of the newly emerging market economy. Judging from the situation of our country, institutionalizing the independent rules of Fair Value Measurement is an important means for the convergence of our country's enterprise's accounting rules with international financial reporting system. However, the differences if the market environment in which the rules apply are the first problem that limits the development of fair value measurement of our country (Barlev and Haddad 2007). Therefore, the precise positioning of our country's

market environment shall be done firstly. In the market environment in which fair value measurement applies, is the overall situation of our country's market environment the active market or the inactive market? How much is the converging degree? In the micro market, what the proportion of the active transaction and the inactive transaction of a certain asset or liability are? What about the distribution of the measuring involved in the levels of the fair value hierarchy? Correspondingly, what kind of value valuation techniques is suitable? All these problems need to be considered in the positioning of our country's market environment. Secondly, the rule-making authority (represented by FASB and IASB) has been influenced more by the economic situation of the developed country in the process of rule-making. Therefore, during the convergence of our enterprise's accounting standards, the compatible problem of rules and environment must be very outstanding, so it is very necessary to deal with the compatible problem of fair value and its applying environment (mainly the market environment). The measures to deal with the compatible problem shall be dual-direction. It is unsuitable to emphasize that the rules shall meet the environment, and the perfecting of applying environment and establishing the system that could predict reasonably the future market environment shall be attached more attention. Finally, compared with the developed country, what can be confirmed is that our country's market environment resembles more the inactive market environment, so the fair value measurement on the second and third level would be relatively more. What's more, fair value measurement in special period of market is the problem which both our country and the developed country have to face up. Thus, the more feasible measures to improve the accessibility of market data and the more perfect guidance for fair value measurement in inactive market environment are needed urgently.

### 34.5 Conclusion

Fair value is the measuring property which takes value measurement as its final goal. It has the fine market compatibility and does not exclude a specific market type. The market in which asset or liability is transacted orderly could become the market in which fair value measurement takes place. However, the key of whether fair value measurement could be adopted lies in that whether the information obtained could represent fair value. Financial crisis environment and the country of newly-emerging economy are the typical market environments for applying of fair value, and also the preferential materials for the research of fair value. Combining the characteristics shown by fair value measurement in the two environments, judging from the realistic situation of our country, several inspirations for our country's fair value measurement could be obtained, and there exist some practical meanings for establishing the framework of fair value measurement with Chinese characteristics.

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# Chapter 35

## The Study on Non-linear Relationship Between Shareholding Ratio of the Largest Shareholder and Corporate Performance

Ji-xiao Xu, Wen Gu and Bo Gu

**Abstract** As the foundation of corporate governance structure, ownership structure ultimately decides corporate performance. In this paper, we study on relationship between ownership structure and corporate performance, and results show that shareholding ratio of the largest shareholder and corporate performance is three times curve; along with the increase of shareholding ratio of the largest shareholder, corporate performance assumes the variation tendency of decline-rise-decline; shareholding ratio of the largest shareholder has incentive effect and entrenchment effect on corporate performance; debt-asset ratio and number of directors are significantly negatively related with corporate performance; companies' size is significant positive related with corporate performance.

**Keywords** Corporate performance · Non-linear relationship · Ownership structure · Shareholding ratio of the largest shareholder

### 35.1 Introduction

In 1932, Berle and Means studied the relationship between equity dispersion and corporate performance for the first time, since then, the relationship between equity and corporate performance became the focus of attention of the academic circles. Ownership structure refers to the proportion that share which has different

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natures accounts for in company's total equity and their relationship. It also refers to the holding proportion by different stockholders accounts for company's total shares (Sun 2011). Ownership structure is the foundation of corporate governance structure, and corporate governance structure is the specific operation form of ownership structure. Big shareholders holding are a core problem in corporate governance. In both developed and developing countries, there are the phenomena of big shareholders holding, but in Chinese listed companies, big shareholders holding is a common phenomenon. Chen and Xu (2001) found that share ratio of the largest shareholder and corporate performance is positive correlation in non-protective industry. Gorton and Schmid (2000) found that banks holding large shares improved corporate performance in Germany. In this respect, the big shareholders play a positive role on the company's management. However, Claessens et al. (2002) found the control powers and cash flow right of controlling shareholders was separated higher, the benefits of small shareholders violated by large shareholder would be more seriously. It is visible that big shareholders have dual characters in corporate governance.

This paper introduces several related control variables between holding ratio of big shareholders and corporate performance, establishes a model, testes it by the White test, revises the model which existing heteroscedasticity by weighted least squares, and finally builds three function curve model to empirical analysis of relationship between holding proportion of big shareholders and corporate performance and analyzes forming reasons briefly.

## 35.2 Literature Review and Hypotheses

Foreign scholars study ownership structure and corporate performance of listed companies mainly from two aspects: one is to investigate the relationship between holding ratio of internal shareholders and corporate performance. Jensen and Meckling (1976) showed that holding ratio of internal shareholders decided companies' value, and with the increase of holding ratio of internal shareholdings, companies' value also increased. McConnell and Servaes (1990) found that the ratio (called Tobin Q value) of enterprises' market value, capital replacement cost and the shareholdings of companies' internal shareholders had an inverted U-shaped relationship. Two is to examine the relationship of equity concentration and corporate performance. Shleifer and Vishny (1986) considered the companies which had high ownership concentration had higher profitability. Claessens et al. (2002) and Lins (2003) found that shareholding ratio of large shareholdings and companies' value were positive correlation; while Holderness and Sheehan (1988) and Demsetz and Villaonga (2001) considered there was no correlation between ownership structure and corporate performance.

In China, scholars focus on studying the influences of different equity on corporate performance and the relationship between shareholding ratio of large shareholders and corporate performance. En-zhong (2007) used segmented model

to represent relationship between ownership structure and corporate performance, and confirmed that the big shareholders were more willing to supervise companies; companies which controlled by big shareholders was more favorable to play supervision mechanism than those whose equity was scattered. Zhang et al. (2009) found that proportion of state shares and corporate performance were not related; proportion of state-owned shares and corporate performance was a U relationship; proportion of social legal person share and corporate performance were non-linear relationship. Mian Du and Liang Gu (2010) evidenced that shareholding ratio of large shareholders and corporate performances were causal relationship each other by Panel-date Granger causality test. Shan-min Li and Xiao-chun Zhou (2007) demonstrated shareholding ratio of the largest shareholder of private enterprise which listed directly and corporate performance had positive linear relationship; shareholding ratio of large shareholder of private enterprise which listed indirectly and corporate performance had non-significant non-linear relationship, or they were not related.

Through literatures review, it can be found that most scholars at home and abroad only inspect linear relationship between big shareholders and corporate performance, and fewer studies non-linear relationship between them. Therefore, we put forward hypotheses:

**Hypothesis 1:** *Shareholding ratio of the largest shareholder and corporate performance has significant positive correlations.*

**Hypothesis 2:** *Shareholding ratio of the largest shareholder and corporate performance has non-linear relationships.*

## 35.3 Empirical Analysis

### 35.3.1 Variable Selection

Along with the establishment, perfection and development of Chinese socialist market economic system, there are more and more listed companies. From the listed companies point, enterprises' profitability is the most important performance measuring index of enterprise managers and is the breakthrough of problems finding and management improving. So it should be measured by some special index, such as EPS, paying dividend ratio, price/earnings etc. except ROA and ROE. This article chooses EPS as dependent variables to measure corporate performance.

The largest shareholder is always in control in listed companies, a series of problems will be affected by the largest shareholder, and its influencing degree is related to shareholding ratio, so we select the ratio R as independent variable, which is shareholding ratio of the largest shareholder. The control variables includes debt-asset ratio(DEBT for short), companies' size(LNA for short), and number of directors(BSIZE for short).

**Table 35.1** Descriptive statistics

Variable	Maximum	Minimum	Mean	Median	Std.Dev
EPS	5.0484	-1.1200	0.5800	0.4000	0.2656
R(%)	74.0900	0.0006	30.9803	12.1586	43.8119
DEBT	9.8411	0.0128	0.4203	0.4225	0.1225
BSIZE	18	5	8.5	9	2.1213
LNA	26.4143	15.7152	22.3940	21.4682	0.9812

EPS = Net profit/total quantities; R = Shareholding ratio of the largest share holder; DEBT = Total debt/total assets; BSIZE = The number of directors; LNA = The natural logarithm of total assets

### 35.3.2 Descriptive Statistics of Sample

This paper uses 2011 data of A-share listed companies in Shanghai Stock Exchange as research object. In the process of sample selection, we eliminate financial companies and the companies whose data are incomplete, finally 572 sample companies meet the requirements. Data are from CSMAR database, and Eviews 6.0 software is as modeling tool and data processing tool. Descriptive statistics shows as Table 35.1.

Viewed from Table 35.1, we can learn that the average shareholding ratio of the largest shareholder is 30.9803 %, which means Chinese listed companies are generally controlled by big shareholder.

### 35.3.3 Empirical Model and Hypothesis Testing

In order to test the hypotheses, establishing the following empirical model:

$$EPS = \alpha + \beta_1 R + \gamma_1 DEBT + \gamma_2 BSIZE + \gamma_3 LNA + \varepsilon \quad (35.1)$$

$$EPS = \alpha + \beta_1 R + \beta_2 R^2 + \gamma_1 DEBT + \gamma_2 BSIZE + \gamma_3 LNA + \varepsilon \quad (35.2)$$

$$EPS = \alpha + \beta_1 R + \beta_2 R^2 + \beta_3 R^3 + \gamma_1 DEBT + \gamma_2 BSIZE + \gamma_3 LNA + \varepsilon \quad (35.3)$$

In equation,  $\alpha$  represents constant,  $\beta_1, \beta_2, \beta_3, \gamma_1, \gamma_2, \gamma_3$  represent coefficients. Doing an ARCH test on Regression model with a White-test, and handling with it by weighted least squares, results shows in Tables 35.2, 35.3 and 35.4.

It can be seen from Table 35.2, Adj.R<sup>2</sup> of regression equation is 0.139941, meeting the general research trend; and F value is 23.82, which is significant at level of 1 %. They demonstrate that the overall significance of equation is very good and it has statistical significance. D-W value is 1.87, meaning that each variable is independent and has no collinearity. From the regression of variables,

**Table 35.2** Model (1)

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	-1.863794	0.372365	-5.005293	0.0000
R	-0.008932	0.00121	-7.383875	0.0000
DEBT	-0.092966	0.036088	-2.576087	0.0102
BSIZE	-0.028745	0.012408	-2.316722	0.0209
LNA	0.130372	0.01865	6.99079	0.0000
R <sup>2</sup>	0.146074	Durbin-Waston stat		1.872096
Adj.R <sup>2</sup>	0.139941	F-statistic		23.82027
S.E	0.478301	Prob.(F-statistic)		0.000000

**Table 35.3** Model (2)

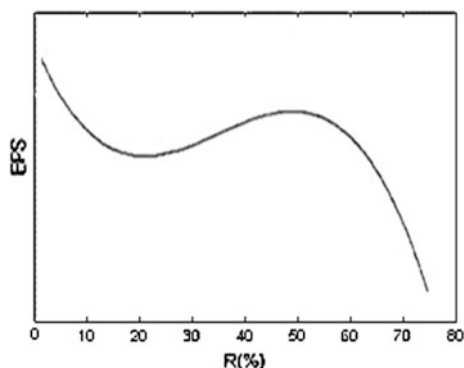
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.789829	0.370886	-4.825817	0.0000
R	-0.018824	0.003660	-5.143761	0.0000
R <sup>2</sup>	0.000188	6.57E-05	2.861731	0.0044
DEBT	-0.085819	0.035944	-2.387556	0.0173
BSIZE	-0.028972	0.012329	-2.349968	0.0191
LNA	0.129629	0.018533	6.994643	0.0000
R <sup>2</sup>	0.158469	Durbin-Watson stat		1.861542
Adj.R <sup>2</sup>	0.150901	F-statistic		20.94009
S.E.	0.475244	Prob.(F-statistic)		0.000000

**Table 35.4** Model (3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.753809	0.368446	-4.760022	0.0000
R	-0.039917	0.007918	-5.041349	0.0000
R <sup>2</sup>	0.001145	0.000326	3.514772	0.0005
R <sup>3</sup>	-1.07E-05	3.55E-06	-2.998318	0.0028
DEBT	-0.081260	0.035721	-2.274860	0.0233
BSIZE	-0.029912	0.012245	-2.442773	0.0149
LNA	0.131367	0.018410	7.135673	0.0000
R <sup>2</sup>	0.171883	Durbin-Watson stat		1.890621
Adj.R <sup>2</sup>	0.162930	F-statistic		9.19916
S.E.	0.471866	Prob.(F-statistic)		0.000000

we can see the regression coefficients of shareholding ratio of the largest shareholder (R) is significant at level of 1 %, which shows that the share ratio of the largest shareholder and corporate performance has significantly negative correlations. It's opposite to the positive correlation of hypothesis 1, so hypothesis 1 is rejected. The Model (1) indicates that the lower shareholding ratio of the largest shareholder is, the better corporate operating performance will be, hence it is not advisable to blindly increase shareholding ratio of big shareholders.

**Fig. 35.1** The relationship between shareholding ratio of the largest shareholder and corporate performance



According to Tables 35.3 and 35.4, although the regression coefficients of shareholding ratio of the largest shareholder and its square are significant in Model (2), the regression coefficient of Model (3) is more significant than that, and the regression coefficient of shareholding ratio of the largest shareholder's, its square and cubes are all significant at 1 % in Model (3). The square regression coefficient of shareholding ratio of the largest shareholder is 0.0005 in Model (3), which is more significant than 0.0044 in Model (2). So compared with Model (1) and Model (2), Model (3) has the best goodness-of-fit ( $\text{Adj. } R^2 = 0.162930$ ), which indicates that the shareholding ratio of the largest shareholder and corporate performance have cubic power relations. Meanwhile the test of quadruplicate and quintic equation are not higher goodness-of-fit than cubes, so hypothesis 2 is proved.

As shown in Fig. 35.1, along with the increase of shareholding ratio of the largest shareholder, corporate performance appears a change trend as decline-rise-decline, which means that shareholding ratio of the largest shareholder has both defensive effect and incentive effect on corporate performance. And the coefficients of DEBT, BSIZE are markedly negative correlation with EPS at level of 5 %, and the coefficient of LNA is markedly positive correlation with EPS at level of 1 %. They means that the higher debt-asset ratio is, the worse corporate performance will be; the more number of directors is, the worse corporate performance also will be; the more Companies' total assets is, the better corporate performance will be.

## 35.4 Conclusion and Limitation

The empirical research results show that shareholding ratio of the largest shareholder has both defensive effect and incentive effect on corporate performance. Research finds that there are three function curve relation between shareholding ratio of the largest shareholder and corporate performance, that is, with increase of

shareholding ratio of the largest shareholder, corporate performance appears variation tendency of decline-rise-decline. When shareholding ratio of the largest shareholder is low, the control power of the largest shareholder and cash flow right are significantly separated, which impels the largest shareholders to make use of controlling status to encroach interests. Lower cash flow rights will make the largest shareholder germinate the motivation of transferring companies resources; "Emptied assets" behavior of the largest shareholders would strengthen with increase of shareholding ratio, consequently corporate performance decreases. With shareholding ratio of the largest shareholdings rises continuously, the separation degree of control power of the largest shareholder and cash flow right begins to reduce; the private interests of "Emptied assets" behavior can not make up losses of corresponding cash flow rights; the exploitation motivation of the largest shareholder begins to diminish, and they will have a strong incentive to improve corporate performance, thus which leads to the incentive effect of the largest shareholder towards corporate performance. When the shareholding ratio of the largest shareholder reaches a very high level, the ability of the largest shareholders to spread the investment risk will weaken dramatically. In order to spread its own risk, the largest shareholder initiate seeking for conservative investing and financing policy, make companies deviate from the ideally optimal model, and cause dropping of corporate performance.

This paper also found that corporate performance is remarkable negative correlation with debt-asset ratio and number of directors, and it is significant positive correlation with companies' size. When debt-asset ratio is high, it means that capital structure of companies may be problems, and companies' interior may exists risk of capital turnover. In this case, if companies encounter fund difficulties, it is hard for companies to get rid of difficulties because of high debt-asset ratio, which affects corporate performance, and leads to corporate performance becoming bad. When number of directors is too many, the process of coordination and organization of companies will be more complicated. Members of directors may generate motivation of hitch-hike, and the sense of responsibility of each director will weaken, which is adverse to monitor big shareholders, makes benefits of control rights increase, and thus result in falling of corporate performance. When the more companies' total assets are, the more assets that companies own or control that can bring economic benefits will be which will have correspondingly stimulative effects for corporate performance.

The studies also have some limitations: there are no studies on what are the specific reasons causing three function curve relationship between shareholding ratio of the largest shareholder and corporate performance; or there are no specific researches on through what way that ownership structure affects corporate performance. In addition this paper also did not consider that shareholding ratio of other several major shareholders impacts on the behavior of the largest shareholders. These problems are worth studying in the future.

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# Chapter 36

## Trading Volume Movement Versus Price Change: The Volume Shock Around Earning Announcement in Chinese Stock Market

Hong-ru Wu

**Abstract** In general, large trading volume with small or even absence of price change can be investigated around event period frequently by international researchers, and attracts much attention from various studies. Major explanation for this phenomenon is that there is an information precision or differential perception about the information for informed traders as well as for liquidates traders. The paper discusses relationship between trading volume and price change under Chinese stock market case. By using basic concept Kim and Verrecchia propose as well as Kandel and Pearson' model, the paper provides findings on informed traders' behavior and volume shock premium, suggesting that the methods can be further applied to investigate investors behavior in Chinese stock market.

**Keywords** Price change · Stock market · Trading volume · Volume shock

### 36.1 Introduction

Bamber (2007) initiated trading volume study, suggesting that the trading volume could be used as an important indicator for explaining differences of consensus among investors under given information released. However, price changes reflect changes in the aggregate market's average beliefs, while in contrast, trading volume is the sum of all individual investors' trade, or actions (Kim and Verrecchia 2002a), which means that trading volume would generally preserve different believes among individual investors, but those differences in the price would be "cancelled out" in terms of averaging (off-setting) process.

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One of the most important features in trading volume study is difference between volume and price changes movement. On the one hand, empirical evidence of a positive relation between share volume and stock price volatility is documented by a number of researchers using a variety of methods. Supports for this relation are found in Schwert. Andersen (2006) uses a random sample traded on the New York and the American Stock Exchanges between 2002 and 2004. His findings confirms that the absolute value of the price change is positively correlated with trading volume, and shows that strong volume is associated with extreme price movements, both positive and negative. However, on the other hand, significant inharmonic relations between volume movement and price change exist, especially during earnings announcements. Karpoff (2007) reports that the correlation between price change per se and volume is statistically insignificant for futures markets while it is positive and statistically significant for equity markets. In general, large trading volume with small or even absence of price change can be investigated around event period frequently by international researchers, and attracts much attention from various studies. Major explanation for this phenomenon is that there is an information precision or differential perceptions about the information for informed traders as well as for liquidate traders (Schwert 2011).

## 36.2 Literature Review

Various theoretical studies suggest that trading volume changes (either from small trading to large one or vice versa) when investors revise their beliefs differently (Atiase and Bamber 2004). Bamber and Cheon's (2005) study on differences between trading volume move and price change shows that only 11–18 % samples having similar magnitudes of trading volume and price change, others perform independent characters between price change reaction and trading volume reaction to earnings announcement, with 20–24 % extremely different. Their research proves that earnings announcements that generate a high trading volume reaction relative to price reaction are associated with (1) more divergent financial analysts (pre-disclosure) earnings forecasts. (2) a large analyst following. (3) the higher random-walk-based unexpected earnings relative to analysts-based unexpected earnings and (4) price increases. These results are broadly consistent with the notion that trading volume reaction is likely to be high (relative to price reaction) when an announcement generates differential belief revisions among individual investors (Bamber and Cheon 2005). Kandel and Pearson provide a model to describe that trading coincident with small price changes, e.g., large level of revision, reflects investors' differential interpretations of information, which is inconsistent with conventional models of trade that assume homogeneous interpretations. And further research conducted by Foster and Vishwanathan (2010) supports K–P measures, and at the same time summarized that differential belief revision around public announcements can arise from either, (1) differential interpretations of the news, or (2) differences in the precision of investors'

pre-disclosure information. Among major international studies, we find that the models Kim and Verrecchia (2002b, 2007) proposed are more systematic and important for our empirical studies. Kim and Verrecchia (2002b) provide basic K–V model to show that expected trading volume purely has a linear relation to absolute price change, with a zero intercept. Kandel and Pearson, on the other hand, provide a different model to explain that empirically volume can arise without price change. Kim and Verrecchia (2007) then propose a more complete model in describing possible differences between volume move and price change. They believe that private information can be generally classified as two types of anticipations of a public announcement, namely, pre-accessed information (it can be defined as pre-announcement information) and information in conjunction with a public announcement (defined as event period information). Here pre-announcement information is considered usually as not to be fully released through earnings announcement, therefore can be further exploited after the announcement. These two kinds of anticipation often act together, and thus the new K–V rational model (2007) incorporates with both types to reflect the “real market”. In fact, six kinds of information are suggested to act differentially to influence investors in event period.

### 36.3 Research Design

If one considers speculations by informed traders, then there should be a complete cycle of buying (or selling) a particular share in pre-disclosure period and selling (buying) that share during earnings announcement process. Especially, well informed traders in the pre-disclosure period would exploit their information advantage by aggressive trading (extremely large trading) and starting their trade well before the announcement and completing their speculation cycle right around the event period. We consider that speculation trading can create differential trade either through opposite direction trading or through different trading magnitude. However, in Chinese stock market case, there are some differences. One of the important features is that there is no short-sell mechanism in Chinese stock market case, therefore, informed traders, when they access “bad news” during pre-disclosure period, cannot exploit this asymmetric information advantage over other non-informed traders, unless they hold the related shares before information comes. Due to the same reason, informed traders in this case can hardly operate any speculation over certain shares through completing the selling-buying cycle. Thus, we can separate those informed non-speculators from other informed traders who may involve speculation.

It should be noted that non-informed traders, or liquidate traders, not only create noise trading but also provide necessary condition for well informed trader to fulfill their speculation process.

Clearly, if informed traders all trade large quantities, the most important influencing factor on price is the volume of large trades, rather than overall trading

volumes. Thus volume shock, rather than overall trading volume, is more important. This paper defines a reference period to compare volume shock relative to normal amount of trading, accompanied by level of excess return (relative to average level during reference period). We borrow concepts from model derived by (Kim and Verrecchia 2002b, 2007) and from model defined by Kandel and Pearson to include our analysis in following equation:

$$V_{it}/v_{i\_average} = D_{it} + K_{it} \cdot [|\Delta P|_{it}/|\Delta P|_{i\_average}] \quad (36.1)$$

Clearly, if trading volume moves correspondingly with absolute price move during certain period  $t$  (in this case,  $K_{it}$  should be larger), then there should be smaller dispersion and higher convergence, and time  $t$  can be informed traders dominant if time  $t$  is in pre-disclosure period, or time  $t$  can be all traders dominate, if  $t$  is in event period. On the other hand, if large trading volume moves differently with price change, it should be reflected by smaller  $K_{it}$ , or larger standard deviation among samples (in this case the model cannot be significant), this means larger dispersion and divergence among investors' behavior, and time  $t$  can be informed trader dominant if  $t$  is in pre-disclosure period, or time  $t$  can be speculators dominant if  $t$  is in event period. We further divide sample into two categories in order to show whether this proposition is empirically significant. One group includes samples of negative return group, or "bad news" group, meaning that samples in the groups suffer major decrease in price and negative returns during pre-announcement period. The other group is composed of samples of non-negative return group without such major decrease in price. For volume shock, on the other hand, if trading volume is extremely large, which is usually driven by informed speculators, there should be very large dispersion if measured with model 1. Considering that speculators will complete cycle to fulfill their premium, there has to be a time lag between trading volume move and price change. Therefore we propose following model to predict behavior of that trading volume shock.

$$|Accumulative\ Return|_{i.T} + N = Q_{iT} + G_i * Large\{V_{iT}/V_{i\_average}\} \quad (N = 0, 1, 2, \dots) \quad (36.2)$$

By exploiting this model, any group, or portfolio, of shares with extremely large trading volume (we define such kind of trading volume as 8 times higher than average volume in reference period), in time  $T$  period, can be tested if the shares' accumulative return is positively related to the trading volume move in the time period  $T$  and particularly after  $T$ . In this model, the most concerned parameter is  $G_i$  as it can be used to show the level of positive influence on accumulative return from trading volume, provided that the model is hold and the Beta is significant.

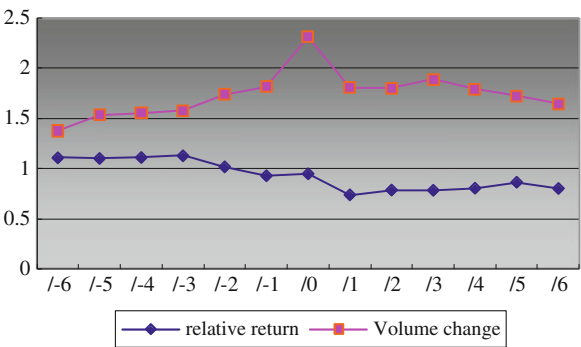
36.4 Empirical Study

The empirical study is conducted based on a database of 1,200 earnings release in 2010 and 2011, representing annual earnings of those sample companies in 2009 and 2010 respectively, based on China Security Week database. This paper, however, only provides part of the empirical study on 700 samples in 2010 fiscal year (the announcements are primarily scattered in first season in 2011). The total testing periods for all samples are divided into four sections: namely, reference period, pre-announcement sections, public announcement period (or event period), and post-event period. We determine our trading volume move and price change move by comparing the volume and price change in investigation window to ones in reference periods. Normal volume is calculated as mean volume over a 30 day duration (defined as reference period) prior to the investigation window. Major investigation window is defined from 19 days before announcement till 19 days after the announcement, including news release date 0, thus totally 39 days.

Figure 36.1 provides overall pattern of relationship between trading volume and price change over investigation window for all 660 samples. It can be seen that there is less connection between them. Although there is a positive trading increase during earnings release, the price change does not correspondingly move.

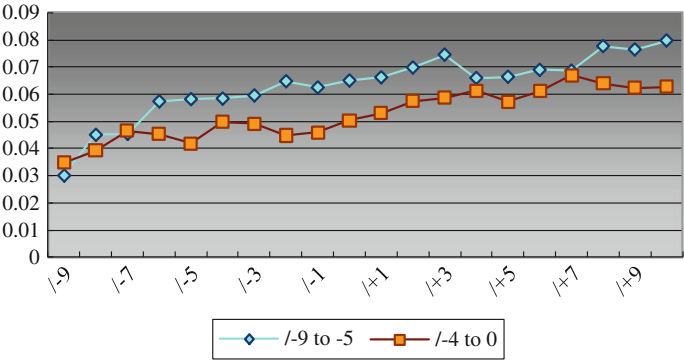
By using the proposed model (2) in Sect. 36.3, we divide the volume shock into two groups, one with volume shock happening in early period (−9 till −5 days) before the announcement, representing well informed traders, the other with volume shock in latter period (−4 till 0 days) before or at the announcement. Table 36.1 provides influencing pattern of volume shock on related accumulative return over period. From the results, we can see that only well informed traders can obtain extra accumulative return in the trading, especially after the trading, which would serve as best condition for them to fulfill their speculation. On the other hand, in-significant relation between volume shock with accumulative return shows that less informed traders, represented by volume shock nearer to announcement have little opportunity to access any extra accumulative return.

Fig. 36.1 Trading volume and price change: total samples



**Table 36.1** Accumulative return driven by large {VIT/VI\_Average}

Windows	T = -9 to -5			T = -4 to 0		
	Beta	Sig	R2	Beta	Sig	R2
-9	0.533	0.005	0.284	N/A	N/A	N/A
-8	0.721	0.000	0.520	N/A	N/A	N/A
-7	0.882	0.000	0.676	N/A	N/A	N/A
-6	0.610	0.001	0.372	N/A	N/A	N/A
-5	0.354	0.076	0.126	N/A	N/A	N/A
-4	0.588	0.001	0.345	0.318	0.043	0.101
-3	0.393	0.043	0.154	0.294	0.062	0.086
-2	0.267	0.177	0.072	0.257	0.105	0.066
-1	0.478	0.012	0.228	0.104	0.519	0.011
0	0.526	0.005	0.276	0.194	0.225	0.038
+1	0.501	0.008	0.251	0.068	0.671	0.005
+2	0.406	0.035	0.165	-0.083	0.604	0.007
+3	0.408	0.035	0.167	-0.008	0.960	0.000
+4	0.347	0.076	0.121	0.011	0.944	0.000
+5	0.416	0.031	0.173	0.127	0.427	0.016
+6	0.388	0.046	0.150	0.137	0.394	0.019
+7	0.204	0.308	0.042	0.158	0.324	0.025
+8	0.160	0.426	0.026	0.137	0.394	0.019
+9	-0.030	0.881	0.001	-0.140	0.929	0.000
+10	-0.035	0.864	0.001	0.108	0.501	0.012



**Fig. 36.2** Comparison of accumulative return between early and latter volume shock

Figure 36.2 shows overall gap of accumulative return between early volume shock and latter volume shock, representing that well-informed traders’ potential profit from their speculations.

## 36.5 Conclusion

Conclusion can be made as follows:

1. K–V model proves to be useful in explaining informed traders' movement in Chinese market, particularly in case of speculation.
2. There is certain level of relationships between trading volume and price change in Chinese market, particularly in negative return group.
3. Differential level among investors around announcement in China can indicate informed traders' behavior, and related speculation.
4. There is a larger trading around announcement in Chinese stock market, and dispersion is related to trading volume.
5. Volume shock in early time before the announcement indicates potential abnormal premium, and speculation opportunities.

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# Chapter 37

## An Analysis of TNCs' Investment Motives and Their Impact on Host Countries' Industrial Security

Xian-yong Zheng and Chun Hu

**Abstract** Since there are differences between transnational corporations' investment motives and host countries' goals of attracting investment, the actual investment behaviors of transnational corporations may cause negative impacts on host countries' industrial security. Based on the non-cooperative dynamic game model between transnational corporations and host countries, it is not difficult to find that host countries can take certain encouraging or restraint mechanism, namely 'positive institutional arrangement' to force transnational corporations to abide by the arrangement in the process of investment in order to better maintain industrial security.

**Keywords** Host countries • Industrial security • Non-cooperative dynamic game • Transnational corporations-TNCs

### 37.1 Investment Motives Analysis of Transnational Corporations

In an increasingly integrated world economy, transnational corporations have become the core organizers of economic activity and major undertakers of international investment activities. Because of the different motives of transnational

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Based on Non-cooperative Dynamic Game Model.

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corporations' foreign investment including mergers and acquisitions led to the different investment behaviors, transnational corporations' investment motives may indirectly affect host countries' industrial security (Berger 2008).

According to eclectic theory of international production, transnational corporations would be affected by ownership advantages, location advantages and internal advantage when engaging in international production activities, and foreign direct investment is the result of the integration of above three advantages. The location advantage is the whole investment environment advantage including the natural endowments, culture, political, legal and other advantages. Dunning further noted that different type of direct investment have different strategic objective. According to the analysis of Dunning and UNCTAD "World Investment Report 1998", the motives of transnational corporations' foreign investment can be summarized as follows (United Nations Conference on Trade and Development 1999).

### ***37.1.1 Marketing-Seeking***

This type of foreign direct investment aims at consolidating and expanding the existing international market share, chasing or excluding competitors, directly opening new market to seize market opportunities, and bypass the tariff or non-tariff barriers of host countries to expand export. The essence of this type investment motive is to ensure the survival and development of transnational corporations. Of course, this type of investment motive is affected by host countries' market scale, market growth conditions, market structure, consumer preference, FDI policy framework and the commercial convenience (Hejazi and Pauly 2003).

### ***37.1.2 Resources and Assets-Seeking***

The purpose of this type of foreign investment includes making use of the of host countries' natural resources, labor resources and innovative assets, and expanding technical advantage or making up for technical advantage through mergers and acquisitions (Hannay 2000). This type foreign direct investment is an important means that against import trade barriers of raw materials and ensure the supplying of raw materials. For example, for the domestic economics' dependence on import raw materials, Japan usually first invest in primary industry in order to obtain cheap raw material resources as far as possible which is extremely important for Japan to maintain its strong export capacity of manufactures.

### ***37.1.3 Efficiency-Seeking***

The purpose of this type of foreign direct investment includes saving cost to improve production efficiency, the realization of regional or global production rationalization, and increasing global innovation and production competitive power (Ivarsson 2002).

### ***37.1.4 Customer-Following***

The performance of this type of investment is such as transnational corporations of accounting, advertising, banking, transporting and manufacturing sectors are affected by their leading clients and follow leading clients to achieve their regional or global distribution. For example, when a transnational bank's many clients expand their foreign investment, the bank will take the following investment policies in order to maintain long-term relationship with its clients.

### ***37.1.5 Policy-Using***

The purpose of this type of investment is to chase host countries' foreign capital incentive policies or to make use of host countries' protecting measures such as tariff constraints and quota constraints to exclusively enjoy the protected market capacity or to make use of national currency advantage led by exchange rate policy to acquire enterprises of other country (United Nations Conference on Trade and Development 2009).

In short, through these analyses of the investment motives, it is not difficult to find that the purpose of transnational corporations actively advocating and promoting their investment in developing countries is not to help the developing countries solving economic difficulties. Objectively, the economic globalization relatively increases the economic quality and improves the participating countries' economic environment. But in the essence, transnational corporations' intentions are: making use of their powerful economic and technological advantage and trying best to occupy more international market share in the process of economic globalization, in order to continue to maintain their initiative in the international economy and achieve the goal of profit maximization. These intentions will not help developing countries to narrow the industrial gap between developed countries and developing countries and sometimes will not conducive to maintaining developing countries' industrial security.

## 37.2 Definition of Industrial Security

In general, industrial security refers to certain ability or status, which a country's institutional arrangements can lead to more rational market behavior and market structure, and a country's industry, can resist the invaders in the international competition under open economic conditions. The essence of industrial security is how to better protect and develop domestic industry in the open environment (Yu 1999). The performance of industrial security is that a country's industry is competitive to maintain its control over the technology or equity of domestic important industry and sustain the development in the international competition. The international competition under open economic conditions include investment liberalization and trade liberalization, specifically, include both the competition between domestic companies and foreign companies while taking utilization of foreign capital and the market competition between domestic goods and foreign goods in the international trade field (Liang 2007).

The range of industrial security is very broad. According to its subject, industrial security can be divided into macro, meso and micro levels. Firstly, the macro-level industrial security can also be called national industrial security which is the security status of the strategic industries related to the national economy or the security status of most industries. Secondly, the meso-level industrial security measures the security status of a specific industry or industry cluster participating in international competition. Finally, the micro-level industry security refers to that domestic national companies have a certain developing scale and can maintain or create certain advantages in the market competition of the open economy.

Industry security discussed in this paper mainly refers to macro and meso level industry security while making use of foreign capital, which mainly focuses on the safety development of the major industries system and the government's regulating ability on national industries, so it does not only require all industries are security.

## 37.3 The Game Between Transnational Corporations and Host Countries

### *37.3.1 Conflict Between Transnational Corporations' Investment Motives and Host countries' Attracting Foreign Investment Objectives*

By analyzing transnational corporations' investment motives, we can see that transnational corporations' investment motives are inevitably conflict with host countries' attracting foreign investment objectives, for example: (1) Transnational corporation's monopoly acquisition is conflict with host countries' goal which

trying strengthening domestic company's development; (2) Transnational corporations just want to use the mature technology and maintain the dominance of technology, but host countries hopes to introduce foreign advanced technology (Ivarsson and Alvstam 2005); (3) Transnational corporations want to strengthen their protection of intellectual property, but host countries want to spread the advanced technology; (4) Host countries hopes transnational corporations' invest profits to reinvest in host countries, but transnational corporations want to repatriate invest profits to home country. In addition, Hymer (1971) analyzed the relationship between transnational corporations and host countries based on the impact of foreign direct investment' monopoly power on host countries (Hymer 1971). He pointed out that transnational corporations introduce the resource of host countries to the centre countries (home countries) through their international branch network, and thereby trigger the contradictory relationship between transnational corporations and host countries (Krishnan 2008). In this situation, a non-cooperative dynamic game model can analyze the contradictory relationship and its impact on host countries' industrial security.

### ***37.3.2 Analysis of Non-cooperative Dynamic Game Between Transnational Corporations and Host Countries***

Before setting the game model, we first make some basic assumptions: (1) Assuming of the parties. Assuming there are only two parties, and they are transnational corporations (TNCs) and host countries (HSC). Both sides have complete information. (2) The strategies of transnational corporations. Assuming that there are two alternative strategies for transnational corporations to choose: to abide by or not abide by the prior investment contracts (such as using or transferring new technologies, training host countries' employees, complying with host countries' environment standards, do not use the monopoly position forming malicious market competition). (3) The strategies of host countries. The choices of host countries are "introduce foreign investment" (believe transnational corporations' ability to abide by contracts and decide to introduce the foreign investment) and "not introduce foreign investment" (do not believe transnational corporations' ability to abide by contracts and temporarily do not introduce the foreign investment). (4) Earnings assumption. Assuming that in the condition that host countries agree to introduce foreign investment, if transnational corporations abide by the contracts, then both can get profit; if transnational corporations don't abide by the contracts, then transnational corporations can get more profits but host countries make loss.

The non-cooperation dynamic game tree of transnational corporations and host countries is as Fig. 37.1, if host countries introduce the foreign investment and transnational corporations abide by the contracts, they respectively get 10 units' profits. However, in the actual practice, there are moral risks from transnational

corporations' non-abiding by contracts after the actual investment, and this would lead to host countries make loss of 5 units' profits, but transnational corporations can get 15 units' profits which are more than those get form abiding by the contracts. The game shows that there may be some conflicts between transnational corporations' invest motives and host countries' introducing foreign investment objectives. Even, transnational corporations may do not abide by the contracts and lead to moral risks which would threat or harm host countries' industrial security.

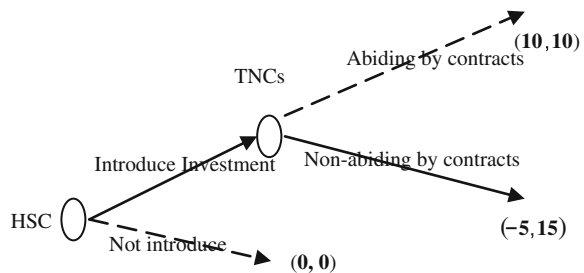
## 37.4 Countermeasures

For the hazards of industrial security result from transnational corporations' moral risks, host countries can design encouraging mechanism or constraint mechanism, namely "institutional arrangement" to force transnational corporations to abide by the contracts (Chen 1999).

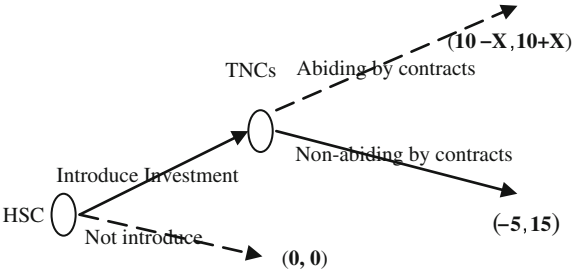
### 37.4.1 Encouraging Mechanism

The encouraging mechanism here refers to the measures adopted by host countries which guarantee transnational corporations' profits while abiding by the contracts. For example, host countries' foreign investment encouraging policy, which mainly divided into fiscal encouraging policy, financial encouraging policy and other encouraging policy (Alexander et al. 2009). Now we assume that after using of encouraging mechanism, transnational corporations' profits increases  $X$  units while abiding by the contracts, at the same time, the foreign investment encouraging policy increases host countries' introducing foreign investment cost, so host countries' profits reduces to  $10 - X$ , and the game tree is as Fig. 37.2. The Fig. 37.2 shows that, to make an effective encouraging mechanism, the additional condition is  $(10 + X) > 15$  and  $(10 - X) > 0$ , namely the range of  $X$  is  $(5, 10)$ , so as to ensure transnational corporations' profits while abiding by the contracts is more than profits while non-abiding by the contracts.

**Fig. 37.1** Non-cooperation dynamic game between TNCs and HSC



**Fig. 37.2** Non-cooperation dynamic game between TNCs and HSC under encouraging mechanism

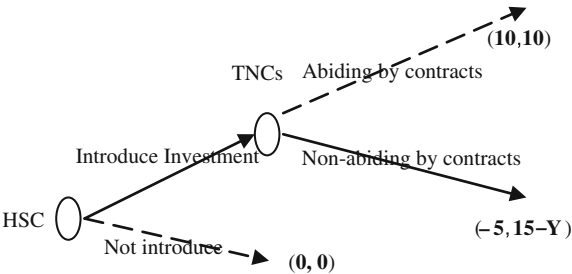


**37.4.2 Constraint Mechanism**

Constraint mechanism refers to the measures adopted by host countries to reduce transnational corporations' improper benefits when non-abiding by the contracts (Backer 2008), for example, host countries' market access policy and foreign investment regulation policy. Now we assume that after using constraint mechanism, transnational corporations' profits decreases  $Y$  units while non-abiding by the contracts, and the game tree is as following Fig. 37.3, To make the constrain mechanism effective, the additional condition is  $(15 - Y) < 10$ , namely  $Y > 5$ , so as to ensure that transnational corporations' profits while non-abiding by the contracts is less than profits while abiding by the contracts.

Except for using the positive and effective foreign policy to force transnational corporations to abide by their commitments, host countries should also fully make the non-profit civil organizations' positive effect. Some non-profit civil organizations have launched a variety of quasi-commercial movement and actively set normative institutional framework for transnational corporations' behaviors. They create all kinds of information systems including more complete transnational corporations' information base, and timely carry out comprehensive investigation including production and business activities, credit status, degree of technological advance and financial status and so on to facilitate a dynamic and comprehensive grasping of the relevant situation of transnational corporations, so the civil organizations can indirectly affect transnational corporations' social responsibility, and further enhance the transparency of transnational corporations' behaviors (Mortimore and Vergara 2004). In addition, host countries' government should

**Fig. 37.3** Non-cooperation dynamic game between TNCs and HSC under constraint mechanism



also strengthen the cooperation between deferent countries' governments so as to regulate transnational corporations' behaviors from international level (Xiong 2006).

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# Chapter 38

## A Multiperspective Analysis of Housing Consumption Selection Behavior Based on Cognitive Process

Xiao-jun Wen, Bo Wang and Ai-bin Liu

**Abstract** This paper reflected the traditional housing consumption selection theory by following the developments of consumption theory. It pointed out that the housing consumption selection theory could not fully explain the reality of the new era in consumer housing selection from a traditional marketing point of view. As a result, by studying on cultural capital, lifecycle, product attributes, and consumer psychology perspective, this paper created a multi-perspective analysis model which combined with the cognitive processes of consumers. The impact of each factor on housing consumption selection has been analyzed by applying this model. As mentioned, the model has created by the cognitive process in this study, which is meaningful for researching the performance of consumers in residential consumption and to perfect the marketing strategy of developers. The multi-perspective cognitive process also helps developers to understand the consumer behavior in housing market, and it is beneficial for improving their ability of market prediction and explanation, in order to “fit” the demand by consumers.

**Keywords** Cognitive process • Cultural capital • Housing selection • Life cycle

### 38.1 Introduction

The dramatic change of social economic on traditional consumption behavior brings new opportunities and challenges, the rational decision making, as the core of the traditional behavioral pattern, has challenged by theoretical and empirical

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studies in a broad way. With its important role, the housing market becomes an important field of consumer behavior changes. Social transition, industrial revolution, economic cycle and other factors make the housing consumer environment increasingly complex. By contrast, consumer preferences and selection behavior also undergoing profound changes, the social environment plays a more important role in the selection of consumption through consumer personality factors. The traditional housing selection model excessively emphasizes the analysis of market overall level, but ignores the family consumption decision factors. However, the neoclassical microeconomic model, such as the basis of hedonic price model and housing location model is too simple since it ignores the intergraded impact of factors (MacLennan and Tu 1996). In the new society, it is necessary for applying a multi-perspective selection model of housing consumption.

### **38.2 Diversification: The Housing Consumption Selection Should be**

Because of its particularity and importance, housing consumption has been treated as a focus among those theorists, the research on housing consumption behavior of domestic and foreign scholars primarily follow two directions: one is the descriptive study which to explore consumer selection process and mechanism (Tu and Goldfinch 1996; Patel and Schlijper 2004 etc.), the other is the normative research to explore how consumer should make a decision (Vipula 1995; Zainuddin et al. 2006; etc.). However, the above researches excessively emphasize the housing product characteristics but ignore the consumer psychology and social effects, and also excessively emphasize the analysis of market overall level but ignore the family consumption micro process. With the social and economic environment changes, consumer psychology and consumer behavior has undergone many changes. The traditional consumer behavior theory refers to a narrow marketing point of view, which cannot solve the problems in housing market (Brief and Bazerman 2003).

Traditional housing consumer selection theory is questioned by cultural consumption theory, this theory considered that the cultural capital and the symbolic capital constitute the consumer selection determinants, the simple product characteristics despite being able to provide consumers with a certain degree of utilities, but under the oversupply of the market environment, consumer will also pursue the accumulation of cultural capital. Housing is a kind of special consumer goods which embody the status and the identity of consumer. It not only represented the consumption capacity and consumer preference, but also showed the psychological characteristics and cultural habits. Therefore, a study of consumer housing selection behavior should be considered about the consumption of the main personality factors as MacLennan and Tu mentioned the micro decision-making process. Life cycle theory of consumption raised new questions about the

traditional housing consumer selection theory from the characteristics of life cycle consumption. According to the life cycle theory, because consumers' income level showed significant difference in the different period of life cycle, consumer preferences in the presence of dynamic changes in order to achieve the utility maximization within the full cycle (Kraft and Munk 2010).

Other studies also shown the housing consumption selection in diversified perspective: Hooimeijer and Schutjens (1991) points out housing consumption correlates to lifestyle changes; Massey and Denton (1993) found that consumers beliefs could affect the housing consumer selection; Harris (1996) believe that the selection of housing consumption is closely related to the energy, environment and background of society etc.

With the industrial upgrade and transformation of society development, consumer housing consumption patterns have changed, consumers will not only pursue housing provides basic living utilities, but also interested in the housing culture, value and social function. Therefore, the multidimensional perspective should be the inevitable selection of the housing consumption selection. Patel and Schlijper (2004) also believe that buying behavior is not only the function of product, but also need to take into consideration of the social environment, competitive products, marketing strategy etc., hence, product design cannot excessive emphasis on product attributes, but also take into account the consumer psychology and the social characteristics of consumer groups.

### **38.3 The Multidimensional Perspective on Housing Consumption Selection**

The reform of housing system and the urbanization to promote the housing demand expansion, stimulate the housing prices rise continually, housing has become the important content of resident consumption. The fixity, durability and high price of housing determined that housing consumption behavior is a kind of high involvement behavior, for instance, there are lots of members involved, long time involved and difficult to make a decision. The high involvement consumer decision-making makes housing selection diversified.

#### ***38.3.1 Product Feature***

Product feature is dependent on their basic attribute, classic housing consumption theory believed that the housing product characteristics include three levels of building structure, location and neighborhood relations (Megbolugbe 1989). building features such as lighting, ventilation, housing area and the internal construction is the key factor of housing users' consideration; regional character refers

to the housing area (space) in the geographical position and the convenience and noneconomic satisfaction from the position; neighborhood characteristics, density and green community supporting facilities, it is important factor to determine whether the user change the place of housing.

### ***38.3.2 Cultural Capital***

Cultural capital refers to a kind of orthodox cultural taste, consumption styles, cultural competence and educational qualifications, those value patterns which could reflect the involver's social status. Belk (1988) found that housing might influence the consumer's personal status obviously, which is often a part of consumer's self concept. It has played an important role in the consumer's self expansion. Therefore, the housing consumption by consumers will be the pursuit of individuality and personal style. Flint and Rowlands (2003) followed the cultural paradigm from economic capital, cultural capital, social capital and symbolic capital four angles to discuss respectively for the impact on housing consumption: The economic capital impacts on housing selection through consumer's financial situation and government's fiscal policy. The cultural capital and social capital have effects on consumption habits and field in housing consumption. The symbolic capital made up consumer's ethics and aesthetic taste. The rapid development of society and economy has made consumers not only seek to meet the basic needs, but also the cultural, social and symbolic demand of higher levels. It plays a more important role in the consumer housing selection.

### ***38.3.3 Life-Cycle***

According to the life cycle theory, in different period of the life cycle consumers will under various constraint of different income, the ultimate goal of consumption decision is to achieve utility maximization in the whole process through intertemporal consumption. Due to the housing features of expensive price and high value, consumers need to consider about the constraint of income during the housing consumption. Tu and Goldfinch (1996) pointed out that consumer's housing consumption is two-stage selection process which based on their budget. Housing selection not only correlated with consumer income but also with the life cycle, consumers will continuously adjust their housing consumption selection in the every different stage of life cycle.

## **38.4 Process of Multiperspective Housing Consumption Selection Based on the Cognitive Process**

### ***38.4.1 Cognitive Processes and Consumer Selection***

Consumer behavior is often interpreted from the perspective of cognitive psychology. Before purchase behavior occurred, consumers will have a conscious information process, consumer attitudes will be formed during the information process. The formation of attitude depends on the participation, belief and evaluation activities. Therefore, the cognitive process is the premise and foundation of consumer selection. In consumer selection, whether consumers could analyze the current information deeply is the key factor to affect consumer decisions (Petty et al. 1994). Consumer selection is not only based on cognitive information processing for consumer goods but also correlated to emotion and normative mechanism. When major situation changed, the selection behavior of the emotion and normative mechanism may be particularly prevalent, such as enhanced competition condition, the economic crisis or other social and political change. Hence, considering the social transition, industry upgrades and other social profound change occurs in our country. It should be fully analysis of the environmental changes impact on consumer housing consumption selection (Petty et al. 1994).

### ***38.4.2 The Housing Selection Process***

According to the theory of consumer behavior, consumers' self concept and lifestyle will serve as the internal factors and external factors effect on consumer selection, during this process, experience and knowledge will lead to internal and external factors updated and changed. For housing, as consumer's self concept extension, they require housing consumption not only reach a living standard, but also can reflect the lifestyle in their consumption, housing structures and materials directly reflects the lifestyle of a family (Koklic and Vida 2009). Thus, in housing selection, consumers' self concept and lifestyle have impact on consumption target via the desire and preference, consumer's purchase decision is determined by the consumption target. To the internal factors which involved self-concept should include consumer motivation, participation, emotion, attitude, cognition and memory, as consumer selection factors in the formation of consumer cognitive process. To the external factors which involved life style should include consumer social class, life cycle, family structure and cultural features etc.

The ultimate goal of the housing consumption selection is purchase of housing. However, in the early stage of housing consumption selection, consumers often lack sufficient information for decision making. Accordingly, continue to gather information and update the target will be throughout the entire consumer choice process. Meanwhile, due to the characteristics of expensive price and high value,

consumer involvement degree will be high in housing consumption, which is conducive to separate the consumer’s ultimate goal in order to construct hierarchical object structure. Information which support consumption selection could be divided into three types: situational factors, product factors and consumer characteristics, those information come from internal (memory) and external (environmental) in consumption (Gibler and Nelson 2003), these different sources of information could be accumulated by consumers in the life cycle and also could be formatted through consumer capital naturally. Therefore, as the capital theory and life cycle reveals that these two affect consumer housing consumption selection via cognitive processes.

According to Hansen (2005), to construct consumer selection model must consider the following factors: the subconscious of consumers, products and decision making context, the alternative, the consumer psychology, the consumer cognition, emotion and its interaction. The cognitive process based housing selection model is constructed based on the consumer behavior model. As the multi-perspective might affect housing consumption selection which mentioned before in this study, a housing consumption selection model could be constructed based on cognitive process (Fig. 38.1).

The completed consumer selection processes include: attention, understanding, evaluation, decision making, the purchase and utilize. The housing consumption process is accompanied by the housing cognitive process. In addition, the capital

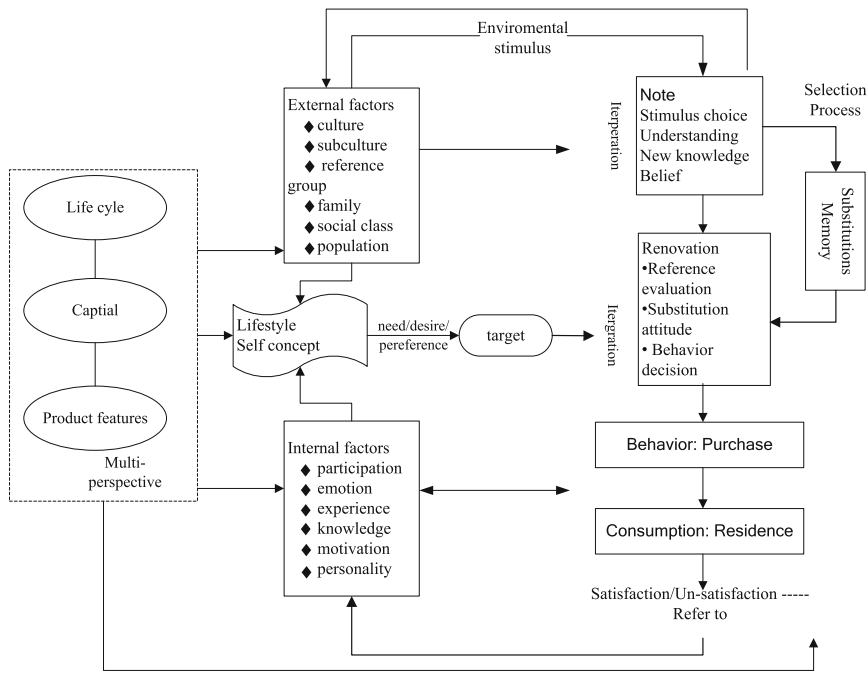


Fig. 38.1 The housing selection process based on cognitive process

by consumers and the stage of consumer life cycle have impact on their cognition. The capital (economic capital, cultural capital, social capital and symbolic capital) can influence the consumers' attention and evaluation; the stage of life cycle determined experience and memory consumers may gained, the product characteristics constituted consumer alternative selection. It is worth mentioning that under multidimensional perspective, life cycle and capital also have effect on the consumer lifestyle and self concept.

## 38.5 Conclusion

Finally, the cognitive process based housing selection model is meaningful for both housing consumers and developers. The model considers not only the effect of external environment, but also the impact of consumer's life cycle and capital on the selection process.

The extension of the self concept, consumers should make sure which period of the life cycle they have been involved, and how much capital they hold in the housing selection process, then to form the consumption target and grasp the information of alternatives as much as possible through the internal (memory) and external (environmental). Consumers should be continuously updated with that information. Housing selection should be based on large amount of information to evaluate consumption goals and needs of the matching degree by comparing different alternative.

For the developers, to understand the housing market consumer selection behavior is better for improving the market prediction and explanation ability and helping them to satisfy consumer demand as well. The housing consumption selection is not only related to housing features, but also correlated with the stage of the life cycle which consumers involved and capital of consumers. Moreover, these two main factors may influence consumer's cognitive process more effective than the product features could do, since it may have impact on consumer's housing selection. Social development and production of consumer has accumulated more than economic capital, capital forms, housing providers should change the single product angles from the perspective of marketing strategy, to satisfy consumers' culture, psychological needs through a customized services. Additionally, developers should also try to provide information to fit consumer's demand. They should focus on the consumer confidence, improve customer satisfaction, and carry out pre-purchasing experience in order to reduce the customers' cognitive risk.

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# Chapter 39

## An Analysis of the Dilemma in Offering Incentive to Mine Operators and Selection of the Ways to Its Solution

Nai-wen Li and Li-rong Zhou

**Abstract** Incomplete information and multiple-task incentive are the dilemma in offering incentives to mine operators. Adopting the game theory and related theories in information economics, first, this paper analyzes the dilemma, then based on Chinese national conditions and the characteristics of mine operators. It suggests that the salary incentive mechanism should be devised to create constraints on both participation and motivation, differentiated incentive contracts should be formulated from the angle of multiple-task incentive and competence-based selection, the role of academic title promotion in motivating mine operators should be brought into full play, and the mine operators should be considered to help improve their own competence in designing the incentive mechanism.

**Keywords** Analysis of a dilemma · Coal enterprise · Miners' incentives · The ways to solution

### 39.1 Introduction

Incentive is a process, the main incentive measures should be taken to stimulate incentive object that produce a kind of inherent power, to the desired goal. Coal mine is a high-risk industry, coal mine safety is a multiple factor, multiple links, dynamic and complex system engineering, and the mine operators and is one of the key ring. The operator has two main basic tasks, output and safety. To coal mine, the two tasks are both important; they determine the long-term sustainable development of coal enterprises and its social image. So the coal mine to design reasonable incentive mechanism to balance the output and safety of production

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safety is becoming major problems. To improve the operator's enthusiasm for work, arouse operator motivation and safety behavior. In recent years coal mine accidents case were studied, people founded that more management problems, the more major accidents (Qing-ren 2007). In order to prevent accidents, we must fully mobilize coal mine operator work enthusiasm and decrease in safety management mistakes.

According to agency theory, enterprises between owners and operators because of information asymmetry and the formation of the principal-agent relationship, incentive agent according to the interests of the principal selection action, clients should be based on the observed information to reward agents (Alchian and Demsetz 1972). Holmstrom and Milgrom in 1987 made the multitask principal-agent model (Holmstrom and Milgrom 1987), which provides a tool for the reason of accidents. Principal agent model theory said: when agent real behavior cannot be observed, interest conflict and information asymmetry will make agent that consider own interests ahead of the interests of the principal. At this point, the best practice for client is to optimize incentive contract design agent, in order to achieve the maximization of self-interest (Wei-ying 1996; Laffont and Martimort 2002; Banker and Kaufman 2004). Desgagne (1999) from the monitoring point of view: the task of alternative into complementary solution. Holmstrom and Milgrom (1991) research show that, when the agents engaged in a number of tasks, the task incentive effect depends not only on the work itself, but also depends on other work. Baker and George studied that performance evaluation influenced on multi-task principal agent incentive mechanism (Baker 1992). Dixit a discusses the economic organization weakened incentive problems, and emphasizes the importance of multi-task analysis method (Dixit 1997).

Domestic research mainly, Cao (2011) uses the double principal-agent theory, to coal mine safety management incentive mode to undertake study, conclusion the risk aversion of the managers in safety work effort level as the security risk by degree decreases, safe working performance coefficient decreases, government incentive coefficient increases; Zhang and Sheng (2011) by the method of system dynamics to build state-owned coal mine operators incentive mechanism system dynamics simulation, on the impact of coal mine operators incentive mechanism analysis of the influencing factors on the operator's safety production management, dynamic assessment, and based on the simulation results get incentive means the influence of different factors on operator safety management actual strength, comparative analysis different motivation patterns on coal mine operators safety production management behavior in rats, so as to the motivation mechanism for the managers of state-owned coal mine to provide foundations of science; when the petrel (Hai-yan 2010) on coal mine safety from the perspective of state-owned coal enterprise manager multi task principal agent problem analysis, pointed out the principal of coal output to delegate tasks to the strong incentive will lure agent ignore the enterprise coal Tan Investment Commission efforts; Lin (2002) research on multiple objective R&D (Research and development) activities in the incentive mechanism design. Yuan and Wei (2006) studied multinomial task incentive cost between independence on the optimal performance compensation effect. This

article from the perspective of coal mine, using game theory and economics theory, analysis of incentive predicament, solve both operators to complete the task of production safety and two task incentive problems, and put forward the corresponding countermeasures.

## 39.2 Analysis the Dilemma of Incentive

### 39.2.1 Analysis of the Incentive Difficulties are Caused by Incomplete Information

Coal mine on the operator's incentive and traditional factory worker incentives have bigger difference. In factories and workers in both the game relationship, information is complete, workers' action is observed. At this time, the factory can be based on the observed action against the workers of rewards and punishment, that is to say, the incentive contract can be established in the action, thereby incentive compatibility constraint is redundant, the factory can design any "mandatory contract". While in the coal mine and the operator of the game relationship, coal (called the principal) to enable the operator (called the agent) according to colliery interests action, but mine are not directly observable operator has to choose what action, can only be observed some other variables, these variables by the operator, the psychological operations and other external random factors together, but they just operator action with incomplete information. Coal mine is the question of how to according to the observed information to incentive operator, to encourage him to choose the most favorable action on coal mine.

Let us use the  $A$  represent agent (mine) all can choose the combination of actions,  $a \in A$  represent a particular action.  $\theta$  is an exogenous (known as the natural state) variable, that can't control by agent,  $\Theta$  is the range of  $\theta$ .  $\theta$  has two functions, distribution function  $G(\theta)$  and density function  $g(\theta)$ , they belong  $\Theta$ . After agent choose an action of  $a$ , exogenous variables  $\theta$  is achieved. " $A$ " and  $\theta$  determine a measurable results  $x(a, \theta)$  and a monetary income ("output")  $\pi(a, \theta)$ , which belongs to the client. Assume that  $\pi$  is increasing concave function. The client according to common problems designs an incentive contract of  $s(x)$ . According to the observed  $x$  on agent of punishment, assume that the expected utility function  $v$ -N-M of client and agent respectively  $v(\pi - s(x))$   $u(s(\pi)) - c(a)$   $v' > 0$ ,  $v'' < 0$ ;  $c' > 0$ ,  $c'' < 0$ . Clients and agents are risk averse and risk neutral. The client and the agent conflict of interest hypothesis and first from:  $\partial a / \partial \pi > 0$  and  $c' > 0$ :  $\partial a / \partial \pi > 0$  means clients hope agents can cost more effort. But  $c' > 0$  means agents want to make less effort. Unless the clients provide enough incentive factors for agents, otherwise, the agent did not if the client would like to work hard. Assume  $G(\theta)$ ,  $\pi(a, \theta)$ ,  $x(a, \theta)$ ,  $v(\cdot)$ ,  $u(\cdot) - c(\cdot)$  are Common knowledge. The principal-agent model of mathematical expression can be expressed as:

$$\max \int v(\pi(a, \theta) - s(x(a, \theta)))g(\theta)d\theta \quad (39.1)$$

$$s.t. (IR) \int u(s(x(a, \theta)))g(\theta)d\theta - c(a) \geq \bar{u} \quad (39.2)$$

$$(IC) \int u(s(x(a, \theta)))g(\theta)d\theta - c(a) \geq \int u(s(x(a', \theta)))g(\theta)d\theta - c(a'), \forall a' \in A \quad (39.3)$$

The principal problem is to choose “a” and  $s(x)$  to maximize the expected utility function (P) and satisfy the constraints (IR) and (ICs). (IR) is involved in the constraint, namely, the agents cannot be less than expected utility from accepting the contract to accept the contract when the maximum expected utility. Agents do not accept the contract to get the maximum expected utility “for other market opportunities faced by his decision, known as the reservation utility, with the delegates. (IC) is the agent’s incentive compatibility constraint: a given client cannot be observed in the agent’s action  $a$  and the state of nature, in any of the incentive contract, the agent always expect the action to a utility maximization, any client want “a” only through the agent’s utility maximizing behavior. The game between coal mines and miners, coal mines cannot be observed the actions of the miners to choose “a” and the exogenous variables. Coal cannot use” mandatory contract to force the miners to select coal hope that action, but only through incentive contracts to induce the miners to select the desired action of the coal mine. The coal mines of the problems are to choose to meet the miners’ participation constraint and incentive compatibility constraint of incentive contract to maximize their expected utility function.

### ***39.2.2 Coal Mine Operators Engaged in Various Tasks Which Will Cause Incentive Dilemma***

Coal mine accidents will affect operator’s life and the sustainable development of coal mine. Summarized up operator have two basic tasks: output and security. To finish the homework the task case is finished simply. Usually, the coal mine uses the scores can grasp the operator’s performance. Security is concerned; it’s difficult to measure accurately each operator’s action.

In 1991 Holmstrom and Milgrom Put forward that clients ask agents finish many tasks in the same time, which is ignored in the standard principal-agent problem (Rasmusen 2009). If the clients use incentive contract to inspire a job, it could lead to ignore other work for agents. We will use the following model

discuss the situation, the coal mine is called the client, the operator is called agent. The clients can observe production ( $g_1$ ) but not observe safety output ( $g_2$ ).

Multitasking game: two main tasks, no leisure

Participants: the principal (coal) and agent (coal mine operators)

Game order:

1. The client provide a incentive contract  $w$  ( $g_1$ ) or supervision contract for agent, that is paid to agent a basic wage  $m$ , if he observed that agent has finished task 1, so increased wages  $m_1$ ; If observed that agent has finished task 2, then increased wages  $m_2$ .
2. Agent decided whether to accept the contract or not.
3. Agent's efforts on the two tasks are  $e_1$  and  $e_2$ .  $e_1 + e_2 = 1$ , 1 represent the total efforts.
4. Output is said  $g_1(e_1)$  and  $g_2(e_2)$ ,  $dg_1/dg_2 > 0$  and  $dq_2/de_2 > 0$ , If the agent refused to contract, All pay for 0, otherwise:

$$\pi_1 = g_1 + \beta g_2 - m - w - c \quad (39.4)$$

$$\pi_2 = m + w - e_1^2 - e_2^2 \quad (39.5)$$

The supervision costs is  $\bar{c}$ , otherwise 0.

From the best,  $e_1, e_2$  (constraint conditions for  $e_1 + e_2 = 1$ ) and  $c$  are used to maximize total paid.

$$\pi_1 + \pi_2 = g_1(e_1) + \beta g_2(e_2) - c - e_1^2 - e_2^2 \quad (39.6)$$

When  $c = 0$ , this need not cost supervision, so put  $e_2 = 1 - e_1$  into above, and to derivate  $e_1$ , calculate:

$$e_1^* = \frac{1}{2} + \frac{\frac{dg_1}{de_1} - \beta \left( \frac{dg_2}{de_2} \right)}{4}, e_2^* = \frac{1}{2} - \frac{\frac{dg_1}{de_1} - \beta \left( \frac{dg_2}{de_2} \right)}{4} \quad (39.7)$$

Therefore, what kind of efforts will become more depends on  $\beta$  (Task 2 correlation value metric) and in each task decrements the effort reward. According to the type of considering different incentive contracts, if the coal mine with fixed wage contract, the operator selection will be split between output and security efforts, therefore  $e_1 = e_2 = 0.5$ . In order to meet the participation constraint,  $\pi_1 = w^* - w - e_1^2 - e_2^2 \geq 0$  is necessary,  $\pi_2 = w^* - w - 0.25 - 0.25 = 0$ , if the coal chooses incentive contract that depends increased output. The operator will be spent much effort in the production, to a certain extent, ignore the importance of safety in production, which will lead to some unsafe acts. How to balance the operator to complete the task and safety production becomes in front of one of the most important problems in coal mine enterprise.

### **39.3 Incentive Dilemma of Solutions**

#### ***39.3.1 Compensation Incentive Mechanism Include Constraint and Incentive Compatibility Constraint***

The salary incentive mechanism design must meet the above principal agent model in the first constraint–participation constraint. The agent (operator) from the acceptance of the contract is not less than the maximum expected utility does not accept the contract can get the maximum expected utility. The operator as a social person, like the rest of the population, need to face the existence of life and all kinds of pressure, is the most basic survival needs and security needs. According to Maslow's hierarchy of needs theory, employee needs is a multi-level structure, coal mine design salary incentive system must first ensure that the operator's basic needs, the compensation, housing, welfare and other aspects of the preferential policies or policy should protect operators to enjoy the basic survival and life rights. To meet the operator's demand.

In the coal mine and the game relationship between operator, coal cannot observe the actions of the operator selection and exogenous variables, therefore, in order to play the managers' enthusiasm and creativity, salary incentive mechanism design should not only meet the participation constraint conditions and meet the principal-agent model in the second constraints, namely the incentive compatibility constraint.

Current, mine disasters occur continuously seriously affected the operator's psychology and the behavior, work stress and burnout has increased year by year, serious impact on operator job enthusiasm, mine should be fully aware of the seriousness of this problem, adjust the employee incentive strategy, deepen the reform of salary distribution system, to take the post allowance and other flexible compensation incentive mode.

#### ***39.3.2 Design Different Incentive Contracts***

The United States Cornell University professor Schleyer from the strategic value and scarcity distinguishes between the two dimensions, internal to the organization's human resources division. The enterprise human resources as the core of human resources, human resources, quality of universal human resource and human resource of four kinds. If human resources for the organization can bring greater strategic interests, it has a higher value, belong core of human resources; if human resources specific to an organization, or on the external market is difficult to obtain, so, it is the nature human resources. For the core of human resources and the features of human resource, coal can be used to American "up-or-out" contract, and provide competitive compensation incentive. Versatile talents with high value, but their knowledge and skills with universality, is engaged in the

traditional work. On the part of the operator can be taken high wages directly tenure contract. Design incentive compensation by basic salary and the safety behavior of the security degree plus performance wage. Auxiliary personnel to the organization's strategic value is relatively small, the salary incentive may provide a basic salary and a post allowance.

### ***39.3.3 Improve the Incentive Subject to Their Own Level***

The operator is a special group, the incentive to with its own characteristics and advanced incentive theory. Therefore, the coal mine must strengthen own construction, first of all, the main incentive should be in-depth study of incentive theory, proper grasp of incentive factors, and then work out the real incentive measures. Secondly, the main incentive to in-depth business groups, often with the operator to communicate, understand them and their families, to really work out practical and effective incentive measures, which meet the real needs of the life and work. Finally, the main incentive in the formulation, the implementation of incentive in the process must adhere to the people-oriented, should be open, fair, justice, without prejudice, personal likes and dislikes, establish a set of scientific institutionalization, standardization of evaluation standard, give full scope to the talents.

### ***39.3.4 Consider the Operator Reputation***

In multi stage game, reputation mechanism plays an important role on the stage, a reputation tends to influence the next phase and the later phase of the utility. But now a good reputation often means the future stage have higher utility. The operator is highly sense of honor and anticipated future population, will not only consider their own efforts behavior and behavior results in the current period is symmetric, will consider the current efforts to the next period and even more distant future impact. In a competitive market, operators of the "reputation" is presented to the potential employment units showed its high capacity of human capital's signal, operators in the talent market value depends on the past performance. Therefore, college teachers should improve the design of incentive system, teachers in Colleges and universities reputation weight, in order to strengthen its own constraints.

## **39.4 Conclusion**

This paper analysis incentive predicament by game theory and economics theory, from incentive angle to solve the compatibility of output and safety, and put forward the way out: the salary incentive mechanism should be designed to satisfy

the operator participation constraint and incentive compatibility constraint, task motivation and ability from the angle of screen design differential incentive contract. Promotion incentive plays in a key role in improving incentive subject (coal), the level of their own. In the above measures, the operator will seriously work to ensure safe, will also strive to increase output, in order to optimize their utility.

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# Chapter 40

## Cultural Incompatibility Influences Psychological Reactions in Cross-Border Mergers and Acquisitions: The Moderating Role of Multicultural Orientation

Jing Shi and Hua-jian Cai

**Abstract** Despite the initial optimism, many companies fail to meet the anticipated goals after cross-border mergers and acquisitions (M&As) on average. Cultural incompatibility (CI) has been widely reported as a cause for poor merger performance. This research attempted to examine the psychological reactions to CI during M&As and the moderating role of multicultural orientation (MO). We propose that cultural incompatibility affect people's psychological reactions toward the acquiring firm depending on multicultural orientation. We manipulated participants' experienced cultural incompatibility in M&A s and measured their multicultural orientation. As predicted, participants who experienced cultural incompatibility in cross-border acquisition showed more negative reactions than those who did not; moreover, those high in multicultural orientation reacted more positively to the acquiring firm than those low in multicultural orientation. Implications for culture and psychological adjustment in the process of cross-border acquisition are discussed.

**Keywords** Cross-border mergers and acquisitions • Psychological reactions • Cultural incompatibility • Multicultural orientation

### 40.1 Introduction

Cross-border mergers and acquisitions (M&As), as a popular strategy for companies' growth and expansion and an important response to globalization and ever-changing market, have become a global phenomenon over the past two decades

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(Weber 1996; Seth et al. 2000). Despite the increasing popularity of M&As, it is not rare that the target companies fail to achieve the anticipated goals after an acquisition (Ravenscraft and Scherer 1989). Cultural incompatibility (CI) has been reported as one of the main causes of M&As' failure (Daniel and Metcalf 2001; Evans et al. 2004), particularly a major obstacle to achieve post-acquisition integration benefits (Cartwright and Cooper 1993; Very and Schweiger 2001; Lodorfos and Boating 2006). Although the influences of CI have been extensively studied, research on psychological reactions to CI is relatively rare. In this research, we attempt to examine the causal relationship between CI and psychological reactions; moreover, we consider the possible moderating role of multicultural orientation.

#### ***40.1.1 The Influences of Cultural Incompatibility***

A classic manifestation of CI is the so-called "cultural clash". Culture Clash refers to the different organizational values and practices as well as us versus them thinking among the employees in the merging organizations. Culture clash may produce many negative influences such as lessened integrated learning, commitment and cooperation (Cartwright and Cooper 1993) among the acquired employees, worse performance of the acquiring firm (Very et al. 1997), greater turnover among acquired managers (Hambrick and Canella 1993) and a decline in shareholder value at the buying firm (Chatterjee et al. 1992).

Although most revealed effect of CI is negative, some do be positive. For example, some research found acquired companies have better performance (Weber 1996). A recent meta-analysis about the existing research (Stahl and Voigt 2008) also showed that the relationship between culture and post-acquisition performance is complex. These findings suggest that some unidentified moderators might obscure the effect of cultural difference on acquisition performance.

#### ***40.1.2 Multicultural Orientation***

Multicultural orientation (MO) may be a potential moderator. MO refers to a pattern of cultural identity arising from globalization-based acculturation (Chen et al. 2008). Globalization has make people from diverse nations become multilingual and multicultural. In globalization-based acculturation, people may remain in their culture of origin but at the same time develop a bicultural or multicultural identity from direct and mediated intercultural contact; that is, they may integrate a local identity rooted in their ethnic culture with a global identity belonging to the worldwide culture. For non-Western acculturating groups, the local identity is embedded in indigenous traditions and norms, whereas the global identity is influenced in large measure by Western values, beliefs and practices.

In the process of M&As, employees at the acquired firm encounter people, groups, and social influences from other cultures and experience substantial differences in practices, values, beliefs, and identifications, consequently developing a need for globalization-based acculturation. They have to integrate different cultures in their mind, which represents a major post-acquisition challenge to them. Whether a particular person can successfully absorb and adapt to the culture of acquiring firm is important for his performance after acquisition. A person with high MO should be better at this. Therefore, we expected that MO may moderate the influences of CI. That is, for those high in MO, the influences would be positive; but for those low in MO, the influences would be negative.

### ***40.1.3 The Present Studies and Predictions***

Overall, this study focused on psychological reactions caused by CI and the potential moderating role of MO. Based on above rationale, we proposed the following two hypotheses:

Hypothesis 1: experiencing CI would lead to more negative psychological reactions to the acquiring company.

Hypothesis 2: MO would moderate the effect of CI on psychological reactions; specifically, individual with high rather than low multicultural orientation is more likely to have positive reaction to the acquiring company.

## **40.2 Methodology**

### ***40.2.1 Participants***

The participants were 110 Chinese undergraduates in Beijing (41 male, Mage = 22.48). Each of them received 10 RMB for their participation.

### ***40.2.2 Materials***

There are two conditions in total: CI condition and control condition. In the CI condition, participant read a real case titled “Unilever in takeover talks with Zhonghua Toothpaste”, which described Unilever, a dominant foreign company, initiating a hostile acquisition of Zhonghua Toothpaste, an iconic, locally grown company. The logos of the two organizations were on the top of the page to emphasize the identity of the two organizations. The scenario highlighted the cultural incompatibility between the two organizations (e.g., the original advertisement

“Zhonghua is always in my heart” will be no longer used; the original symbol of the Zhonghua toothpaste was changed a little bit and put the symbols of Unilever and Zhonghua side-by-side). Participants in the control condition read nothing.

**Reactions to Unilever:** To measure the reactions to Unilever, we measured the participants’ behavioral, cognition, and affective responses toward Unilever. For the behavioral component, participants were asked to indicate how likely they would buy the products of Unilever on a 9-point scale (1 = definitely won’t, 9 = definitely will;  $M = 5.34$ ,  $SD = 1.78$ ). For the cognitive component, they were asked to indicate their appraisals of the Unilever on three 9-point scales (bad-good, undesirable-desirable, and unfavorable-favorable; from  $-4$  to  $4$ ;  $M = .17$ ,  $SD = 1.52$ ;  $\alpha = 0.92$ ). Third, for the affective component, they were asked to rate on 9-point scales (1 = not at all, 9 = very much) how intensely they experienced three positive emotions (liking, happiness, admiration;  $M = 3.35$ ,  $SD = 1.41$ ;  $\alpha = 0.602$ ) and three negative emotions (hatred, anger, contempt;  $M = 3.79$ ,  $SD = 1.92$ ;  $\alpha = 0.872$ ) toward the Unilever.

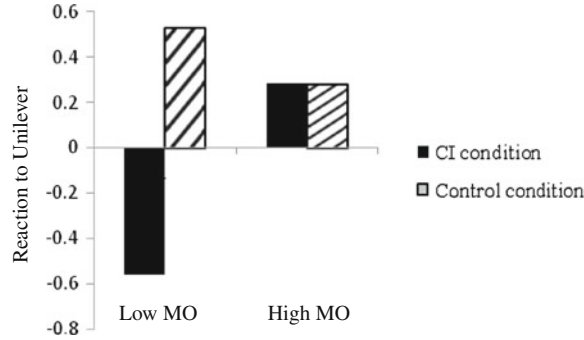
To create a composite measure of reaction to the Unilever, we (a) subtracted the scale midpoint (3.5) from the behavioral item; (b) computed an affect-balance score by subtracting the mean of the negative emotion items from that of the positive emotion items; (c) standardized the adjusted behavioral item, the affect balance score, and the mean cognitive appraisal score without altering their means, so that each component score had a standard deviation of 1.00; and (d) took the mean of the three component scores to form a reaction score ( $\alpha = 0.70$ ). The value of 0 on the reaction score indicated neutral reaction (neither positive nor negative), whereas positive (negative) values indicated positive (negative) reaction.

**Multicultural orientation scale:** We used the Multicultural orientation scale developed by Chen (S. X. Chen, “Title of paper if known,” unpublished). The scale included 30 items, consisting of affective, cognitive, and behavioral subscales. Responses were anchored on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Some items were formulated in the reverse direction to reduce the impact of an acquiescence response set. Sample items are, “I am proud of being able to speak more than one language” (affective), “Cultural diversity is beneficial to a society” (cognitive), and “I learn customs and traditions of other cultures” (behavioral). Internal reliability of the measure was  $\alpha = 0.854$ .

### 40.2.3 Procedure

Participants were randomly assigned to the CI condition or the control condition and escorted to a private cubicle. Participants in the CI condition were instructed to read the story first and then write down at least three thoughts they had about the news. After that, all participants completed the reaction measures and the multicultural orientation scale. Participants were then thanked and debriefed.

**Fig. 40.1** The effects of multicultural orientation and condition on reaction to Unilever



40.3 Results

According to Aiken and West (1991), we used multiple-regression analysis to examine interaction between our categorical and continuous variables. We centered continuous multicultural orientation variable by subtracting the sample mean from each multicultural orientation score. We represented the CI by using dummy variable coding in which the control condition was coded as the comparison group. In the analysis, three predictors were used (a) MO, (b) CI, (c) the interaction between MO and CI.

The main effect of CI was significant,  $\beta = -0.37$ ,  $t(106) = 4.36$ ,  $p < 0.001$ . Participants in the CI condition reacted to the Unilever more negatively ( $M = 0.295$ ,  $SD = 0.915$ ) than those in the control condition ( $M = -0.295$ ,  $SD = 0.502$ ). More importantly, the predicted MO  $\times$  CI interaction was significant,  $\beta = 0.38$ ,  $t(106) = 3.54$ ,  $p = 0.001$ . To test the moderating effect of MO, we divided the MO into high MO group and low MO group according to the lowest and highest 27 % MO score. Consistent with our hypothesis, for those with low MO, participants reported the reaction to Unilever significantly more negative in CI ( $M = -0.560$ ,  $SD = 0.682$ ) than in the control condition ( $M = 0.527$ ,  $SD = 0.339$ ),  $t(28) = -5.735$ ,  $p = 0.000$ ; but for those with high MO, there was no significant difference between CI condition ( $M = 0.280$ ,  $SD = 0.416$ ) and the control condition ( $M = 0.286$ ,  $SD = 0.545$ ),  $t(28) = -0.030$  ns. The results were shown in Fig. 40.1, (Table 40.1).

**Table 40.1** Cultural incompatibility and reaction to Unilever as a function of multicultural orientation

	Regression equation	Regression coefficient
First step	$Y^a = 0.298 - 0.584X^b + 0.175M^c$	$SE = 0.140$ , $t = -4.174$ $SE = 0.112$ , $t = 1.565$
Second step	$Y = 0.298 - 0.580X - 0.113M + 0.781X \times M$	$SE = 0.133$ , $t = -4.363$ $SE = 0.134$ , $t = -0.841$ $SE = 0.221$ , $t = 3.537$

<sup>a</sup> Reaction to Unilever, <sup>b</sup> Cultural incompatibility, <sup>c</sup> Multicultural orientation

## 40.4 Discussion and Conclusions

CI is very common in M&As in the time of globalization. CI may cause lots of negative as well as positive effects. In this study, we examined the influences of CI in M&As on psychological reactions toward acquiring company. We proposed two hypotheses and both are confirmed. Participants experiencing CI have more negative reactions in the process of M&As than those not experiencing CI. Further, this effect was moderated by MO, people high in multicultural orientation exhibiting less negative reaction to the acquiring firm than those low in MO.

This research has theoretical implications for understanding of the role of culture in the process of cross-border acquisitions. Our primary aim in this experiment was to test whether CI would influence people's psychological reactions in the process of M&As. Consistent with our hypothesis, we found the significant main effect of CI, that CI negatively influenced people's psychological reactions to the acquirer. This finding suggests that merging companies should seek for fit, especially cultural fit, in order to avoid conflicts. A survey of more than 200 European chief executives found that the "ability to integrate the new company" was ranked as the most important factor for acquisition success (Booz 1985). Cultural similarity can bring members of the merging organizations together and create a sense of cohesion, while cultural incompatibility can impair information flow, obstruct knowledge transfer and, even, firms' survival. What's more, our study extended prior studies by using a quantitative approach. Although the importance of culture has been widely acknowledged in the process of M&As, but most studies have relied on qualitative investigations. In most cases, qualitative investigations use very small samples or even a single case design, which make it hard to draw any robust generalizations and test the causality of the surveyed relationship. Being aware of this, this empirical study demonstrated the causal relationship between CI and psychological reaction by experimental manipulation.

This work also has practical implications for the recruitment exercise. The interaction result showed that people high in MO reacted less negatively to the acquirer than those low in MO. Individuals low in MO, particularly if they have the experience of cultural incompatibility, may feel and believe that they lack an effective cultural base, as if they are "culturally homeless" (Vivero and Jenkins 1999) or experiencing "cultural identity confusion" (Schwartz et al. 2007). In contrast, having high level of multicultural orientation is linked to better psychological adjustment when facing the cultural difference through cross-border acquisition. Therefore, Multinational Corporation should pay much more attention to the effects of multicultural orientation during the practice of employment. People who prefer multicultural environment and have willingness and openness to new cultures are the potentially needed employees.

Two limitations are notable. In the management literature, culture has been conceptualized in a variety of ways such as: existing artifacts, espoused values, and basic assumptions (Schein 1985); strategies of action (Swidler 1986); rules that govern identity or identification (Fiol 1991). In this paper culture is defined as a

system of shared symbols and meanings (Smircich 1983), in which we manipulated cultural incompatibility by high lightening the different symbols of acquired and acquiring firms and the changes of the original symbol. Research operating cultures in other forms is needed in future research. The other limitation concerns the external validity. The sample in this experiment consisted of undergraduate students only. Replications on real employees in the multinational corporations are needed.

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# Chapter 41

## Examining Satisfaction Paradox of Industrial Behavior: Case of High-tech Firms Using Air Express

Ming-Chih Tsai, Chih-Wen Yang and Che-Yu Cheng

**Abstract** This research aims to develop an attribute thresholds multinomial logit model to evaluate satisfaction matrix resulting in satisfaction paradox in B2B settings. High-tech manufacturers' choice on air express for product shipment is chosen as a case study. Based on the 124 samples collected, the study concludes that the satisfaction paradox appears in the business to business settings. The significance of satisfaction measurement that affects customer choice is not positively associated with the significance of customer reservation to rebuy the service. By examining the relationship between importance of satisfaction (IOS) and reservation of satisfaction (ROS), we developed an indicator to illustrate the significance of satisfaction paradox. These satisfaction attributes are all moderated by customer relationship and customer characteristics.

**Keywords** Discrete choice model · Industrial behavior · Satisfaction paradox · Threshold model

### 41.1 Introduction

One of the key factors for customer retention is satisfaction. However, several recent studies indicated that customer satisfaction is not sufficient to explain customer retention (Voss et al. 2010). Customers claiming to be satisfied or highly

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satisfied may still cease to be retained, and the phenomenon was defined as ‘satisfaction paradox’ (Wu et al. 2012).

Satisfaction paradox was often discussed on consumer market, such as banking, e-platform, and retailing services (Voss et al. 2010; Paulssen and Birk 2007), but few in B2B settings. Relational characteristic is identified as one of important variables moderating the satisfaction paradox (Massad et al. 2006; Paulssen and Birk 2007). Nowadays relational strategy is prevailing in business to retain customer. However, it is not well addressed in the past references. Relational length, depth, and breadth are often used as proxy for customer relationship (Bolton et al. 2004). The effect of relational scheme used by service suppliers to invest in its customers is grossly overlooked. Relational characteristics are in particular important in B2B settings, because industrial customers transact with great volume of business and the number of customers is relatively few (Williams et al. 2011; Paulssen and Birk 2007). Customer satisfaction on relational scheme may positively impact on the transaction. So the relational strategies may strongly affect satisfaction paradox (Voss et al. 2010). But its effect on satisfaction paradox is not properly justified in industrial market.

As a result, this study aims to investigate the effect of relational scheme on satisfaction paradox in industrial market. Satisfaction measurements are validated and the reservation of the satisfaction measurements is calibrated using attribute thresholds multinomial logit model (ATMNL). The reservation of the satisfaction indicates the degree of anxiety and concerns of users over satisfaction measurements. A higher level of reservation implies a higher probability of customer defect and thus a lower chance of repurchase, or a lower level of customer loyalty (Paulssen and Birk 2007). By comparing the importance of satisfaction (IOS) and reservation of satisfaction (ROS) measurements, we may identify satisfaction paradox by measurement. We use ATMNL model to improve statistical robustness in assessing satisfaction measurements. The ATMNL model is a choice model that uses customers’ actual behavior to better calibrate their purchasing behaviors in the marketplace with competing service choice set based on the law that competition may affect customer satisfaction (Paulssen and Birk 2007). Satisfaction paradox was hardly calibrated in considering service competition in previous studies. So the ATMNL model can better examine the importance and reservation of satisfaction measurement to calibrate satisfaction paradox. But it was few attempted (Chao and Lin 2011).

The behavior of high-tech industry in choosing air express service is chosen for empirical study. Air express is one of important supporting business for high-industry. Both businesses are important in terms of industrial value in developed and some developing countries. The air express service is highly customized to effectively support the high-tech industry and also response to the fierce competition market. Relational scheme is broadly used by air express to retain customers but the effects on customer satisfaction and choice are not well explored. Finally, the number of air express service providers is few, including FedEx, DHL, and UPS, to form an oligopoly market. So clustering of service providers is not necessary and the competition effect is easily observed.

## 41.2 Methodology Design

### 41.2.1 Conceptual Model

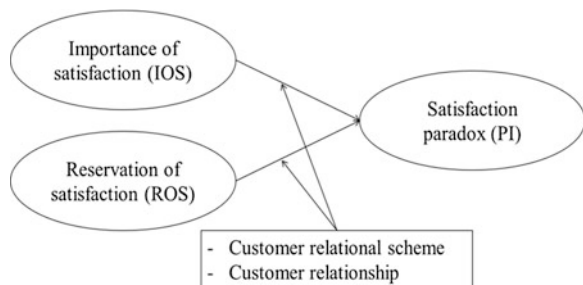
As stated, this study investigates both importance of satisfaction (IOS) and reservation of satisfaction (ROS) on consumer actual choice behavior. As indicated in Fig. 41.1, IOS ( $\beta_k$ ) indicates the significance of a particular satisfaction measurement  $k$ , in affecting customer choice. A higher level of  $\beta_k$  implies the effectiveness of the satisfaction measurement in choice. On the other hand, ROS ( $\theta_k$ ) represents the threshold level of a particular satisfaction measurement  $k$ , in affecting customer choice. A higher threshold value indicates a higher level of customer reservation of a particular satisfaction measurement and thus affecting loyalty for customer repurchasing behavior. Both  $\beta_k$  and  $\theta_k$  are examined to identify satisfaction paradox. Satisfaction paradox appears when a satisfaction measurement is important, i.e. a high level of IOS, but is highly reserved by customer, i.e. a high level of ROS, for choice. Conversely, when IOS is high and ROS is low, the satisfaction measurement is important and is also easily satisfied by customer for revisit. This customer examination on satisfaction measurement can provide service providers with useful information on clarifying the effects of satisfaction measurement to better manage resources for customer retention.

Furthermore, we examine and compare the moderating effect of customer relational scheme and customer relationship. To illustrate the significance of satisfaction paradox, we develop a paradox indicator (PI) measured by multiplying  $\beta_k$  by  $\theta_k$  ( $\beta_k \times \theta_k$ ). The two parameters are standardized, so the PI value may range from zero to one. A higher value indicates a higher level of satisfaction paradox; and, vice versa.

### 41.2.2 Attribute Thresholds Multinomial Logit Model

Both  $\beta_k$  by  $\theta_k$  are calibrated by attribute thresholds multinomial logit model. Attribute thresholds multinomial logit model is a discrete choice model that

**Fig. 41.1** The conceptual model for examining satisfaction paradox



analyzes users' actual behavior and predict users' demand. It bases on Lancaster's characteristics approach and random utility maximization theory. The random utility theory considers that perceived utility of alternative  $j$  for user  $i$ ,  $U_{ij}$ , is assumed to consist of two components,

$$U_{ij} = V_{ij} + \varepsilon_{ij}$$

where  $V_{ij}$  is a utility that can be explained by the alternative's measurements as well as by the decision maker's characteristics, and  $\varepsilon_{ij}$  is the systematic error term that indicates the unknown factors about users' or measurement errors or imperfect information.

Random utility maximization theory also indicates that user is assumed to choose alternative that has the greatest utility among the available alternatives. So, because of the presence of the random term, the probability that user  $i$  selects alternative  $j$  in the choice set  $B$  is given by the expression.

$$\begin{aligned} P_{ij} &= \Pr[U_{ij} > U_{ik} \quad \forall k \in B, k \neq j] \\ &= \Pr[\varepsilon_{ik} < \varepsilon_{ij} + (V_{ij} - V_{ik}) \quad \forall k \in B, k \neq j] \end{aligned}$$

Additionally, discrete choice models are formulated with linear-parameter addable function. In other words, linear parameter addable function means compensatory decision process; a positive evaluation on one measurement can balance out a negative evaluation on some other measurement. But theories of consumer behavior suggest that user's behavior is economics suggest the true relationship between utility and variable is nonlinear.

This article develops attribute thresholds multinomial logit model combining compensatory and non-compensatory processes. Threshold is a general concept in the context of marketing. Many marketing problems discussed about purchase evaluation and choice behavior can be manifested by this quantitate technique (Kau and Hill 1972; Manyiwa 2006). The threshold level may vary widely from one user to another. According to previous research (Han et al. 2001), threshold indicates customer reservation for reusing the service. If the threshold of any measurement for a given alternative is not surpassed, the alternative is rejected. The general formula are follows:

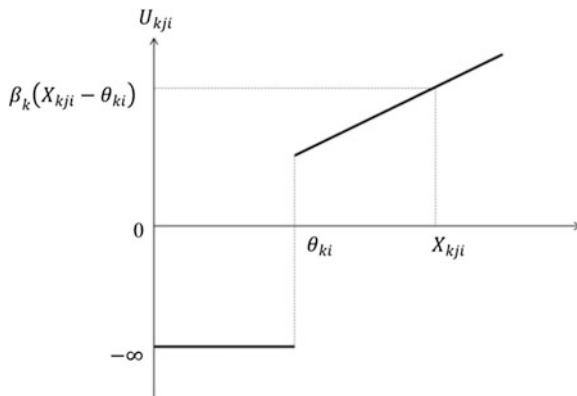
$$\begin{aligned} \frac{\max_{j \in B_i}(X_{kji}) - \theta_{ki}}{\max_{j \in B_i}(X_{kji})} &= T_k \\ \Rightarrow \theta_{ki} &= (1 - T_k) \max_{j \in B_i}(X_{kji}) \end{aligned}$$

where,  $X_{kji}$  is the observed value associated with user  $i$  to each measurement  $k$  of air express service providers, and  $B_i$  is the choice set of user  $i$ .  $\theta_{ki}$  is the threshold of measurement  $k$  for user  $i$ . And  $T_k$  is the tolerance value for measurement  $k$ .

Previous research also indicates that the thresholds may differ from customers to customers by different characteristics (Paulssen and Birk 2007). In other words,

customer reservation may be different among different customer at the same level of satisfaction (Mittal and Kamakura 2001).

Previous research has not adequately integrated the threshold concept as consumer reservation to explore the satisfaction paradox. This research uses attribute thresholds multinomial logit model to measure the effect on satisfaction and reservation. Attribute thresholds multinomial logit model assumes that the observed value  $X_{kji}$  surpasses the threshold of measurement  $\theta_{ki}$ , then the utility is equal to the multiple of important value of measurement  $i_k$  and the slack utility of measurement  $(X_{kji} - \theta_{ki})$ . The formulas are the follows:



$$U_{kji} = \beta_k \times (X_{kji} - \theta_{ki}), \quad \text{if } X_{kji} \geq \theta_{ki}$$

$$U_{kji} = -\infty, \quad \text{if } X_{kji} < \theta_{ki}$$

for all,  $j \in B_i$ ,  $T_k \neq 1$ ,  $\beta_k \neq 0$ ,  $ASC_i \neq 0$ .

In our study, the threshold model was used to explore the air express choice behavior of high-tech manufacturers. The choice set of alternatives includes three air express firms: DHL, FedEx, and UPS.

## 41.3 The Case

### 41.3.1 Air Express

Air express is a critical supporting industry to assist the development of high-tech manufacturer. Because of the characteristic of timeliness and form value in high-tech industry, the effective of logistics is a key element to help high-tech industry to achieve remarkable success (Chao et al. 2011; Hsu and Liao 2005). There is a massive demand for air express as high-tech industry develops rapidly. But the demand also incurs fierce competition between the very few number of express

service providers. It is essential to develop a framework to understand the customer choice behavior and customer satisfaction (Park et al. 2009). Customer reservation is an ultimate goal to retain the market. The relationship between customer satisfaction and reservation should be closely examined to ensure the effectiveness and efficiency of marketing practices.

The air express service providers become highly concentrated to respond the high competitive condition in Taiwan, relational investment become broadly common in industry (Park et al. 2009). Although the high concentration, competitors' strategy to expand market share is still a huge threat and challenge. The original service measurements cannot become the strategic advantage any more. So, air express service provider needs more changeable and adaptable for survival and the service provider should understand and cooperate with their customer to retain the stable partnership (Dong et al. 2011; Ku et al. 2005).

To keep the relationship, it is important for express to examine the demand of the high tech customers and examine their choice behavior for customer retention.

### ***41.3.2 Variables***

A new model of air express is developed to associate with satisfaction and customer reservation. To ensure comprehensive identification, we reviewed a broad range of references on air express service. Variables concerning customers' behavior in the perspectives of satisfaction measurements and moderation variables are identified. Thereby, a focus-group meeting was held to test the face validity of the variables proposed, justifying the effectiveness of variables in fitting in with this study case. Participants for this research include senior managers from air express providers, sales managers from the study manufacturers, as well as academia. During the focus group meeting, repeated discussions were encouraged to eliminate opinion differences. After a several repeated feedback processes, six major satisfaction measurements were considered to be effective for this case study. Moreover, customer relational scheme and customer relationship were considered as moderators for this case study (the variables are indicated in Table 41.1). The variables are all based on past references from some different sources. They are examined and described by the focus group to fit in with this case for choice analysis.

Variables measuring satisfaction measurements have been identified to consist of pricing, damage compensation, delay compensation, privacy, flexible delivery, and tracing. On the other hand, variables concerning customer relational scheme are identified to include bargaining, quick response, information sharing, and special cargo handling. Variables measuring customer relationship has been identified to consist of relationship length, relationship depth, and relationship breadth. Relationship length is divided by two levels, using 3 years as critical point developed from the focus group meeting for classification. Relationship depth is identified by the frequency of interactions per month for air express. It is divided

Table 41.1 The satisfaction measurements and moderating variables

Variables	Descriptions	References
<b>Satisfaction measurements</b>		
Pricing	Air express providers' capability of providing varied pricing mechanisms	Chao et al. (2011)
Damage compensation	Satisfaction related to the efficiency in compensation of negligence	Kau and Hill (1972), Chao et al. (2011)
Delay compensation	Satisfaction related to the efficiency in compensation when cargo delayed	Kau and Hill (1972), Chao et al. (2011)
Privacy	Satisfaction related to exposure and misuse of sensitive information on their trading activities	Bolton et al. (2004)
Flexible delivery	Air express providers' capability of time and spatial control on cargo delivery	Park et al. (2009)
Tracing	Air express providers' capability of tracing and tracking service	Paulssen and Birk (2007)
<b>Moderating variables</b>		
<i>Customer relational scheme</i>		
Bargaining	Air express providers' capability of pricing negotiation	Bolton et al. (2004)
Quick response	Air express providers' capability of resolving unexpected problem quickly	Paulssen and Birk (2007)
Information sharing	Air express providers' capability of providing instantaneous market and logistics information	Homburg et al. (2003)
Goal sharing	Air express providers' capability of sharing business goals for establishing long-term alliance	Kau and Hill (1972)
Special cargo handling	Air express providers' capability of providing customization and personalization service	Park et al. (2009)
<i>Customer relationship</i>		
Relationship length	The length of time that a relationship between exchange partners has existed	Manyiwa (2006)
Relationship depth	The frequency of interactions per period between exchange partners	Manyiwa (2006)
Relationship breadth	The number of products or services purchased from a company over time	Manyiwa (2006)

by 20 times as critical point into two levels. Relationship breadth is identified by using the amount of transection per year for air express. It is divided by 5,000 US dollars as critical values into two levels.

## 41.4 Survey and Sample

We chose e-mail survey for data collection. To ensure a successful response rate, we conducted telephone recruitment prior to the survey to obtain permission and agreement to participate from potential respondents. The survey questionnaires were filled out during March 1–May 31, 2012. Totally, there are 124 valid samples returned, and the return rate is 25 %. The return rate is acceptable compared to other published studies in a business-to-business setting (Homburg et al. 2003).

The surveyed respondents must have experiences of contracting with at least two air express providers to raise the effectiveness of survey. Respondents largely consisted of chief of sales division (48 %), and 28 % from marketing and 24 % are of vice general managers or above, with an average job experience within the high-tech industry of 8.5 years.

The questionnaire designed consists of four major sections. The first section of the questionnaire assesses respondent's satisfaction levels on the behavioral variables, concerning at least two alternative decisions, i.e. DHL, FedEx or UPS. This survey used a five- point Likert scale, with 5 representing "very satisfied", and 1 indicating "very dissatisfied". The second section of the questionnaire contains firm-demographic variables, namely, customer destination, firm size, and product status. The third section of the questionnaire contains two information about respondents—respondents' titles, and how long have been the respondents working with this company. The last section chooses the air express alternatives companies prefer to use. A pre-test study was executed and minor revisions were made to ensure the quality of survey design.

## 41.5 Results

### 41.5.1 *Effects on Satisfaction Paradox*

The choices of the users are analyzed by attribute thresholds multinomial logit model. The most effective satisfaction measurement affecting choice behavior is delay compensation ( $\beta_k = 1$ ), followed by privacy ( $\beta_k = 0.92$ ), tracing ( $\beta_k = 0.83$ ), flexible delivery ( $\beta_k = 0.33$ ), and pricing ( $\beta_k = 0$ ). On the other hand, measurement with the highest threshold is tracing ( $\theta_k = 1$ ), followed by pricing ( $\theta_k = 0.98$ ), flexible delivery ( $\theta_k = 0.66$ ), delay compensation ( $\theta_k = 0.06$ ), and privacy ( $\theta_k = 0$ ). Paradox appears in tracing, flexible delivery, and delay compensation. The importance and reservation of satisfaction are indicated in Table 41.2.

**Table 41.2** Original effects of paradox

TS	IOS ( $\beta_k$ )	ROS ( $\theta_k$ )	PI
Pricing	0.00	0.98	0.00
Delay compensation	1.00	0.06	0.06
Flexible delivery	0.33	0.66	0.22
Privacy	0.92	0.00	0.00
Tracing	0.83	1.00	0.83

The moderating effects of relational scheme are significant. But the moderating effects of customer relationship are significant in some variables like relationship length and relationship breadth. The effects of the moderating variables on the five measurements are indicated in Table 41.3.

**Table 41.3** Moderating effects of paradox

PI-value of relational scheme		
	<i>High bargaining</i>	<i>Low bargaining</i>
Pricing	0.18	1.00
Delay compensation	0.24	0.00
Flexible delivery	0.00	0.08
Privacy	0.12	0.04
Tracing	0.16	0.38
	<i>High information sharing</i>	<i>Low information sharing</i>
Pricing	0.08	0.77
Delay compensation	0.00	0.00
Flexible delivery	0.00	0.70
Privacy	0.39	0.00
Tracing	0.78	0.42
	<i>High goal sharing</i>	<i>Low goal sharing</i>
Pricing	0.00	0.57
Delay compensation	0.00	0.00
Flexible delivery	0.24	0.42
Privacy	0.35	0.31
Tracing	0.40	0.54
	<i>High special cargo handling</i>	<i>Low special cargo handling</i>
Pricing	0.00	0.39
Delay compensation	0.00	0.00
Flexible delivery	0.64	0.41
Privacy	0.55	0.13
Tracing	0.33	0.25
	<i>High quick response</i>	<i>Low quick response</i>
Pricing	0.00	0.00
Delay compensation	0.00	0.00
Flexible delivery	0.42	0.31

(continued)

**Table 41.3** (continued)

Privacy	0.39	0.05
Tracing	0.23	0.05
<b>PI-value of customer relationship</b>		
	<i>Long trade length</i>	<i>Short trade length</i>
Pricing	0.00	1.00
Delay compensation	0.00	0.00
Flexible delivery	0.90	0.19
Privacy	0.14	0.13
Tracing	0.85	0.00
	<i>Large trade breadth</i>	<i>Small trade breadth</i>
Pricing	0.00	1.00
Delay compensation	0.00	0.00
Flexible delivery	0.06	0.41
Privacy	0.22	0.08
Tracing	0.35	0.14

### 41.5.2 Conclusion

The satisfaction paradox appears in the business to business settings. The significance of satisfaction measurements that affects customer satisfaction is not positively associated with the significance of customer reservation, or say threshold, to rebuy the service. In our logistics case, the delay compensation is the most significant satisfaction measurement affecting customer's choice, followed by privacy, tracing, flexible delivery, and pricing. But the ranking of effect on threshold is quite different with the ranking of effect on satisfaction.

By examining the relationship between IOS and ROS, we developed an indicator to illustrate the significance of satisfaction paradox. These satisfaction measurements are all moderated by customer relational scheme and customer relationship. The empirical results calibrated may help air express providers strengthen customer retention in competition.

### 41.5.3 Limitation

The major limitation in this study lies in insufficient sample size. This limitation causes a wide difficulty in Business-to-Business (B2B) study.

Second, the results of this study reflect only the experience of high-tech manufacturer in Taiwan, and the air express provider they choice. Results may differ for environmental settings, such as different manufacturing regions, different cargo destination, and different industry sector across the country. The generalization of the findings requires more investigation.

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## Chapter 42

# Human Resource Development of Chinese Rural Women in E-business

Pei Jiao

**Abstract** Women are the main human resources in Chinese rural areas today. E-business opens door for Chinese rural women to get job or become entrepreneurs. This study aims to find the methods to develop the Chinese rural women resources by fostering e-business in rural areas. First, the study presents the overview of rural women resources and e-business in China. Second, the study examines the problems of Chinese rural women resources in e-business and put forward strategy to solve these problems. The results of the study show that rural women cooperative, education and training concerned with computer, information and communication technology (ICT), and e-business management skills, investment of related facilities, and logistic distribution development and food hygiene supervision is of key important strategy.

**Keywords** China • E-business • Human resource • Rural women

### 42.1 Introduction

China is the home to over 1.3 billion people and nearly 49 % of the population living in rural areas. The majority is small-scale famers, and a large of number of them is women farmers because of male migration to urban areas seeking job opportunities (Qin and Wang 2012). The women left behind to take care of the home and became the main human resources in China's rural areas. Recently, Chinese government is promoting a plan of "building the new socialist countryside", which puts emphasis on the equal economic and social development in urban and rural areas, steadily and safely promotes the earning lever of farmers

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(Bai and Hu 2010). To achieve the aim of “building the new socialist countryside”, we consider development of women human resources is the key factor.

However, the men-centered gender culture has suppressed women’s natural advantages throughout its long history. As a result, women’s advantages, which include elegant behavior, excellent oral expressing, attentive to detail, etc., cannot give full play in the human resource market (Zhang 2006). Fortunately, e-business opens the door for female labors because women have gender characteristics that distinguish women from man, and those are very useful for women to use all their skills that e-business requires to the maximum. In e-business, females have more advantages than males due to better service, more patience and natural affinity, which will make the business environment comfortable and give better effect accidentally (The Editorial Office 2011). In spite of that, women resources do not adequately and fully used nowadays.

Like urban areas, it is common to use Internet, such as checking e-mail or searching information, in some rich rural areas of China. Some farmers even begin to set up e-agriculture system, which connects farmers to farmers, farmers to consumers, or farmers to consultants. The e-agriculture system reduces the transaction costs of farm produce, saves the expenses for training and counseling, strengthen the cooperation between farmers. Considering the active role of e-business in rural areas and women resource development, this study attempts to investigate the relationship between human resource management and rural women power in e-business era. For this purpose, this study specifically investigated the research questions below:

1. What are the new features of e-business in China’s rural areas?
2. What is the efficient strategy to develop China’s rural women resources in the e-business field?

## **42.2 Overview of Rural Women Resources and E-business in China**

### ***42.2.1 China’s Rural Women Resources***

According to the Third Survey on Chinese Women’s Social Status by Statistics Bureau and All-China Federation of Trade Unions of China in 2011, 82.0 % of women in the 18–64 age range are in employment, 24.9 % of employed rural women are engaged in non-agricultural labor, respectively increases of 17.9 % points compared with 10 years ago. The proportion of rural women who have returned home from cities to do non-agricultural labor is 37.8 %, 16.3 % points higher than women who have never left their hometown to work away. The survey finds that 9.0 % of women have taken out loans for production and business, and

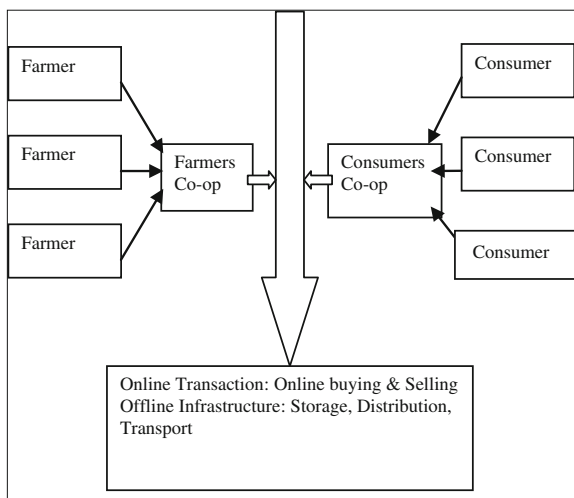
that 39.9 % of rural women taking out loans from government. The survey shows that there is a wide income gap between men and women, the average annual income of women laborers is respectively equal to 67.3 % of that of men in urban areas and 56.0 % of that of men in rural areas. The survey also shows 31.1 % of rural women have access to social security pensions and 95.0 % to social medical insurance, as compared to respectively 7.3 and 87.6 % of urban women. Over the past five years, 83.6 % of rural women have participated in village committee elections, and 70.4 % “tried to know the candidates well before voting”. Additionally, 33.7 % of women have received high school education and above, 54.2 % of whom are from urban areas, and 18.2 % of whom from rural areas (The All China Women’s Federation 2011).

From the above data, it is clear that there are some of important characteristics of Chinese rural women resource. First, more and more rural women become non-agriculture employees in countryside. Second, the women who have working experience in city are easy and prefer to do non-agriculture labor than others when they come back to countryside. Third, the rural women still receive discrimination in labor market, earn less money than men earn. Forth, Chinese government works out some corresponding policy to help rural women to do their own business and enhance their personal security, such as rural loan fund, rural medical succor system, and rural social pension insurance system. Finally, the education level of rural women is lower than urban women’s.

### ***42.2.2 China’s E-business in Rural Areas***

E-business has become one of the most commonly used term in China recently. The number of Internet users in China soared to 457 million in 2010, 73.3 million more than last year. Approximately 34.3 % of Chinese use the Internet, up by 5.4 % year-on-year. China also saw a rapid expansion in the use of mobile Internet, with 69.3 million new users in 2010, accounting for 66.2 % of the total online population (National Bureau of Statistics of China 2011). With the rapid development of information technology, many people become self-employment. For instance, they open shops to sell products on the Internet. The number of online shoppers rose by 48.6 % in 2010, followed by people using e-bank and paying online, up to by 48.2 and 45.8 % respectively (National Bureau of Statistics of China 2011). At a disadvantage in the traditional labor market, women have less opportunity than men’s. However, e-business facilitates flexible employment to women. By the end of November 2011, the number of Chinese women Internet users had accounted for 44.1 % of the total. Women bloggers even outnumbered men, taking up about 57 % of the total (The All China Women’s Federation 2011). So many women choose to become entrepreneurs in e-business. According to a survey, although women entrepreneurs only account for 20 % of the total in China (The All China Women’s Federation 2011), 40.5 % among Chinese e-business owners are women (The All China Women’s Federation 2011).

**Fig. 42.1** E-business about agriculture products



Compared with urban women, rural women has less experience going online, only 10.8 % of rural women have access to Internet, 29.7 % of whom spend less than three hours per day on the Internet (The All China Women's Federation 2011). However, more and more people like to order agriculture products on Internet, especially no pollution and no pesticides agriculture products are popular among netizens. Organic food online business would offer strong potential for rural women entrepreneurs. By the e-business channel, rural women farmers would set the network between farmers and consumers directly, but also would collect all the small resources into one and make a cooperative entrepreneurship. In 2009, the WOLO co-ops set up its own website ([www.wolochina.com](http://www.wolochina.com)) to promptly collect consumers' per-orders through Internet shopping style. The farmer will send organic agriculture products to consumers two times one week after the custom pay 600 yuan one month previously. Now there are 1,000 people become consumers of WOLO, the sales have reached 600,000 yuan one month. As shown in the Fig. 42.1, e-business in rural areas mainly deals with agriculture products by Internet technology and Logistics technology.

### 42.3 Problems of Chinese Rural Women Resources in E-business

There is enormous room for e-business growth in China's rural areas. While most of rural men have migrated to bigger cities to earn a better living, the left-behind women become the main human resources of rural areas. How to develop the rural women power is the key of countryside development. E-business, which set up a bridge from agriculture products to consumers, will be an effective way to develop

**Table 42.1** Comparison of traditional agriculture business and e-business agriculture

	Traditional agriculture business	E-business agriculture
Marketing channel	Farmer to distributor	Farmer to consumer Farmer Co-op to Consumer Co-op
Trade pattern	Decentralized style	Network style(customers, business partners and other stakeholders)
Business channel	Person to person	Internet, fax, mobile phone, etc

rural women power. As shown in the Table 42.1, e-business agriculture has many special characteristics that are distinguished from traditional agriculture business because of using ICT. By developing e-business agriculture for rural women farmers, they can earn more money, can change existing gender imbalance in rural livelihoods, and can rise up social status. However, there are some problems and barriers to development e-business agriculture for rural women farmers.

**42.3.1 Lack of Literacy of Rural Women**

E-business requires many kinds of knowledge and skills about computer, ICT, customer relationship management, and so on. But many rural women lack the necessary capacity and skills for e-business because of low education level. Among Chinese rural women, about 42.3 % only graduate from middle school, about 13.6 % are illiteracy until 2011 (The All China Women’s Federation 2011). Due to the idea of women being inferiority, rural women have less opportunity to receive education and training that held by villager’s community. Lower education makes women left behind rural areas because they are hard to get a foot in the city life. The migrant men workers are further more than migrant women workers. So women are the majority in the countryside. To develop rural areas, it is very important to make rural women worker to become useful human resources by the way of e-business. But the great obstacle to develop e-business for rural women is low education level and lack of literacy of women.

**42.3.2 Lack of Affordability of Rural Women Workers**

As mentioned above, the average annual income of women laborers is respectively corresponds to 67.3 % of that of men in urban areas and 56.0 % of that of men in rural areas, and 39.9 % of rural women taking out loans from government. Since most rural women workers are relatively poor and their income is very little, hardware software, and other ICT equipment are expensive for them to buy and maintain, affordability is another barrier to e-business in rural areas.

### ***42.3.3 Defective Infrastructure in Rural Areas***

#### **1. Defective transport facilities and local distribution channels**

It is impossible to develop e-business in a place where lack of transport facilities. Many rural places are out of express delivery range because of inefficient transportation. Today, the big five express delivery companies in China are ShunFeng-express, ShenTong-express, YuanTong-express, YunDa-express and EMS. With the exception of EMS that is state-run, other express delivery company only delivery to town with country government. Without convenient traffic, the development of e-business bristles with difficulties.

#### **2. Defective electricity supply and Internet infrastructure**

ICT Infrastructure to share among people and to use and store ICT equipment, continue electricity supply is necessary but some rural areas are often not prepared for supplying enough electricity. Moreover, today in China, there are still many rural areas that there is no wired network.

### ***42.3.4 Lack of Trustworthiness***

According to a report by China E-Business Research Center, the revenue of China's online retail sector hit a record of 800 billion yuan in 2011, which is popular for unemployed people to start their own businesses. 49.5 % of e-business owners started with an initial capital of less than 50,000 yuan. However, lack of trust is at the root of failure in the e-business. The trust refers to the faith of customers in the quality of the products. Most of people who buy agriculture product from Internet are try to get organic agriculture food from farmers directly. If there is no method to assure the quality of organic agriculture food, the future of e-business agriculture will be very bleak.

## **42.4 Chinese Rural Women Resource Development Strategy for E-business**

In order to solve the problems of Chinese rural women resources in e-business, and at the same time to realize e-business for them successfully, the local government should develop the strategy as shown in the Fig. [42.2](#).

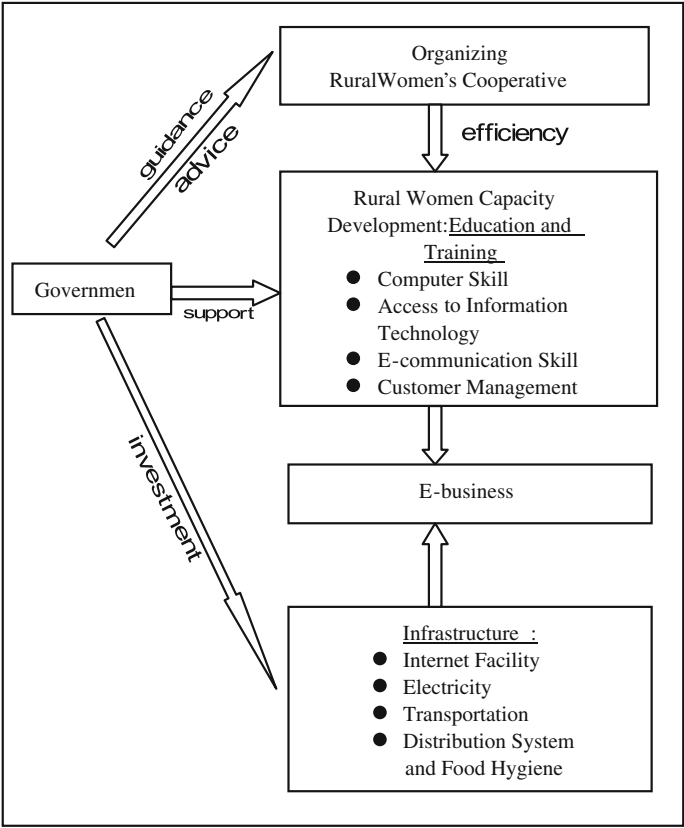


Fig. 42.2 Strategy for development of rural women resource in e-business

**42.4.1 Organizing Rural Women’s Cooperative for E-business**

To organize rural women cooperative is helpful in implementing education training program for rural women, serving as a major support network, fostering entrepreneurship, strengthening their self help, and generating their income. Therefore in order to develop rural women resources in e-business, local government in the first place should guide and encourage them to organize cooperative and join in it.

#### ***42.4.2 Developing and Executing Education Training Programs for Rural Women in E-business***

Education and training programs being concerned with computer, ITC, and other e-business management for rural women is of much help for them to do e-business of agriculture products. Local governments should take the responsibility for such training programs. The programs should include basic computer knowledge and skills, how to access to ICT, customer relationship management knowledge and skills, and so on. Through the program, women farmers will quickly participate in information society and get capacity to manage an e-business (Chowdhury 2008). First, women farmers are able to communication with customers, investors, and agro-technicians by Internet communication programs. Agriculture technology and market information would be shared each other. Second, women farmers could master searching methods to gather useful information from web sites. So they would gain competitive knowledge and do better strategic business decision. Finally, women farmers could create an online community or online product discussion to anticipate customers' needs and preferences. Then they would improve customers' loyalty by offering appropriate products and services for customers.

#### ***42.4.3 Enhancing Investments of Infrastructure of Rural Areas***

Without infrastructure, such as Internet facility, electricity, and transportation, it is impossible to operate e-business. In order to realize e-business of rural women successfully, government should invest to make up the deficiency of infrastructure.

Especially Internet infrastructure plays one of the most important roles in e-business. Chinese government should set up a supportive regulatory network framework in rural areas.

Since most rural women workers relatively are poor, Chinese government should consider give loan or subsidiary to rural women workers to buy computer and software.

#### ***42.4.4 Developing Logistic Distribution System and Food Hygiene Supervision***

It is necessarily to improve the service networks of Express in China, expand the services landscape from urban area to rural area. The logistic distribution system should set up more services branches, not only covering large and medium-sized cities, but also covering country-level cities, towns and villages. Like traditional

agriculture market, e-business agriculture market needs supervision and inspection, too. Only the online agriculture products are supervised closely, the customs could buy the organic agriculture food at 100 % quality, avoiding false upon as genuine.

## 42.5 Conclusion and Discussion

The study presented the overview of rural women resource and e-business in China, and then examined the problems of Chinese rural women resources in e-business and put forward strategy to solve these problems. In the development strategy, organizing rural women cooperative, education and training concerned with computer, access to ICT, and e-business management skills for rural women, investment of related facilities, and logistic distribution development and food hygiene supervision is of key important.

However, some elements that affect the strategic of the rural women resources development to implement, including external environment, time, plan, participation and cooperation, the tractability of problem and so on. To make the best use of the strategy of the rural women resource development, the following measures are necessary. (1) Strengthen legal and institutional organizations support for implementation, (2) create more opportunities for companies and NGOs to participate and cooperate, (3) ensure budget support, (4) keep substantiality of the annual enforcement plan (Sabatier and Mazmanian 1983). As a result, further research on this subject, in which the factors affecting the strategic of the rural women resource development, is suggested.

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# Chapter 43

## Human Resource Flexibility and Firm Performance in China

Qing-hui Xue and Ling Xu

**Abstract** Human resource flexibility which includes numerical flexibility and functional flexibility is regarded as key determinants of national competitiveness and successful firm performance. Human resource flexibility effects firm performance on product cost, human resource cost, customer satisfaction, product quality. As a result, functional flexibility plays a positive role on the above performance. Numerical flexibility plays a passive role.

**Keywords** Functional flexibility · Human resource flexibility · Numerical flexibility · Performance

### 43.1 Introduction

Human resource flexibility which includes numerical flexibility and functional flexibility is regarded as key determinants of national competitiveness and successful firm performance (Blanchard and Wolfers 2000; Michie and Sheehan 2003). A growing body of international research has examined the relationships between human resource flexibility and firm performance (Michie and Sheehan 2003; Hoque 1999; Storey et al. 2002). But only a few scholars in China (Reimei 2009; Liu and Reimei 2009) have focused on this area. This area also remains

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underdeveloped both theoretically and empirically in China. To contribute to these literatures, this paper using 113 samples in China examines: (1) dimensions of human resource flexibility and organizational performance, (2) the effects of human resource flexibility on organizational performance.

## **43.2 Methodology**

### ***43.2.1 Measures of Human Resource Flexibility***

At the firm level there are two dimensions of flexibility: Numerical and functional flexibility (Johnson et al. 2008).

1. Numerical flexibility. Numerical flexibility is the ability of firms to vary the amount of labour employed, by making use of part-time, temporary and seasonal employees, short fixed-term contracts, agency labour, etc. (Michie and Sheehan-Quinn 2001). The use of this type of flexibility is also commonly referred to as flexible employment contracts (Nesheim 2003) or contingent labor.

The purpose to use numeral flexibility is to reduce human resource cost in the precondition of retaining long-term employees which works by adjusting outside labour amounts (Boyce et al. 2007). To make the analysis more manageable, only employees that are short term contracts as a percentage of total employees is used in this paper.

2. Functional flexibility. Functional flexibility is the ability of firms to vary the amount and type of labour they use without resorting to the external labour market, and is accomplished primarily by having a labour force that is able to carry out a wide range of tasks—that is, the ability to move workers from one task to another (Blyton and Moris 1997), Bhattacharya (2000) considered that skill flexibility and behavior flexibility are the two dimensions of functional flexibility. Based on this point of view, these two dimensions are used in this paper. 16 terms are designed to measure functional flexibility which is input as variables to regress equation.

### ***43.2.2 Measures of Firm Performance***

In contrast to many other studies we use objective rather than subjective measures of performance. In addition, the data used in this analysis were collected at the company level. We use five measures of performance: cost of human resource (Ruiz-Santos and Ruiz-Mercader 2003), quality of production, cost of production (Arthur 1994), customer satisfaction and output (Huselid 1999). All the measures are asked by one question.

### 43.2.3 Control Variables

The following standard control variables were used:

Firm size: with dummies for firms with less than 100 employees; 101–500 employees and 501 or more employees.

The age of the firm (Age): with dummies for firms with less than 5 years; 6–10 years; 11–20 years and 21 or more years. Less than one year is regarded as one year.

Industry: two sector dummies, manufacturing and non manufacturing.

### 43.2.4 Sample and Data Collection

113 samples in China are collected which is showed in Table 43.1. In the samples, 69 % firms use flexible employees, which show that firms that use flexibility are a grate deal. As for ages, 7.1 % are less than 5 years, 25.7 % are 6–10 years, 48.7 % are 11–20 years, 18.6 % are more than 20 years. As for firm size, 15.0 % are 50–100 employees, 54.9 % are 101–500, 30.1 % are more than 501. As for industries, 54 % are manufacturing, 46 % are non manufacturing.

The measure is conducted as follows which reports ordinary least squares (OLS) regressions using SPSS: first, only control variables are entered; second, independent variables (numeral flexibility and functional flexibility) are entered.

## 43.3 Results

### 43.3.1 Human Resource Flexibility and Firm Cost

Firm cost is measured by cost of human resource and cost of production. Results are in Tables 43.2 and 43.3.

**Table 43.1** Characters of samples

Character	Numbers (%)	Character	Numbers (%)	Character	Numbers (%)
AGE (years)		Employees		Industry	
≤5	8(7.1)	50–100	17(15.0 )	Manufacturing	61(54.0 )
6–10	29(25.7 )	101–500	62(54.9 )	Others	52(46 )
11–20	55(48.7 )	501–1,000	21(18.6 )		
21–30	14(12.4 )	≥1,001	13(11.5 )		
≥31	7(6.2 )				
Total	113(100 )	Total	113(100 )	Total	113(100 )

**Table 43.2** Human resource flexibility and cost of production

Variables	Cost of production			
	Model 1	Model 2	Model 3	Model 4
11–20 years	0.101	0.049		
More than 20 years	0.203	0.239+		
101–500 employees			−0.018	−0.017
≥501 employees			0.212	0.15
Industry(manufacturing = 1)	0.038	−0.068	0.049	−0.065
Functional flexibility		0.728**		0.716**
Numeral flexibility		0.139		0.159
Adjusted R2	−0.022	0.187	−0.015	0.188
F	0.202	6.053**	0.452	6.184**
ΔR2	0.006	0.224	0.012	0.224

+ $P < 0.10$ ; \* $P < 0.05$ ; \*\* $P < 0.01$

**Table 43.3** Human resource flexibility and cost of human resource

Variables	Cost of human resource			
	Model 5	Model 6	Model 7	Model 8
11–20 years	−0.229	−0.255		
More than 20 years	−0.467	−0.45		
101–500 employees			−0.515+	−0.513+
≥501 employees			−0.675*	−0.706*
Industry(manufacturing = 1)	0.277	0.227	0.266	0.208
Functional flexibility		0.347*		0.367*
Numeral flexibility		0.075		0.034
Adjusted R2	0.013	0.035	0.033	0.061
F	1.493	1.808	2.293+	2.463
ΔR2	0.04	0.079	0.059	0.103

+ $P < 0.10$ ; \* $P < 0.05$ ; \*\* $P < 0.01$

As showed in Table 43.2 models which only using control variables are not significant. Firm age (model 1), firm size (model 3) and industry are all not statistically significant in relation to product cost. After variables of functional flexibility and numeral flexibility are added (model 2 and model 4), R<sup>2</sup> increases correspondently, which shows that models explain more effectively. In the two models functional flexibility is significant. In model 2 and model 4, control variable —industry is negative to product cost. That is to say product cost in manufacturing industry is higher than non-manufacturing industry. So the higher in functional flexibility the lower in product cost. Functional flexibility is positive to reduce product cost. Numeral flexibility is not significant to product cost.

As showed in Table 43.3 firm age (model 5) is not statistically significant in relation to reduce human resource cost. Firm size (model 7) is statistically significant in relation to reduce human resource cost. That is, the bigger firm size the higher human resource cost. In model 6 and model 8, numeral flexibility is not

significant but functional flexibility is significant. Functional flexibility is significantly to reduce human resource cost. Numeral flexibility is positive to reduce human resource cost but not significant.

In conclusion, functional flexibility is significant to reduce product cost and human resource cost. Though numeral flexibility works to reduce cost, it is not significant in these samples.

43.3.2 Human Resource Flexibility and Customer Satisfaction

Employees who are satisfied can lead to customer satisfaction. Human resource flexibility does contribute to customer satisfaction. The results are in Table 43.4.

As showed in model 9 and model 11, control variables are all not significant. After independent variable are added, regress equations become significant. Customer satisfaction in manufacturing industry is lower than in other industries. In model 10 and model 12, functional flexibility is significant which is positive to customer satisfaction. But numeral flexibility is not significant which is negative to customer satisfaction. In conclusion, the higher the functional flexibility, the higher the customer satisfaction. The higher numeral flexibility, the lower customer satisfaction.

43.3.3 Human Resource Flexibility and Product Quality

As showed in Table 43.5 model 13 and model 15, control variables are all not significant. After independent variable are added, regress equations become

Table 43.4 Human resource flexibility and customer satisfaction

Variables	Customer satisfaction			
	Model 9	Model 10	Model 11	Model 12
11–20 years	0.228	0.232		
More than 20 years	−0.005	0.046		
101–500 employees			−0.11	−0.086
≥501 employees			0.036	−0.034
Industry(manufacturing = 1)	0.063	−0.059	0.06	−0.07
Functional flexibility		0.814**		0.817**
Numeral flexibility		−0.537+		−0.426
Adjusted R <sup>2</sup>	−0.01	0.321	−0.02	0.306
F	0.637	11.403**	0.258	10.889**
ΔR <sup>2</sup>	0.018	0.352	0.007	0.337

+P < 0.10;\*P < 0.05;\*\*P < 0.01

**Table 43.5** Human resource flexibility and product quality

Variables	Product quality			
	Model 13	Model 14	Model 15	Model 16
11–20 years	0.153	0.133		
More than 20 years	−0.105	−0.066		
101–500 employees			−0.097	−0.084
≥501 employees			0.076	0.016
Industry(manufacturing = 1)	0.133	0.03	0.149	0.036
Functional flexibility		0.695**		0.708**
Numeral flexibility		−0.202		−0.148
Adjusted R <sup>2</sup>	−0.006	0.252	−0.01	0.253
F	0.791	8.431	0.62	8.602
ΔR <sup>2</sup>	0.022	0.286	0.017	0.287

+ $P < 0.10$ ; \* $P < 0.05$ ; \*\* $P < 0.01$

significant. In model 14 and model 16, functional flexibility is significant which is positive to product quality. But numeral flexibility is not significant which is negative to product quality. So in conclusion, the functional flexibility can increase product quality, but numeral flexibility reduces the product quality.

## 43.4 Conclusion

Investing in progressive human resource practices can clearly pay dividends in terms of corporate performance.

What is different from overseas researches, numeral flexibility in this research is not significant to reduce cost. That is to say, flexible hired forms give much flexibility, but hired effects must be further considered in China.

Numeral flexibility is passive to product quality. Though numeral flexibility can lessen production tension in fastigium, it leads to reduced product quality which is not advantageous to long development for firms. The results also are proved in reduced customer satisfaction.

Functional flexibility contributes to durative development for firms which shows significant and positive effects to cost reduction, quality improvement, and advanced customer satisfaction.

Moreover this paper may be limited because of sample numbers and areas. Deep researches are necessary in future study.

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# Chapter 44

## Research on Knowledge Worker Incentive Factors

Xin Wang and Zai-Sheng Zhang

**Abstract** In order to incentive Knowledge worker effectively, based on the total compensation model which was first proposed by WAW (World at Work), from the five dimensions of incentive, use factor analysis and correlation analysis, the research analyze the knowledge worker incentive factors and the incentive effects. The results show that the total compensation model can better adapts to China's situation, basically covers the important knowledge worker motivation factors, but the sort of factors is a little different.

**Keywords** Incentives · Knowledge employees · Model test · Total compensation model

### 44.1 Introduction

With the coming of the knowledge economy and society, the main job will be creative knowledge work in future, how to management knowledge better is related to the success or failure of the enterprise. Therefore, incentive knowledge worker more effectively and arouse their work potential becomes an essential problem in enterprise management.

“Knowledge worker” is different from common employee; they pursue more autonomy, individual character and elastic in work. As early as in 2006, the “World at Work” (WAW) system, in conjunction with the relevant research results, put forward the total compensation ideas based on the new “total

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An Analysis Based on Total Compensation Model

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compensation incentive model”, it represents the future comprehensive integrated multiple angles incentive trend. Yet in the domestic and foreign relevant research, this model is still established and certificated in the western culture background only. This study combine the total compensation model and Chinese culture, in view of the knowledge employee groups, use empirical study, verify the validity of the model, and based on analysis, to find out enterprise knowledge employee incentive factors in China culture, so as to provide theory basis for hiring and keeping knowledge worker better.

## **44.2 A Review of the Theory**

### ***44.2.1 The Characteristics of Knowledge Workers and its Validity of Incentive Analysis***

The father of the modern management Peter Drucker firstly put forward the concept of “knowledge workers”, namely “master and use symbol or concept, use knowledge and information work worker” (Drucker 1998, 1999). About the Knowledge worker incentive factors, whatever at home and abroad, have some related research. As a representative, In the United States and foreign some scholars’ view is that the main motivation for knowledge worker element and the importance is as follows: the individual growth, working independently, business achievement, money wealth (Bock and Kim 2002; Tampoe 1993; Frey 1997). The incentive for knowledge worker, money is not the most important. The domestic opinions is representative by Wang-Jun Zhang and Jian-Feng Peng, they use the empirical analysis, constructed the incentive factors of knowledge workers in high-tech enterprise in China are salary reward, personal growth and development, challenging work, company’s future, secure and stable (Zhang and Peng 2001).

In comparison, the domestic incentive theory about knowledge is not perfect yet; the traditional relatively single separated motivational methods are not meeting their needs.

### ***44.2.2 Total Compensation Incentive Model and the Theoretical Basis***

In 2006, the WAW systems proposed new total compensation incentive model (This is shown as chart1). The new total compensation incentive model based on the theory of the original, highlighted the organization of human value, and the incentive factors related to the organic combination of arrangement. The model highlight a concept: “all employees’ need is effective incentive factors”.

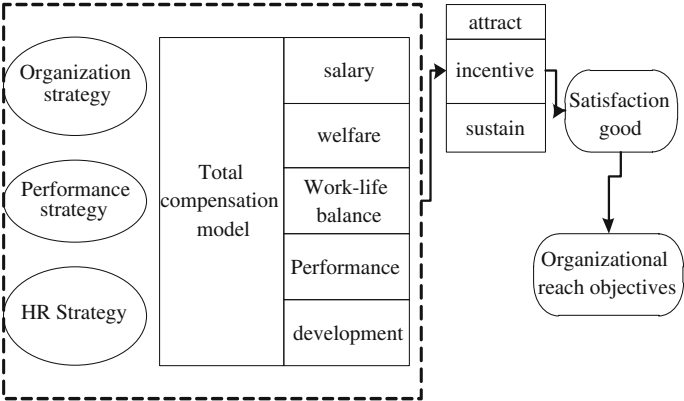


Fig. 44.1 Total compensation model

Work-life balance concept, mainly to emphasize that happy family can give employees more active mental feelings, this is directly related to the employee’s work efficiency and results. Salary incentive still is the foundation. The new total compensation model, the salary incentive and performance were combined organic, more emphasis on performance of fairness and more emphasis on the employees recognition and this is also the internal psychological demand of employees (Deci 1971; Song 2007; Kantor and Kao 2002; Osterloh and Frey 2000); The personal development refers to the organization provide relevant professional training for employees and go out the opportunity to study discussion; Career opportunities refers to the employees get promotion channel, help them to build self-career management, so as to retain employees and reduce the turnover rate (Fig. 44.1).

However, despite the total compensation model theory has been put forward, and obtains the domestic and foreign relevant experts’ and scholars’ recognitions (Deci and Ryan 2000), most of the existing literature is only the introduction of this theory, and few model of empirical science. Therefore on the China culture background, in view of the knowledge worker, use empirical analysis method, inspection the applicability of the total compensation model, to provide theoretical reference for incentive more effectively.

44.3 The Knowledge Worker Incentive Factors Statistics Analysis

44.3.1 The Research Object

The questionnaire survey is overall graduate. The study sample selection in Beijing, Tianjin and Shandong, Henan, Jiangsu, Fujian province, Total release 2,400,

recycling of 1,800, the recovery is 75 %, among them the effective questionnaire was 1500, effective questionnaire rate is 83.3 %. On the basis, bachelor degrees were chosen in high-tech enterprise (IT, biological medicine, etc.) and university personnel, the total is 520. In which the workers responsible for the relevant science and technology work (knowledge worker) are 358, and the other (knowledge worker) are 162.

44.3.2 *The Incentive Components*

Based on the total compensation model, from five incentive dimension, design the questionnaire investigation and research, altogether collected 38 incentive components. After data processing, there are 15 incentive factors (This is shown as Table 44.1).

44.3.3 *The Research Hypotheses*

In total compensation model, based on correlation processing, the 15 extracted incentive factors were classified further, the five dimensions of the total compensation model are as follows from Table 44.2.

Based on the total compensation model and above idea, puts forward the knowledge worker’s incentive factors research hypotheses:

**Table 44.1** Knowledge worker main incentive components

Incentive programs	Project description
Compensation levels	Competitive salary
Salary fairness	Fair compensation
Welfare	Competitive welfare
Work life support	Meet individual life needs
Life feedback work	Life and promote
Work pressure	Family in the way
Family pressure	Work interfere with family
Job approval	Recognition
Working achievement	Accomplishment
Work for	Can fully up to work
Performance fair	Fair performance
The company’s future	Bright future
Job promotion	Outstanding work
Training and study	New knowledge and skills
Participate in decision	Participate in decision

**Table 44.2** Five incentive dimensions of main factors

Incentive category	Incentive factors
Salary	Fair compensation
Welfare	Competitive welfare
Work life	Work support life, life feedback work, Work and life pressure
Performance evaluation	Recognition, achievement, qualified, fair
Personal development factors	Prospect of company, job promotion, training, participation in management

H1: Knowledge worker incentive factor are: salary, welfare, work-family balance, work performance, growth-personal development. And the incentive factors internal will be associated.

H2: Salary incentive factors include compensation levels and salary fairness.

H3: welfare incentive factors including competitive welfare.

H4: “work life balance” includes work support life, life feedback work, work pressure, family pressure.

H5: “work performance” factor includes working recognition, achievement, qualified and performance fair.

H6: “Personal development” includes prospect of company, job promotion, training, participation in management

H7: Knowledge worker and the no-knowledge worker have different sensitive degree of incentive.

H8: incentive factors important sort are different and incentive effect also different.

#### ***44.3.4 The Knowledge Employee Incentive Factors Statistical Analysis***

Basis on the total compensation model theory, according to the hypothesis, design the knowledge worker incentive elements questionnaire. The questionnaire is divided into three parts: background, incentive factors importance, incentive effect, totally 15 incentive programs. Use Likert five scale scores, male accounts for 62.01 %, female accounts for 37.99 %; “under 30 years” occupied 57 %, “30–40 years old” occupied 30 %, “40 ~ 50 years old” is occupied 10 %, “50 years old or above” is 3 %; Undergraduate is occupied 70 %, master is 21 %, PHD accounted for 9 %; Research and technical personnel account for 51.3 %, management personnel account for 46.4 % and other worker is 2.3 %. The research use SPSS15.0 to analysis (Wu 2010).

From in Table 44.3 shows, all the worker seem the “pay”, performance fair and prospect of company as the most important incentive factors. The knowledge worker, their basic material life was assured, and more important is the salary

**Table 44.3** Score of important incentive factors (knowledge worker vs non-knowledge employee contrast)

Incentive factors	Mean	Percentage	SD
<i>Knowledge worker</i>			
Salary fairness	6.28	25.3	0.777
Performance fair	6.23	25.4	0.754
Company future	6.14	14.3	0.786
Work life support	6.11	13.3	0.743
Achievement	6.01	10.8	0.821
Competence	5.98	7.3	0.722
<i>No Knowledge worker</i>			
Compensation levels	6.37	26.9	0.818
Salary fairness	6.28	23.7	0.633
Performance fair	6.15	15.2	0.774
Job approval	6.13	12.1	0.782
Work life support	6.04	9.6	0.722
Working achievement	6.01	8.3	0.794

equity; the non-knowledge worker pays more attention to salary level, because their salary level lower than knowledge worker (Medcof and Rumpel 2007).

For work-family balance dimensions and working achievement, the knowledge worker’s identities are much higher than the knowledge worker. Knowledge worker is highly mental workers need more spiritual support, therefore, they pay more attention to the balance of the family and work; Knowledge worker think their own work achievement is very important, they work of innovation and highly technical and they pay more attention to the self-realization. But non-knowledge worker’s property decided they pay more attention to “Approved by the leader”, because of their superior recognized largely determines whether they can “rise”.

In addition, through the research result the non-knowledge employees pay much more attention to the interpersonal relationship than the knowledge worker. Harmonious interpersonal relationship is all the employee hopes to have, this difference between reaction is, for knowledge workers, because their work can’t be alternative easily, so the competition between colleagues is lower, Rather than the non-knowledge worker, they need to spend more energy to do the interpersonal relationship, to more conducive to personal career development.

Before the factor analysis is validity analysis, which is a factor analysis of the conception in the questionnaire validity theory for verification. From the Table 44.4 shows, KMO value is 0.979, suitable for factor analysis (>0.9). Table

**Table 44.4** KMO value and bartley sphere inspection

KMO	0.979
Approx. Chi Square	2645.8
df	199
Sig.	0.004

Bartley sphere of inspection of the values of the  $\times 2$  statistical significant probability is 0.004, less than 1 %, pertaining to data correlation, suitable for the factor analysis.

Through the analysis of “incentive factors questionnaire”, there are four incentive factors (chart5), after examination, four factors of the consistency of the coefficient  $\alpha$  were reached 0.9371, 0.9014, 0.8987 and 0.9345, the measurement of the consistency degree is higher, the reliability of the questionnaire is higher (Table 44.5).

F1: Include three incentive factors, the original total compensation model of the salary and welfare factors are merged into F1, calls it “hard reward.”

F2: consistent with the original model, called the work-family balance.

F3: consistent with the original model, 4 incentive factors, they all related to employee’s performance, called work motivation.

F4: consistent with the original model, 4 incentive factors, they all and personal growth and development related, called growth incentive.

After exploratory factor analysis and factors of classification, basic accord with total compensation model of incentive five dimensions, salary and welfare attribution to a dimension, this is because no matter salary or benefits are closely related and monetary compensation, according to the double incentive factors theory, all belong to the health care incentive factors (Kwan and Cheung 2006; Hippel 1987).

And then the research do the correlation analysis. First is the knowledge worker in different categories of incentive factors on the correlative analysis of the incentive effect.

This is shown as Table 44.6, classification of the knowledge-type employee incentive factors and the incentive effect in the 0.01 level significant positive

Table 44.5 Knowledge worker incentive factors importance analysis

Incentive factors		Load factors				a
		F1	F2	F3	F4	
F1	A salary level	<b>0.688</b>	0.165	0.321	0.254	0.9371
	B salary fairness	<b>0.783</b>	0.276	0.234	0.376	
	C welfare	<b>0.742</b>	0.461	0.431	0.176	
F2	D work to support life	0.211	<b>0.869</b>	0.376	0.281	0.9014
	E life back-feeding work	0.312	<b>0.897</b>	0.386	0.143	
	F work pressure	0.401	<b>0.786</b>	0.178	0.291	
	G family pressure	0.257	<b>0.803</b>	0.342	0.159	
F3	H job approval	0.342	0.301	<b>0.809</b>	0.251	0.8987
	I work achievement	0.352	0.238	<b>0.777</b>	0.371	
	A salary level	0.198	0.177	<b>0.734</b>	0.327	
F4	B salary fairness	0.281	0.217	<b>0.691</b>	0.172	0.9345
	C welfare	0.155	0.345	0.187	<b>0.765</b>	
	D work to support life	0.375	0.407	0.367	<b>0.742</b>	
	E life back-feeding work	0.362	0.333	0.349	<b>0.707</b>	
	F work pressure	0.209	0.297	0.405	<b>0.675</b>	

**Table 44.6** Correlation analysis

Incentive factors	Incentive effect
Salary welfare	0.923**
Work/life	0.878**
Performance	0.823**
Career opportunities	0.805**

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

**Table 44.7** Knowledge worker specific incentive factors and the incentive effect of correlation analysis

Factors	Results	Factors	Results
A compensation	0.679**	I achievement	0.545**
B fairness	0.656**	J qualified	0.529**
C welfare	0.623**	K fair	0.561**
D support life	0.610**	L prospect	0.486**
E life feed work	0.635**	M job promotion	0.445**
F work pressure	0.644**	N training and study	0.420**
G family pressure	0.601**	O join in decision	0.419**
H job approval	0.534**		

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

correlation. Next is the knowledge worker incentive for the specific factors and incentive effect of relevant points: in Table 44.7 result shows, the knowledge worker incentive factors and the incentive effects are significant positive correlation.

The results can be seen as follows:

#### 44.4 Several Suggestions for Enterprise Knowledge Worker Management

Firstly, through the knowledge worker and the knowledge worker incentive factors of comparative analysis can be summed up in our country the most important knowledge workers five incentive factors for: salary, benefits, work-family balance, performance and recognition, personal development and career opportunities. This fit with the total compensation.

Secondly, knowledge worker incentive mechanism model construction was set up. According to the research results, the total compensation incentive model relevant inspection showed that (Tables 44.6 and 44.7), the enterprise should be comprehensive from five aspects of knowledge employee incentive, just can make the incentive effect more significant and effective.

Knowledge worker salary, benefits, work family balance, performance and recognition, personal development and career opportunities incentive factors is a significant positive correlation. Knowledge worker and the knowledge worker on all the incentive factors needs different degrees should be targeted to take different incentives.

Knowledge worker itself, with high quality, to the work of the life expectancy is high. So the knowledge worker incentive way different from the knowledge to employees in the basis of the theory of total compensation, flexible using of five kinds of stimulation, according to the different characteristics of the employees, adjust the excitation intensity and stimulating their passion for the work, the greatest degree of improving knowledge the employee's work efficiency. Incentive compensation and benefits should be put on, but the amount of attention in absolute also should pay more attention to equity; Next to the employees for the full knowledge of working families balance of space, so more conducive to improving the efficiency of their work and loyalty to maintain. In short choice modes of encouragement, we should pay attention to the comprehensive care, ensure that core knowledge worker's ability to full play.

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# Chapter 46

## Research on the Incentive Mechanism of the State-Owned Coal Enterprise Managers Based on the Principal-Agent Theory

Ai-yun Xing and Guo-hui Wang

**Abstract** Based on the Principal-Agent theory, combined with characteristics of China's state-owned coal enterprise industry and the managers, through the introduction of manager capacity level, managers' external degree of efforts and the output brought by uncertainty, established a principal-agent model, analyzing quantitatively and further discussing incentive problem of managers of the state-owned coal enterprise. At last, based on the actual situation, this article put forward the suggestion: establish a system for investors of state assets, establish long-term incentive mechanism, play the law supervision and restraint function, and establish and develop manager market and so on for the formulation and implementation of state-owned coal enterprise manager's incentive strategy.

**Keywords** Incentive • Principal-agent • State-owned coal enterprise managers

### 46.1 Introduction

In this competitive market based on ability and quality of global, the traditional state-owned coal enterprise are facing more and more management challenges, this make them gradually turned to the direction of diversity and industrialization to cope with global competition (Kong 2010), this must be liable for more economic and social responsibility, such as the coal enterprise's safety production, etc., and accordingly need high level managers to make the enterprise more competitive (Xue 2002). However, based on problem of state intervention too much, high operating pressure and safety production pressure, the society does not give correct

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evaluation on the special labor contribution and lacking of effective long-term incentive mechanism, so how to effectively motivate managers is a to be solved urgently and complex problems.

At present, in principal-agent framework, to the state-owned coal enterprise managers incentive research, scholars focuses on salary incentive, reputation stimulation and control-right incentive (Qu 2009). Meanwhile scholars were standing in the point of view of their respective on the three aspects of research: salary incentive focus on material incentive of the operator (Zhou and Sun 2003), reputation stimulation focus on the spiritual incentive (Xu 2007), and control-right incentive focus more on the constraints of the operator incentive (Huang 2000), this three stimulation form a organic system, supplement each other, promote each other. At present there is lack of combination of incentive research. This article, based on present situation of the state-owned coal enterprise managers' incentive, combined with the state-owned coal enterprise characteristics and all sorts of stimulation, exploring the state-owned coal enterprise managers' comprehensive incentive mode.

## **46.2 Principal-Agent Relationship of the State-Owned Coal Enterprise**

Principal-agent relationship mainly refers to a relationship based on the contract of responsibilities and interest which formed by the client authorized agent in certain scope in its own name engage relevant activities, deal with matters. The principal-agent theory put all the activities as a contract arrangement between the principal and agent risk distribution, the objective function of the principal and agent is not the same, relevant information asymmetry between both sides in the distribution.

In our country the state-owned coal enterprise, the country have the enterprise ownership, are client; Managers are agents; they constitute a principal-agent relationship. Based on the fact that coal mine safety accident occurs frequently, principal-agent relationship has their particularity. Specifically the principal-agent relationship consists of three parts: firstly, as a political entity, the country are not in a specific of coal industry, master little production information of coal industry. However, managers who entrusted by state, work for a long time in coal industry, grasp more information about coal industry production, so there is obvious asymmetric of production information between the two; Secondly, State regulations responsibility, right and interest, etc. of managers in the actual production of the coal management, this kind of contract relationship, supervises managers' actual management activities, promotes coal enterprise toward direction of safety to formal, diversity, industrialization; Finally, the state design certain contract, prompted managers to take appropriate action for the safety in production, in pursuit of his own benefit maximization, at the same time, make the state and society to maximize benefits, reducing economic and non-economic loss caused by coal mine accident to the state and society.

## 46.3 The Principal-Agent Model

### 46.3.1 Basic Assumptions

**Hypothesis 1** There is risk preference difference between country and coal enterprise managers. In this paper, as coal mine accident occurs frequently, that causes serious economic and non-economic loss to society, so country prefer to the type of risk aversion. Managers who are introduce by vast sums of money interests and interests of power are the risk preference type. For  $r < 0$  (Zhou and Chen 2008) simplicity's sake, set the utility function for managers is  $U(\omega) = -e^{r\omega} - R(\omega)(\omega$  run for the state-owned coal enterprise managers' income;  $R(\omega)$  run for risk cost;  $r$  is risk aversion coefficient;  $r < 0$  run for the parties like risk).

**Hypothesis 2** In principal-agent model, the principal and agent must meet three conditions: first, in meet the minimum payments agent level to the client under the premise of high benefit as far as possible (Liu 2009); Second, in order to ensure the minimum income level that under the premise of utility of the agent as high; Third, make the sum of principal and agent as much as possible (Cao and Cao 2011).

### 46.3.2 The Principal-Agent Model

Set  $\Lambda$  as all action of the state-owned coal enterprise managers in the process of management.  $a$  as some certain act among them (Shen 2011), meanwhile it runs for output of managers pay after the unit. Set  $\theta$  as Normal distribution random variables which mean is zero, variance is  $\sigma^2$ , run for the output which decided by uncertainty factor beyond state-owned coal enterprise (Zhang 1996).

Based on Agent-Principal Theory, output function of the state-owned coal enterprise  $\pi$  has linear function:

$$\pi = Aa + \theta \quad (46.1)$$

Countries signed contract with managers are as follows:

$$S(\pi) = \alpha + \beta\pi \quad (46.2)$$

Among them,  $S(\pi)$  represents revenue of managers who perform the contract,  $\alpha$  is managers fixed income,  $\beta$  is share of profits of managers, Mines  $\alpha$  each ascending one unit, the agent will increase  $\beta$  unit.

Set  $c(a)$  as cost of managers whose ability level is  $A$  pay effort  $a$ , and  $c(a)$  has the properties (Ress 1985):

(1)  $\partial c / \partial a > 0$ ; (2)  $\partial^2 c / \partial a^2 > 0$

So, set

$$c(a) = \frac{1}{2} b a^2 \quad (46.3)$$

Among them,  $b > 0$ , is a constant, run for Cost coefficient;

So, managers' revenue is:

$$\omega = s(\pi) - c(a) \quad (46.4)$$

Expected revenue  $E(\omega)$  is:

$$\begin{aligned} E(\omega) &= E[s(\pi) - c(a) - R(\omega)] \\ &= E\left(\alpha + \beta\pi - \frac{1}{2} b a^2 + \frac{1}{2} r \beta^2 \sigma^2\right) \end{aligned} \quad (46.5)$$

As they are prefer to risk, Certainty equivalent of earnings which managers achieve  $CE(w)$  equals expected income minus the safety production risk cost (Feng and He 2010), for specific said:

$$CE(\omega) = E(\omega) - R(\omega) \quad (46.6)$$

Among them,  $R(\omega) = -\frac{1}{2} r \text{var}(\omega)$  is the risk cost of production safety (Shen 2011).

As  $\text{var}(\omega) = \text{var}\left[\alpha + \beta(Aa + \theta) - \frac{1}{2} b a^2\right] = \beta^2 \sigma^2$ . So  $R(\omega) = -\frac{1}{2} r \beta^2 \sigma^2$  (Liu 2011). Put it into (46.6), then

$$CE(\omega) = \alpha + \beta Aa - \frac{1}{2} b a^2 + \frac{1}{2} r \beta^2 \sigma^2 \quad (46.7)$$

Countries expect utility is equal to the expected return, mean  $EU[\pi - S(\pi)] = E[\pi - S(\pi)]$

$$EU[\pi - S(\pi)] = E[\pi - S(\pi)] = (1 - \beta)Aa - \alpha \quad (46.8)$$

Set  $\underline{CE}$  as the biggest opportunity cost benefit, then the managers in constraint  $IR$  is  $CE(\omega) \geq \underline{CE}$ , mean

$$(IR)\alpha + \beta Aa - \frac{1}{2} b a^2 + \frac{1}{2} r \beta^2 \sigma^2 \geq \underline{CE} \quad (46.9)$$

managers' utility function  $U(\omega) = -e^{r\omega}$  is add function, so managers' incentive compatible constraint (IC)

$$\max_a [CE(\omega)] \quad (46.10)$$

Summing up the above, the principal-agent model based on managers' effort degree  $a$ , managers' share of the profits  $\beta$ , work environment variables  $r$  is:

$$\begin{aligned} & \max_{\{a, \beta\}} \{EU[\pi - S(\pi)]\} \\ & st \quad \max_a (CE) \\ & CE(\omega) \geq \underline{CE} \\ & b > 0, r < 0 \end{aligned} \quad (46.11)$$

To meet the  $\max_a (CE)$ , then  $\frac{dCE}{da} = 0$ , so the best effort level of managers is :

$$a^* = \frac{\beta A}{b} \quad (46.12)$$

Set  $\underline{CE} = 0$ , and Simultaneous formulas (46.7–46.9), the Rumsfeld multiplier coefficient is 1; at the same time simultaneous (46.12), then Solution of the techniques (46.11) is:

$$\max_{\beta} \left[ \frac{\beta A^2}{b} - \frac{\beta^2 A^2}{2b} + \frac{1}{2} r \beta^2 \sigma^2 \right] \quad (46.13)$$

To type (46.13) derivation so it orders derivatives is zero, can have to meet (46.15) the best  $\beta^*$ , mean the country's best incentive level to managers

$$\beta^* = \frac{1}{1 - br\sigma^2/A^2} \quad (46.14)$$

Will (46.14) generation into (46.12):

$$a^* = \frac{A^3}{b A^2 - r b^2 \sigma^2} \quad (46.15)$$

Will  $a^*$ ,  $\beta^*$  generation into (46.8) get the country's expected return:

$$E[\pi - S(\pi)] = \frac{-r \sigma^2 A^4}{(A^2 - br \sigma^2)^2} - \sigma \quad (46.16)$$

At this time, managers of certainty equivalent gains:

$$CE(\omega) = \frac{A^6}{2b(A^2 - br \sigma^2)} + \frac{r \sigma^2 A^4}{2(A^2 - br \sigma^2)^2} + \alpha \quad (46.17)$$

## 46.4 Model Analysis

### 46.4.1 Managers' Best Effort Level

According to (46.12), namely  $a^* = \frac{\beta A}{b}$ , we can know, managers' best effort level have much to do with excitation intensity  $\beta$ , ability of managers  $A$ , managers fixed income have nothing to do.

### 46.4.2 Excitation Intensity

Analysis (46.14), namely  $\beta^* = \frac{1}{1-br\sigma^2/A^2}$ , we can know that excitation intensity  $\beta$  are decided by management ability  $A$ , managers' risk preferences degree  $r$ , external uncertainty  $\sigma$ , excitation intensity country add to managers increase with management ability  $A$ , managers' risk preferences degree  $r$ , have inversely proportional to external uncertainty  $\sigma$ .

### 46.4.3 Relationship Between Managers' Best Effort Level and External Uncertainty

For (46.15), mean by differentiating to  $a^* = \frac{A^3}{bA^2-rb^2\sigma^2}$  by differentiating to, we can get  $\frac{\partial a^*}{\partial A} = \frac{bA^4-3rA^2b^2\sigma^2}{(bA^2-rb^2\sigma^2)^2}$ ,  $r < 0$ , so  $\frac{\partial a^*}{\partial A} > 0$ , mean managers' best effort level are increasing to external uncertainty  $\sigma$ .

## 46.5 Incentive Mechanism Design

Based on the analysis of principal-agent model, in order to effectively motivate the state-owned coal enterprise managers, make them work harder achieve maximum of the coal benefit while achieve personal benefit maximization under the premise of production safety. The State can adopt following incentive measures:

### ***46.5.1 Achieve the Reward Income Operator Diversification, Establish Long-Term Incentive Mechanism***

Firstly, actively promote managers' annual salary system. The enterprise managers' income are combined with its contribution to the enterprise, and through evaluation of market, its intuitive reaction is let income and production managers hook, therefore, contains a significant share of risk income, be helpful for in the responsibility, risk income on the basis of equality and increase the excitation intensity, make managers' value of human capital can be brought into full play. Out of fear and bear liability concerns, promoted managers to strengthen safety production in coal enterprise.

Secondly, execute manager shareholding system. Manager shareholding system is based on the solution to nation and managers of the conflict between the medium and long term incentive mechanism, can avoid managers give up those short-sighted which will bright bad effect to enterprise's financial position while good for long-term development of enterprise.

Thirdly, establish a stock option system. Managers who do not in when no income; do the option, if the enterprise share ticket prices, managers at right after will get the market price and the price difference authority price earnings; If share prices fell, stock options lose value, managers do give up right. Stock options will be in the interests of managers with company's interests tightly bound together, be helpful for play to the supervision of the capital market managers incentive and restraint function.

### ***46.5.2 Reform Administrative Management Electing Mechanism, Introducing Competition, Evaluation Mechanism***

For state-owned coal enterprise managers, it should be abolished old administration appointed personnel system, established reasonable personnel system. Meanwhile adopt market selection method, make good, really have the ability to become managers. At the same time, introducing competition mechanism, the implementation of the quantitative evaluation mechanism will measure actual ability *managers*.

### ***46.5.3 Increase Safety and Scientific Research Investment***

Countries need to increase the coal mine safety input and scientific research investment, change the coal mine safety level of poor situation. The increasing scientific research investment, not only can promote the innovation ability of coal

mining enterprises, but also can use of scientific research to bad natural environment management coal mine, improve the level of safety production in coal mine, reduce the uncertainty of the coal mine accidents and state-owned coal mining enterprise managerial risk aversion degree.

#### ***46.5.4 Play Legal Supervision and Restraint Function***

Regulate managers' corporate governance structure, perfect for managers' legal restriction mechanism. For example, through design system of high pension plans, provide managers high levels of pension and health care. And also it should prevent managers abusing power. Therefore, we should regulate the state-owned coal enterprise legal person governance structure, make each level managers have clear responsibilities, while enhancing legal restriction, formulating relevant laws.

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# Chapter 47

## Study on Human Resource Capacity of the New Generation of Peasant Workers: The Empirical Research of Central Six Provinces Based on SEM

Xin-jie Li and Ze-hou Sun

**Abstract** This paper has put forward a human resource capacity (HRC) concept model for the New Generation of Peasant Workers based on four capacity factors: physical capability; intellectual capability; technical ability and psychological capacity. And then, on basis of investigation in the six provinces of central China, this paper has verified the rationality of the HRC concept model by using the structural equation. Research shows that the successive order of factors affecting the HRC is psychological capacity, intellectual capability, technical ability and physical capability. According to the path coefficient of variables calculated from the structural equation model, it is easy to get the weights of evaluation elements of HRC. This evaluation method avoids the uncertainty of direct expert estimation, and reduces the subjectivity of evaluation, thus providing a more feasible scheme with an overall and scientific evaluation system for HRC of the New Generation of Peasant Workers.

**Keywords** Human resource capacity • SEM • The new generation of peasant workers

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## 47.1 Introduction

After the experience of labor shortages in Fujian, the Pearl River Delta in 2004, coastal city of traditional intensive industry faced with a much severer shortage of workers. Not only had that, in the spring of 2012 recruiting season, the same problem occurred in the traditional labor-exporting provinces like Henan, Anhui, and Hubei province. The reasons were not only because the financial crisis, the adjustment of industrial structure, but also because the chief component of peasant workers team has changed, to be more specific, the new generation of peasant workers have replaced the traditional migrant workers and became the main force of migrant workers team<sup>1</sup> (Zhao et al. 2010). The new generation of peasant workers refer to those workers who were born after 1980, at the age of 16–31 years old, mainly employed by the secondary and tertiary industries, but still with the rural household registration (Luo 2010). Compared with elder generation, they have the following features: with a higher education, a long-term occupation planning and employment expectation, and have a stronger intention to melt themselves into the city (Liu 2007). However, due to lack of skills and experience, the new generations of peasant workers have to suffer from employment of poor quality (Xianping 2008). There are about 100 million new generation peasant workers in China, accounting for about 60 % of the total number of migrant workers.

With the china economic development alters from traditional investment mode to technological mode, technology-based growth not only needs a lot of new machines and equipments, but also needs a large number of technically skilled workers (Zhang and Hong 2007). Study on the new generation of peasant workers' human resource capacity (HRC) has important practical significance to help enterprises and government solving the "labor shortage" problem.

## 47.2 Literature Review

### 47.2.1 *The Connotation of Human Resources Capacity*

The earliest thought of human resources capacity (HRC) can be traced back to the Adam Smith's "*wealth of nations*", in which he regards the enhancement of worker skills as the basic source of economic progress and welfare's growth. "Human resources" first was put forward by an American scholar named John Commons in 1912, while the concept of "human resources capacity" was derived from the theory of human resources.

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<sup>1</sup> All-China Federation of Trade Unions "Research report of the new generation of migrant workers issue" [http://news.xinhuanet.com/politics/2010-06/21/c\\_12240721.htm](http://news.xinhuanet.com/politics/2010-06/21/c_12240721.htm) [DB/OL].

In 1990 the United Nations Development Programme (UNDP) begun to publish “the Human Development Report”, pointing out that the important theme of the report was to develop of human ability. In 1995, “Human Development Report” of UNDP considered one’s capability is unit of physical capability, technical ability and intellectual capability. In Schultz’s idea, there are five kinds of important ability that compose human beings’ economic value: learning ability, work capacity, various cultural and sports ability, creativity and ability to cope with troubles (Schultz 1975). While Sandberg (1995) thinks that human resources capacity are the adaptable results of individual characteristics which generated from the meaningful environment.

UNDP’s “the human development report” in 1995 has exerts great influence on the Domestic research of “human resources capacity”. Wenyuan and Chen (2003) held that HRC is a synthetic ability of physical capability, intellectual capability and technical ability, which composed of primary, intermediate and senior ability. Xu and Wang (2002), Qi and Yang (2003) considered ability as the competence of an individual natural person coping with a certain task, and the human resources capability is the skill, energy and proficiency show in social activities. Han (2002) points out that HRC is a unique human proper, which can generate performance knowledge, technical skills attitude and behavior, and can externalize capability, energy and proficiency in dealing with social activities. HRC is productivity in nature, usually including learning ability, team cooperation ability, communication ability, work skills and creativity (Hongri 2006). Erduo (2006) thinks that HRC is knowledge, skills and comprehensive quality, which have an important impact on labors’ production efficiency. Zheng (2008) argues that HRC refers to the inner quality of human beings, including power, intelligence, skill, physical agility.

Different from other scholars, ChenShaoFeng et al. begin to use modern empirical research methods studying the HRC. Chen et al. (2002) constructs the human resources equivalent coefficient equation, and evaluates the domestic HRC. Zhao and Yang (2009) has discussed the connotation of HRC, and analyzed Dalian’s human resources capacity from physical fitness, intelligence and skills. Xia (2009) creates an index system of HRC for peasant workers, which utilizes the factor analysis and multiple linear regression analysis to analyze structural relationship of the migrant workers from rural areas, giving some theoretical and practical reference for the rural force transfer in our country.

### ***47.2.2 Studies on Human Resource Capacity of the New Generation of Peasant Workers***

There are many research achievements on the ability and quality of new generation of migrant workers, issues are related to or are important parts of the HRC. Hu (2010), Yang and Zhao (2011), Wang (2011) studies the current situation and existing problems of the new generation of peasant workers’ vocational skills

training, hold that only through the education training can improve the new generation of peasant workers' quality and ability. Luo (2010), Yeyun and Zhao (2011) try to find the factors which influence new generation peasant workers' employment ability, and establish the corresponding evaluation system. Liu et al. (2011) analyzes and evaluates the status of the new generation of migrant workers' knowledge ability by spot field investigation. Janjuan (2010) measured the new generation of migrant workers' employment ability of construction industry in Jilin province, recommendation on how to improve the employment ability was put forward based on the occupation training and education.

## **47.3 Study Design and the Sample**

### ***47.3.1 Study Design***

HRC is high unification of the physical fitness, intellectual capabilities and technical ability. Physical capability is the carrier and the foundation of the human resources capacity and it is also the physical guarantee of the young man to learn and work. Physical capability mainly includes physiology, body disease resistance and physical quality. Intelligence is an ability of observation, analysis and problem solving by using knowledge and experience. Considering the new generation of migrant workers' low cultural level and wearied out with the strenuous manual labors, this article discusses the measurement of intelligence, mainly from the professional knowledge, cultural theory level, and complete work ability, etc. Technical ability refers to use the specialized knowledge flexibly in practical work, is one of most important ability which can produce the fruits of labor. Main indexes including occupation search capability, technical expertise and professional qualification are used to measure their technical ability.

New generation of peasant workers have different characteristics with their fathers, their motivation to go out to work not only for survival, but for living. They want to pursuit urbanized way of life and desire to change life state. Their "aspirations" for the development are very strong, they have the more persistent "urbanized dream". But there is still a long way for them to achieve urbanization because the restriction of existing obstacles: household registration system, regional compartmentalized education system, the low level of education and skills, the low civil awareness and morality (Zeng 2011). Their city dream encountered many unfair treatments in reality, and brought them a strong psychological pressure which the parents cannot understand. Therefore, psychological quality, enterprising attitude and other factors must be taken into account. Psychological capacities refer to development of psychological potential savings, and the ability to withstand the outside pressure, usually including psychological potential, anti-frustration ability and ability to overcome adversity.

In conclusion, this paper will analyze the new generation migrant workers' HRC from four aspects: physical fitness, intellectual capabilities, technical ability and psychological capacities. Considering the human resources capacities, physical fitness, intelligence, skills and psychological capacities are latent variables; traditional statistical method can't effectively interpret these variables' relationship, so the paper will resort to the structural equation to verify the HRC concept model. Research ideas are as follows: firstly, using one order equation analyzes four capacity factors. If the four ability factors have high correlation and the one order equation analog effect is good, that means four capacity factors are subject to a higher order factor (human resources) influence. And then using second-order equation analyzes the new generation migrant workers' HRC, if the second-order equation analog effect is good, that means the new generation migrant workers' HRC (higher order factor) explains four capacity factor very well.

### ***47.3.2 Scale Design and Data Acquisition***

Questionnaire is composed of two parts, the first part is about the demographic characteristics and regional information; the other part is the survey of the new generation migrant workers' HRC. Scale is composed by a group of human resources ability's related questions or statements, which is used to indicate the respondents' view, evaluation, intentions or attitudes to something. In addition to demographic characteristics and regional information, this scale resorts to Likert scale form category, 1, 2, 3, 4, and 5 on behalf of the "absolutely dissident" and "dissident", "uncertain", "agree" and "strongly agree" respectively.

The survey data comes from the investigation of new generation of migrant workers in six provinces of central China which was carried out by the members of the project during June to September in 2011. The migrant workers of six provinces of central China account for 31.1 %<sup>2</sup> of total migrant workers, Henan, Hubei, Anhui province is famous labor-exporting province of China. So it has certain representation and realistic significance to do research with the central region's new generation peasant workers as the research object. 6,000 questionnaires were sent out in six provinces of central china and acquired 3,823 questionnaires. Eliminating the sample of missing values or obvious answer at the will, finally got 2,517 effective questionnaire, effective return ratio is 41.95 %.

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<sup>2</sup> All-China Federation of Trade Unions "Research report of the new generation of migrant workers issue" [http://news.xinhuanet.com/politics/2010-06/21/c\\_12240721.htm](http://news.xinhuanet.com/politics/2010-06/21/c_12240721.htm)[DB/OL].

47.3.3 *Sample Situation*

The gender distribution of the new generation of peasant workers indicates that the proportion of males is slightly larger than the female. The sample proportion of six provinces of central china is equally distributed, and thus with appropriate representativeness. The new generation of peasant workers is mainly graduated from junior high school or senior high school, few get college degree or above. Young migrant workers’ age are generally small, about 64.2 % workers below 20 years old, the age between 25 and 31 years old are only account for 2.6 % of total number. The new generation of migrant workers’ income is very low, more than half of the respondents’ income below 1,500 yuan, and less than 15 % migrant workers’ income over 2,500.

47.4 The Empirical Results and Analysis

47.4.1 *The Reliability and Validity of Sample*

The sample data is tested and analyzed by SPSS17.0 and AMOS17.0 software package. Through reliability analysis, we got the results in Table 47.1. All the Cronbach’s alpha of the scale and capacity factors is above 0.6, except physical capacity which is 0.579. As for the reliability, there is no a clear principle in academia for judging whether Cronbach’s alpha is appropriate. But most scholars have adopted Kline’s (1998) classification view: reliability coefficient above 0.9 is the best, near 0.8 is very good, more than 0.5 is the minimum acceptable limits (Teng 2011). The calculation results of the model show that the scale and capacity factor scale has good reliability.

According to Fornall and Larcker (1981), all standardized factor loadings should be between 0.5 and 0.95, and T values should be greater than 2 (Kline 1998). In the data processing procedure, this paper resorts to confirmatory factor analysis to verify capacity factor and measurable variables’ internal validity of the model. Results as shown in Table 47.2: the standardized factor loadings of validity and measurable variable are greater than 0.5 and T are greater than 2, illustrates the scale has a high convergent validity.

**Table 47.1** The reliability of scale

Latent variable	Measurable variable	Cronbach’s alpha
Physical fitness	3	0.579
Intelligence	3	0.722
Technical ability	3	0.616
Psychological capacities	3	0.726
Scale	12	0.795

**Table 47.2** The validity of scale

Capacity factor	Measurable variable	Standardized factor loading
Physical fitness	Physical quality(t1)	0.521
	Occupational disease resistance(t2)	0.515
	Disease resistance capacity (t3)	0.659
Intelligence	Professional knowledge(z4)	0.675
	Cultural level(z5)	0.631
	Ability to complete tasks (z6)	0.733
Technical ability	Ability to search jobs (j8)	0.578
	Professional skill(j9)	0.692
	Position certification (j10)	0.503
Psychological capacities	Psychological endurance (x11)	0.723
	anti-setback ability (x12)	0.748
	outlook on life (x13)	0.636

### 47.4.2 Results and Discussion

Based on analysis of all index's reliability and validity, this paper used maximum likelihood estimation (ML) analyzing the new generation of migrant workers' HRC model. Results of one-order equation model shown as Table 47.3: the covariance among four latent variables is not equal to 0, which indicates that four capacity factors have high correlation. Four groups of capacity factor correlation coefficient are greater than 0.5, which illustrates the four ability factors are highly correlated. That means four capacity factors may subject to a higher order factor (human resources) influence, and the results of the one-order equation analog effect is good. One-order equation model and the actual sample data match each other very well.

The one-order equation model analysis results indicate that the four capacity factors subject to a higher level constitutive factor. One order constitutive factors

**Table 47.3** Results of one-order equation model

	Covariance	Correlation	P	Fit Index
Psychological ability ↔physical fitness	0.156	0.614	***	$\chi^2/df = 1.365 < 2$ ; GFI = 0.996 > 0.9;
Physical fitness ↔ intelligence	0.117	0.785	***	
Intelligence ↔psychological ability	0.262	0.66	***	RMR = 0.012 < 0.05; RMSEA = 0.012 < 0.08;
Psychological ability ↔technical ability	0.194	0.35	***	CFI = 0.997 > 0.9; NFI = 0.99 > 0.9
Physical fitness ↔technical ability	0.078	0.463	***	PNFI = 0.735 > 0.5; PCFI = 0.730 > 0.5
Intelligence ↔technical ability	0.17	0.583	***	PGFI = 0.625 > 0.5; RFI = 0.986 > 0.9

of second order equation model are “physical capacity”, “intelligence”, “skill” and “Psychological capacity”, which change into internal latent variables. While exogenous latent variables is the higher order factor “HRC”. Then with the help of AMOS17.0 to calculate the new generation of migrant workers’ HRC model, outputs of the model shows that second-order equation model analog effect is very good and all the indexes reach to a good level, which suggests the “HRC” model that has been put forward for the new generation peasant workers is supported by the data from six provinces of central China very well.

According to the result of model calculation, it is easy to get the path coefficient of all latent variables and measured variables of the “HRC” model. The path coefficient of the “physical (0.59)”, “intelligence (0.81)”, “skill (0.68)” and “Psychological ability (0.98)” shows that psychological capacities had the biggest impact on HRC, then the intellectual capabilities, and physical fitness is the smallest effect factors. With the pale education background, heavy workloads and poor employment circumstances, young migrant workers who have positive attitude towards life, facing the pressure and failure calmly and professional in careers will easily win from his companions. There are 490 million rural labors in our country and only around 20 % of them have received the short-term training, only 0.13 % of them have accepted secondary vocational and technical education. This have already exerted bad influence on the cultivation of peasant-workers’ new technologies, new processes and new skills. The new generations of peasant workers always engage in industries where the physical labor is given priority and the technology content is little, so it is in reason that the physical fitness has the minimum effect on human resources.

## 47.5 Conclusion

The New Generation of Peasant Workers’ HRC is not only unification of physical capacity, intelligence and skill. Psychological ability also plays an important role in promoting young peasant Workers’ HRC. Through analysis of the four capacity factors, this paper obtains the new generation of peasant workers’ HRC model. Model results shows that psychological capacity had the biggest impact on HRC, then the intellectual capabilities, and physical fitness is the smallest effect factors.

According to the path coefficient which calculated from the structural equation model, it is easy to get the weights of evaluation elements of HRC, and then based on the index score it will gain the comprehensive value of the evaluation for the young migrant workers’ human resources capacity. This evaluation method avoids the uncertainty of direct expert estimation, and reduces the subjectivity of evaluation, thus providing a more feasible scheme with an overall and scientific evaluation system for HRC of the new generation of peasant workers.

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# Chapter 48

## The Challenges and the Countermeasures to Human Resource Management through Flattening Organizational Structure

Xiao-ming Li and Jing-liang Chen

**Abstract** In the market environment of rapid development and increased competition, more companies had chosen the flattening organizational structure to respond to environmental challenges. The flattening organization brought immediate change was a substantial reduction of middle management; it was felt that the era of middle management was coming to an end. Therefore, to reduce the organizational level and improve the continuity of business processes had become an important trend of the modern organizational change. In this paper, the case study of R Bank in Zhejiang had been explored on the flat organizational structure. Firstly, the characteristics and performance of the Zhejiang R bank flattening organizational structure had been analyzed; then, the challenges that had been brought to human resource management in the process of flattening organizational structure were discussed. Finally, the countermeasures for human resources management had been put forward to.

**Keywords** Flattening organizational structure · Human resources management challenge · The countermeasures

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A Case Study of R Bank in Zhejiang.

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## 48.1 Introduction

Zhejiang R Bank was a bank that was registered capital of 900 million yuan, with net assets of nearly 4 billion yuan rural commercial bank. The loan scale was \$66 billion; non-performing loan rate was 0.73 %, provision coverage ratio 461.88 % and capital adequacy ratio 12.61 %. Comprehensive strength lied in the forefront of Zhejiang Province Rural Credit System for three consecutive years as “super bank”, “one of top ten banks” in Zhejiang Rural Credit System.

## 48.2 Flattening Organizational Structure of Zhejiang R Bank

Flattening organizational structure was to minimize the management levels between the decision level and operation layer, increase management range, compress functional organization, so that decision-making power would be extended as far as the bottom to improve organizational performance and a compact flexible and full of new horizontal organization that was a flexible, fast, efficient, creative and so on would be set up (Ren and Chen 2007).

In response to changing market developments, Zhejiang R Bank flattened organizational structure in 2011; the core of change had transferred from traditional business processing-centered to client-centered. According to the strategic goal—“the preferred retail bank”, the blueprint of “quality and scale” medium-sized commercial bank was proposed, which highlighted integrated marketing, credit appraisal, risk control and other core business processes to rural users and small enterprises. The bank had 12 management departments, 22 function centers and 100 business networks. To the axis of headquarters, the organizational structure had formed a “trinity” of vertical management system according to business development, management support and supervision. The front ground included sale departments, retail departments, and departments for corporate, investment departments, financial center and small business development centers. Management Support System included credit appraisal department, financial accounting, risk control center and supervision center etc. There were many departments in Supervision & safeguards system such as Information technology department, Human resources department and Audit department etc. Through the integration of product structure, customer structure and internal processes, flattening body and vertically-oriented business had been established in Zhejiang R bank (Fig. 48.1).

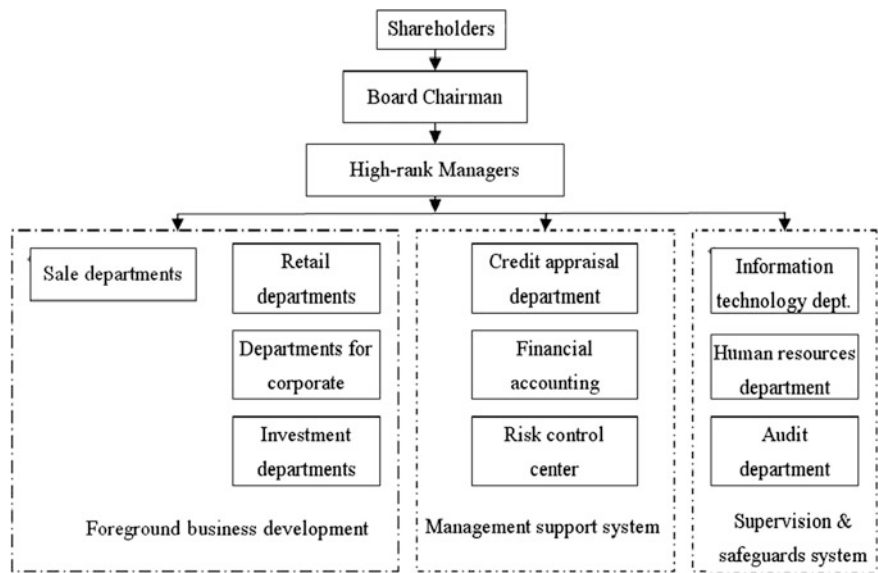


Fig. 48.1 Zhejiang R bank flattening organization structure diagram

### 48.3 Main Features and Performance of the Flattening Organization Structure

In order to allow top management team to quickly understand the market trends, information for customer demand, the center of gravity was shift down to strengthen communication and exchange of ideas properly between the upper and lower levels (Wang and Dong 2006). Then, decision-making thought would be executed well to the bottom in Zhejiang R Bank. Meanwhile, the retail business (the broad masses of peasants, residents and SMEs) of the bank’s 12 different departments was taken as the main target market for deployment, recording customer feedback and providing customers with personalized and diversified services. Since vertical management system, the function of front desk department of banking and retail banking department etc. had changed from accounting transactions to marketing development. Front desk work gradually simplified, financial accounting and credit appraisal moved in the back, tellers free from burdensome accounting and transactions services would mainly concentrate on product development and customer relationship management. Product marketing and customer development in accordance with the classification “4C marketing mix” strategy, a distinctive integrated marketing model had been build up. At the same time, product pricing and product development were decentralized to the Sales Department and the branch, which greatly improved the responsiveness of the Bank on the market and better satisfied with customer needs. This flat organization

structure management simplified the vertical management hierarchy and shortened the chain of command, more procedural work shifted to the background with automated processing, so that a new management model had been formed.

Within the Bank, the center of gravity in the management shifted to the grass—roots level, so that employees were given more decision-making power. For example, in terms of product marketing and customer development, people were based on market needs and customer characteristics to express their views freely, and directly involved in management decisions. In terms of financial product development, it needed particularly frontline staff from Sales Department, the Department of retail banking, financial accounting and risk control center working together, and they had developed a unique and practical value financial products such as “loan Bao”, “merchant link” etc. which fully met the needs of the majority of households and small and medium enterprises. In addition, strengthening cooperation and exchanges between the various departments, many employees continued to carry out job rotation, forming a horizontal collaborative work team, softening the Bank’s internal relationships. Meanwhile, the Bank established staff care centre, tea party for employees, the enterprise stars regularly exchanged their experiences, which would create a positive and open atmosphere of the organization and strengthen learning from each other.

The concise and flexible governance structure of Zhejiang R Bank combined staff, business and operations with strategy organically. According to the flattening organization structure of operation management profiles, management performance and the main features of the flat organization structure could be summarized from a theoretical perspective as follows (Table 48.1) (Yuan and Xiao 2008):

Table 48.1 Main features and management performance of flattening organizational structure	
Management performance	Main features
1. Reducing management layers, business process reengineering and decentralized management;	1. Simplifying vertical management layers and establishing business process as the centre of organizational structure;
2. Collaborating across departmental boundaries, softening the internal relationships and nurturing a flexible organizational mechanism;	2. Close contact between lateral sectors, mutual penetration among departments and integration development;
3. Paying attention to staff participation in organization decision-making;	3. The Centre of gravity of the Organization’s resources and powers sloping downward and improving democratization of decision-making;
4. Respecting employees’ personality, integrating knowledge structure, establishing learning organization and developing knowledge staff	4. Improving the knowledge sharing and the innovation capacity of transforming

## **48.4 The Challenges to Human Resource Management by Flattening Organizational Structure**

### ***48.4.1 Flattening Organizational Structure to the Promotion Challenge***

After the organization change, departments of Zhejiang R Bank reduced from 21 into 12, second-line staff from more than 300 were compressed down to 176, including more than 60 people went to the counter, lobby manager or other positions, other managers had become front-line staff. As flattening organization structure, employee promotion had encountered unprecedented challenges. It was mainly in the following two aspects: first, employee promotion space became narrow. Flattening organization structure brought the most direct result was that with the reduction of the level of management, middle management position would be a big drop in the number, result in promotions compared to become more competitive than before. Second, it was liable to appear “career plateau” crisis. Promotion opportunities would be reduced, so that it was easy to form a “professional ceiling” and cause the “plateau crisis”. For example, many bank staff found a large number of management posts disappear, which their long-term career development would be in a “plateau state” and come to a halt, was bound to bring pressure to these level officers. As a result, the resist emotions even passivity were caused, thereby the efficiency of organizational operations was enormously affected. Such as bank accountant, financial auditors, credit officers and other knowledge workers were very good employees in their own area of expertise, but promotion channel that designed for them was narrow, only up promotion to management. If some people probably cannot be promoted to management positions, which would have dampened enthusiasm for their work; and some were likely to leave. No matter what happened, this would be a great loss to the organization.

### ***48.4.2 The Challenges to Recruitment and Configuration with Flattening Organizational Structure***

After flattening the organizational structure, management range increased significantly. Management range of Zhejiang R bank expanded from 5–8 to 12–15, along with management content became detailed and complicated. Such as the business manager simply was responsible for business management, and now the manager need related to retail banking, financial and accounting department, risk control department and other departments. The coordination of the relationship between departments had changed more complex, thus professional management skills and interpersonal skills were demanded higher. Consequently, the selection

and recruitment of management personnel to adapt to the flattening organizational structure had become the problem of human resource management. On the other hand, the operation of the flattening organizational structure was the business process of market demand-driven and independent team management, which needed requiring employees to have a strong ability to learn and be skilled to manage different work in a business process or a stage, but also have a good team spirit. This requirement was raised to a new level for staff quality. Therefore, how to recruit and configure the talent to adapt to the flattening organizational structure would pose serious challenges to human resource management.

#### **48.4.2.1 The Challenges to the Training with Flattening Organizational Structure**

Flattening organizational structure made the overall functions of all departments of the Bank for “specialization and wide”, which requested the departments to mainly complete the basic business functions, operating characteristics should be highlighted. This also meant that employees needed learning new skills and knowledge continuously. Such as Zhejiang R bank credit officers needed to master the knowledge of credit of all aspects of business operations and processes (i.e., understanding credit system operations, credit reporting, credit management system processes, customer classification and recognition of credit risk). The acquisition of such knowledge requested the organization to learn continuously, so that training became an effective means for employees to pursue their study. In addition, the flattening organizational structure improved the quality requirements for not only the general staff, but also the managers. The process of flattening organizational structure required managers to grant the authority to employees, valid authorization needed managers to have a strong supervision and motivational skills. Therefore, to cultivate the “compound or innovative staff” and “versatile manager” was bound to bring ordeals to the training (Lin and Lin 2008).

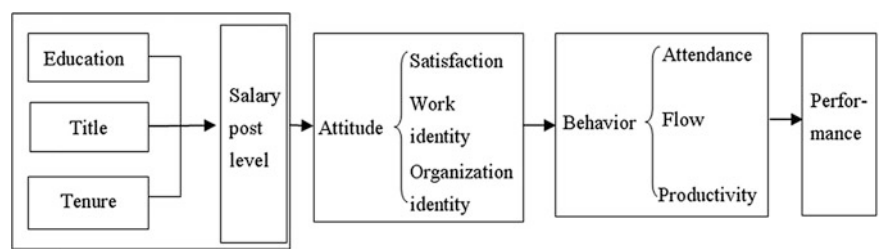
#### ***48.4.3 The Challenges to Performance Management with Flattening Organizational Structure***

Flat organization was based on business processes those were broken down into multiple projects or operating units, and then the assigned tasks were handed over to the independent team or working group to complete. Therefore, organizations needed to clear each task or business unit boundaries, objectives and performance indicators. After the reform of the organization structure, rights and responsibilities of branches and departments of Zhejiang R bank increased substantially. For

instance, a lending task would involve different types of staff (i.e., the counter, savings officers, account manager, risk control personnel), there was a big difference in employees’ knowledge structure, and that produced a criss-cross complex relationship which would result in the rights and responsibilities not clear. It had brought great difficulties to the performance appraisal. Thus, how to establish a comprehensive and fair performance evaluation mechanism had become a great problem in performance management.

**48.4.3.1 The Challenges to Salary Distribution with Flattening Organizational Structure**

In the system of the traditional “pyramid” organizational structure, there were many grades of compensation level. The main determinant factors which influenced the compensation level were employees’ job grades and rank, and the change of each grade salary was smaller (Hu 2010). Employees in order to achieve a breakthrough in the previous salary level, it was necessary to enhance the post grades by rising title, education and position time. According to the analysis of traditional “pyramid” compensation management mode, compensation level would affect the attitude of employees such as job satisfaction, work identity and organizational identity (Zhao and Shi 2007). Staff attitude decided to work behavior, and ultimately directly affected organizational performance (as shown in Fig. 48.2). Such as Zhejiang R Bank had been fully hierarchy before organizational reform, the hierarchy was set to 15 job ranks. Compensation level assessment mainly considered the qualifications of the staff, professional titles, the tenure and skill levels (Xu 2004). But with the organizational structure gradually flattened and the increased uncertainty of external environment, the original salary distribution system was increasingly difficult to effectively motivate staff (Sun et al. 2006). Hence, the flattening organizational structure posed a new challenge to salary distribution.



**Fig. 48.2** Effect analysis of the traditional “pyramid” salary management mode

## 48.5 The Countermeasures to Human Resource Management with the Flat Organizational Structure

### 48.5.1 To Create a Variety of Channels to Promote the Career Development of Employees

With the change of the flat organizational structure, the compression of a large number of management-levels was bound to a huge impact on staff promotion space. For this reason, to solve the problem of staff promotion, it was necessary to change the traditional mode of staff promotion and establish various types of promotion channel. First, double staircase promotion channel should be set up for administrative staff and professional technicians. In accordance with the characteristics of management and technical staff, Zhejiang R bank had built up a parallel promotion system (Fig. 48.3). The internal management staffs were promoted through the administrative channel, and professional technicians get promoted not only by technicians' channel, but also by administrative channel according to their wishes to the administration of the same grade promotion. The two promotion channels were comparable in terms of positions, responsibilities and remuneration for professional technicians. So he needed to move to the equivalent post before promoting to a higher level post. Such as a professional technician with senior accountant title was willing to engage in administrative work and fit for the job, firstly, he should be deployed to the same level of administrative post served as department head or branch governor, and then proceed to higher positions: the top executive. Secondly, according to the demand of the business and employees, the level promotion channel should be established to mitigate “professional ceiling” crisis (Liu 2010). Zhejiang R bank implemented job rotation system: Counter—

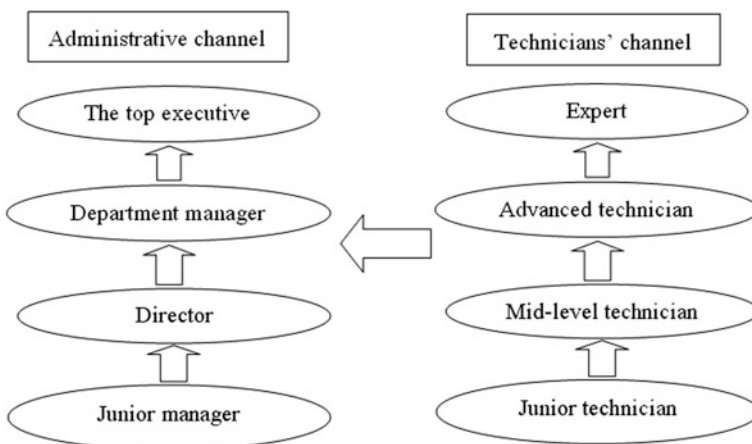


Fig. 48.3 Promotion channels of administrative staff and professional technicians

Marketing—Accounting—Credit—Risk control—Audit, which increased the depth and scope of the work to make the job interesting and challenging, and thus a sense of accomplishment and pride was obtained by the staff at work (Li 2006).

### ***48.5.2 To Formulate Staff Recruitment and Configuration Standards Reasonably Based on Business Needs***

In accordance with the requirements of the flattening organization, the enterprise should consider that the candidate must have the ability to complete a different task with specialized skills in personnel recruitment. This required the candidate need to be in a good learning skills and teamwork spirit, whose knowledge was specialized and wide. The method of the post competition combined with the recommended staffing could be adopted in configuration, which may fully tap the human resources potential of the organization (Gandolfi 2007). Zhejiang R Bank had collaborated with several universities, and set up students practice base which made a graduate student be familiar with different work. It could recruit outstanding university graduates from students-in-training. Also from the perspective of sustainable development or reducing cost, forms of employment could be various and flexible to different employees. According to different needs, the bank could recruit temporary workers, contract workers, formal workers, and had introduced the “Talent Recommended Reward System” and “Talent Introduction Approach”. In the term of configuration, the bank used the staff in an open and transparent atmosphere.

### ***48.5.3 To Perfect the Training Mechanism to Improve the Organization’s Operational Capacity***

Zhejiang R bank continued to improve and perfect the training system of the organization; all members would be trained in skills, the concept of thinking and psychological quality. In order to adapt to the flat organizational structure, the bank carried out different training for various staff. Firstly, the counter staff, lobby managers and auditors were implemented special training and employees was helped to broaden their knowledge in the nurture and master new technologies (Lamieri 2006). The business exchange of new and old employees should be strengthened, and the organization had taken advantage of experience and knowledge of older employees, the old helped the new, so that new employees qualified for positions as soon as possible which ensured operation orderly. Secondly, employees should be encouraged to participate in senior certificate examination of professional accounting, credit and auditing. And training methods may include the various forms of short-term training, job training and technical

competition (Cameron 1994). Finally, the management personnel conducted regular external training and internal management experience exchange, and should pay attention to develop management skills, management concepts, self-confidence and leadership (Katzenbach 1996).

#### ***48.5.4 To Strengthen Performance Management and Build a Sound Organizational Performance Appraisal System***

Flat organizational structure achieved the objective based on self-management team, thus the team and individual performance needed evaluating effectively, and a scientific management system of performance plan, performance appraisal and performance feedback should be built, which could motivate employees to improve job performance continuously and achieved organizational goals (MacKenzie 2008). Zhejiang R bank used vertical and horizontal evaluation method to assess teams of various departments, branches and other processing centers, the team performance evaluation needed to combine quantitative with qualitative, creating Economic Value-Added should be the core of the assessing all task units. Secondly, the horizontal assessment of process-oriented business was implemented within the task team. According to the nature of business process, the evaluation method of “internal market chain” was established, which meant that each team member’s performance evaluation was determined by downstream of the employees. Finally, compensation level depended on not only the staff qualifications, professional titles, skill level and tenure, but also individual performance and team performance, which fully reflected the employee’s personal abilities, qualifications and quality differences. In the process of dynamic management for all employees, the results of performance evaluation were linked to staff development, training and other incentives.

#### ***48.5.5 To Construct Salary Distribution System Based on Post Levels and Contribution***

The flat organization would pay more attention to contribution; the staff salary should be linked with individual performance and team performance in the same post level (Hiltrop 1995). Therefore, to establish salary distribution system combined post levels with contribution had become the inevitable choice of a flat organization compensation management. In order to adapt to flat organization’s management, Zhejiang R Bank had set up four levels in post, post levels had been reduced rapidly compared to the original, at the same time, each level had set 12 salary levels, which expanded the vertical space of salary level, and made them

level overlap appropriately, wide multilevel hierarchy was formed. In this way, the organization had supplemented with the broadband salary when it implemented the grade wage system. In the broadband salary system, salary depended on not only the grade of the staff positions, but also the performance. Thus, it could be reflected the management effectiveness that the same post didn't mean the same salary, and the same salary didn't mean the same post.

## 48.6 Conclusion

With the advent of the information era, the traditional organization had been difficult to adapt to the development of enterprises, organizational structure changed gradually from the pyramid to the flat, and the tremendous changes of management models and methods had taken place. From the perspective of human resources management, the characteristics of a flat organization structure system was described, the main features and management performance of the flat organizational structure were concluded, and the challenges brought about by the enterprise in the process of flattening organizational structure were analyzed in the article. Combination of the management practices in Zhejiang R bank, the strategies and methods of flattening organization were proposed from the employees career development, staff recruitment, training, performance appraisal and salary incentives etc. Together with the case study analysis, it attempted to provide theoretical instruction and experience reference for the flat organization structure transformation in Chinese enterprises.

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# Chapter 49

## The Effects of International Intelligence Outflow on Human Capital Levels of Mother Countries

Ping Li and Li-na Yang

**Abstract** We divide the samples into developing countries and developed countries in this article, and analyze the effects of international intelligence outflow on human capital levels of mother countries by system generalized method of moments (sys-GMM). The results show that international intelligence outflow prompt human capital levels of mother countries as far as all countries are concerned. When we test the effects of human capital outflow on developing countries and developed countries separately, we get similar conclusions, but the effects on developed countries are more remarkable. According to these conclusions, we suggest that all the countries in the world should encourage human capital flow and reduce the barriers of international intelligence outflow to increase the human capital levels of all countries.

**Keywords** Developed countries • Developing countries • Human capital levels • International intelligence outflow • Sys-GMM

### 49.1 Introduction

Grubel and Scott (1966), the forerunner of international intelligence outflow, defined intelligence outflow in this way: they are high professional qualified people such as engineers, scientists, doctors and professors who accept training in one country but live and work in another country. Most of them come from developing countries. Kanbur and Rapoport (2005) gave definition in another way:

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international intelligence outflow is the migration of human capital who received higher education before going from one country to another country.

On the basis of short-run static perspective, some theoretical research pointed out that international intelligence outflow could bring about many negative influences to mother countries (Adams and Page 2005). Since 1980s, on the basis of long run dynamic viewpoint, scholars began to pay more attention to the positive effects caused by international intelligence outflow on mother countries. They pointed out that, international intelligence outflow could bring about positive effects for mother countries' human capital levels through many channels in the long-run, and even reverse the negative effects (Stark et al. 1997; Beine et al. 2001). On the basis of previous researches, we divide the samples into developing countries and developed countries, and use the model presented by Beine et al. (2007) to analyze the international intelligence outflow effects on mother countries by system generalized method of moments (sys-GMM). The structure of this article is arranged as follows: in the second part, we analyze the reasons, the positive effects, and the negative effects of human capital outflow on the basis of some related researches. In the third part, we use panel data of 8 countries (China, Russia, Brazil, India, the United States, Japan, Canada, and Australia) from 2000 to 2010 and put the variable of human capital outflow into the econometric model to test the effects of international talent outflow on the human capital levels of mother countries. In the fourth part, we get conclusions and put forward relevant countermeasures.

## 49.2 Reviews

### 49.2.1 *Reasons of International Intelligence Outflow*

The American Scholar (Leven and Jonsson 2002) thought that there was a strong functional relationship between personal and environment just like physical field in the physical field theory, and the formula was as follows:  $B = f(p, e)$ . In this formula,  $B$  indicates individual performance;  $p$  indicates the individuals' ability and quality,  $e$  indicates the environment. This formula shows that the people' performance is not only connected with their abilities and qualities, but also with the environment around them. When they feel that the environment around them is not good for their development, the intelligence outflow occurs. There are three main external reasons for international intelligence outflow: incompatibility between personal and the environment, imbalance of interpersonal relationship and other financial reasons.

In real life, whether talents choose to go to foreign countries or not depend not only on the income difference, but also on work opportunities and migration costs between mother countries and destination counties. Whether the outflow talents

choose to come back mainly depends on the present value deference of their recompense and direct cost of coming back.

From the macroscopic angle, international intelligence outflow is caused by supply and demand imbalance of human capital in different countries. With the economic growth and progress, many countries need more senior human capital. From the microscopic angle, economic incentive is the direct reason of international brain outflow. Senior talents can find jobs with much higher incomes in foreign countries. For example, in Jamaica, South Africa and Ghana, a significant proportion of professional talents are attracted by high salaries and good jobs in developed countries. Besides, other noneconomic factors are also important reasons for international brain outflow including hardware facilities and assistant atmosphere among colleagues.

### ***49.2.2 The Positive Effects of International Intelligence Outflow on Human Capital Levels of Mother Countries***

The first positive effect of international intelligence outflow on human capital levels of mother countries is education investment effect. If international migration is uncertain, people in developing countries will increase their education investment when people face higher expected earnings and other good immigration prospects. On one hand, in the short run, international intelligence outflow will decrease the human capital levels in mother country. On the other hand, it can also stimulate the government and individuals to increase education investment which may prompt the human capital accumulation. From this angle, international intelligence outflow prompts the human capital levels of mother countries (Lien and Wang 2002).

Under the conditions of open economy, once senior talents in developing countries have opportunity to work abroad, they will get higher salaries and other good conditions. This kind of possibility makes people have higher prospects about going abroad, so they may increase education investment to work in developed countries some day in the future. Beine et al. (2008) pointed out that people with higher education levels will get good reward in foreign developed countries, so they will increase their own education in order to have such opportunities. In other words, the rate of return to education will increase greatly once people go to developed countries, and this kind of anticipation may encourage them to invest in education more (Beine et al. 2011). From the point of developing countries, not all the people who increase the education investment will have chance to go abroad, some of them will stay in mother countries because the quotas are limited, so people who work in mother countries can make a contribution to the promotion of human capital levels of their mother countries.

The second positive effect is intelligence backflow effects. Intelligence backflow prompts mother countries' technology diffusion and production efficiency, so it makes up the loss caused by intelligence outflows (Carr et al. 2005). If mother countries provide higher wage to returnees, intelligence backflow will quicken human capital accumulation and increase human capital levels of these countries greatly. Rapoport et al. (2009) pointed out that capital flow should have corresponding labor markets, so brain backflow is potential factor to capital backflow.

Besides, those backflow talents play great roles in making use of foreign capital and advanced equipments and technologies. Foreign capital in developing countries need corresponding professionals, so those people from overseas are necessary and important because they are not only familiar with some advanced management technologies and experiences, but also with institutions and laws in their mother countries.

The third positive effect is remittance effects. Acosta et al. (2006) thought that remittance is a very important source of income for developing countries. Brain outflow makes some money flow back into developing countries in the form of remittance (Richard and Adams 1998). Remittance is another channel to prompt economic growth of developing countries (Catrinescu et al. 2009). According to the World Bank data, remittance to developing countries came to 205 billion dollars in 2005. It is almost close to foreign direct investment and three times as much as official aids. When GNI increases, household consumption will increase to a great extent. They are able to pay more on children's education investment. From this standpoint, international intelligence outflow makes positive effects on the human capital levels of mother countries.

The fourth positive effect is network effects. The outflow of intelligence will form a kind of social relation networks between mother countries and destination countries which are good to the human capital accumulation both in developing countries and developed countries. But the positive effects on developing countries are more remarkable (Mckenzie and Rapoportb 2007). Also, the talent outflow can form relations with other countries which are benefit for trade, investment, culture and education in developing countries. Saxenian (2005) found that the networks formed by oversea talents play very important roles in the communication of knowledge and technologies between mother countries and destination countries. They are bridges which connect developing countries and developed countries (Pedersen et al. 2008). Wilson (2001) found that there are close relationships between network externality and human capital levels, so the networks are important links to obtain knowledge, information and technologies.

### ***49.2.3 The Negative Effects of International Intelligence Outflow on Human Capital Levels of Mother Countries***

International intelligence outflow could make negative effects on financial revenue. On one hand, intelligence outflow can reduce tax base, on the other hand,

higher educated talents are the main taxable objects and state tax revenue will drain with talent outflow. In most countries, the governments appropriate a good deal of financial revenue as education expenditures, and most of these funds come from taxpayers. Intelligence outflow means national talents leave their mother country after finishing higher education, so they do not feed the knowledge back to their mother country and they do not carry out their obligations of paying taxes to subsidize the next generation's education. Kwok and Leland (1982) pointed out that brain outflow may lead a country to vicious circle, because talents need collaboration and cooperation with each other which makes more and more talents flow into other countries. So individual leaving implies the decreasing of team qualities to some degrees which reduce the human capital levels of mother countries.

## 49.3 Methodology

### 49.3.1 Models

We use the model set by Beine et al. (2007) to study the effects of international intelligence outflow on human capital levels of mother countries as in formula (49.1):

$$\ln(h_{i,t}) = c + \gamma_r m_{i,t}^r + \gamma_d m_{i,t}^d + \beta \ln(h_{i,t-1}) + \xi_{i,t} \quad (49.1)$$

In this model,  $m_{i,t}^r$  is the migration rate of skilled workers in country  $i$  from rich countries in year  $t$ ,  $m_{i,t}^d$  is the migration rate of skilled workers in country  $i$  from developing countries (following the World Bank classification) in year  $t$ ,  $h_{i,t-1}$  is the human capital level of country  $i$  in year  $t - 1$ ,  $h_{i,t}$  is the human capital level of country  $i$  in year  $t$ .  $\beta$  is a parameter which measures the speed of convergence to the long run level of human capital.  $\gamma_r$  and  $\gamma_d$  are the influence coefficients of human capital separately from developed countries and developing countries on human capital levels of destination countries very year.  $C$  is intercept.  $\xi_{i,t}$  is stochastic disturbance term.

From the first part of this article, we can conclude that the change of human capital levels not only have relationship with numbers of talents from other countries, but also with intelligence outflow levels, so we add intelligence outflow variable into the model. We use students abroad every year to measure the intelligence outflow levels. The final model is as in formula (49.2):

$$\ln(h_{i,t}) = \gamma_r m_{i,t}^r + \gamma_d m_{i,t}^d + \beta \ln(h_{i,t-1}) + \alpha \ln s_i + c + \xi_{i,t} \quad (49.2)$$

In this model,  $s_i$  is the index of human capital outflow, and it is presented by the number of students who study abroad.

### 49.3.2 Data Measurements

Measurement of human capital levels ( $h_{i,t}$ ,  $h_{i,t-1}$ ): We choose 8 main countries in the world (China, Russia, Brazil, India, the United States, Japan, Canada, and Australia). We measure these countries' 2000–2010 human capital levels by the number of university students in every country.  $h_{i,t}$  is the human capital level of country  $i$  in year  $t$ , and  $h_{i,t-1}$  is the human capital level of country  $i$  in year  $t - 1$ .

Measurement of intelligence outflow levels ( $m_{i,t}^d$ ,  $m_{i,t}^r$ ):  $m_{i,t}^d$  is student proportion from developing countries in country  $i$ , and it is the percentage of students from developing countries comparing with all students from all over the world.  $m_{i,t}^r$  is student proportion who come from developed countries in country  $i$ , and it is the percentage of students from developed countries comparing with all students from all over the world.

### 49.3.3 Quantitative Inspection to the Relationship between International Intelligence Outflow and Human Capital Levels of Mother Countries

We estimate the model with system generalized methods of moments which is widely used in recent years. There are two generalized methods of moments in applying: difference generalized methods of moments and system generalized methods of moments. Blundell & Bond believed that lag level is only weak instrumental variable for first-order difference equation, so system generalized methods of moments are more appropriate to estimate dynamic panel data. System generalized methods of moments can not only solve endogenous problem, but also can eliminate the influence of individual effects by using orthogonal moment of level variables and first-order difference random entry and orthogonal moment of first-order difference variable and level random item. Also, system generalized methods of moments are appropriate for panel data with less time dimension and more section dimension. The time dimension of our data is 11, and the section dimension is 88, so system generalized methods of moments are more appropriate.

We use system generalized method of moments to estimate the effects of international intelligence outflow on human capital levels of all countries (8 countries), developed countries (4 countries) and developing countries (4 countries) separately. The result is shown as Table 49.1.

**Table 49.1** Dynamic test results

	All countries	Developing countries	Developed countries
$\ln(h_{i,t-1})$	0.751 (139.07***)	0.853 (240.84***)	0.916 (64.72***)
$\ln s_i$	0.108 (50.91***)	0.026 (14.32***)	0.031 (4.02***)
$m_{r,t}^r$	0.331 (3.99***)	0.371 (2.42***)	0.067 (1.94***)
$m_{r,t}^d$	-0.010 (-0.13)	0.110 (-0.73)	-0.135 (-4.19***)
Wald value	42,743.51	10,096.26	30,527.82

Note \*\*\*, \*\*, \* means variables are significant on 1, 5 and 10 % statistical level separately

### 49.3.4 The Analysis to Parameter Estimation Results

After analyzing the overall samples of 8 countries, we get a conclusion that the human capital level in year  $t - 1$  can prompt the human capital accumulation in year  $t$  greatly. Its influence coefficient is 0.751 and is significant on 1 % statistical level. When we test developing countries and developed countries separately, we get similar results.

The influence coefficient of human capital level last year is 0.835 and 0.916 on developing countries and developed countries separately. They are both significant on 1 % statistical level, because the previous human capital accumulation provides good condition for new human capital forming. In this way, human capital levels are the results of knowledge and technology accumulation, so higher knowledge and technology stock may be good for technology innovation and human capital accumulation once more.

For all the countries in the sample, international intelligence outflow has positive effects on human capital levels in mother countries and its influence coefficient is 0.108. It is significant on 1 % statistical level. In this article, we can find that international intelligence outflow has double effects on mother countries. On one hand, when international intelligence outflow occurs, a lot of senior intellects go to foreign countries, so human capital stock and human capital levels decrease in mother countries. This is a negative effect caused by international intelligence outflow. On the other hand, talents outflow can prompt human capital levels in many ways such as increasing education investment effects, talents backflow effects, network effects and remittance effects. When positive effects are greater than negative effects, total effects are positive. When negative effects are greater than positive effects, total effects are negative. Regression results show that international intelligence outflow encourages the human capital accumulation in mother countries efficiently. Taking Australia, a developed county for example, whose public education expenditure raised to 7.9 % in 2000, and was 2.3 % more than that of last year. Taking Brazil, a developing county for example, its public education expenditure was 6.7 % in 2000, but in 2008, its public education expenditure raised to 7.0 %.

When testing the effects of international intelligence flow on developing countries and developed countries separately, we get similar conclusions. But the positive

effects on developed countries are greater than that of developing countries. The influence coefficient of international intelligence outflow on the human capital levels of developing countries is 0.026 and it is significant on 1 % statistical level. The influence coefficient of international intelligence outflow on the human capital levels of developed countries is 0.031 and it is significant on 1 % statistical level. By comparing the effects on developing countries and developed countries, we can see that international intelligence outflow has greater positive effects on developed countries. Because some talents from developing countries choose to stay abroad for good work conditions, high salaries, advanced scientific research facilities and so on. But for developed countries, most of the students will come back to mother countries after finishing their study, so international intelligence outflow in developed countries play more positive roles in prompting human capital levels. According to data from international statistical yearbook, from 2007 to 2009, 70 % of Indian students and 81 % China students stay in America after they get doctor degree, but only 11 % Korea and 15 % Japan students stay in America after finishing their study.

For all the countries in the sample, talents from developed countries can prompt the human capital levels efficiently. Their influence coefficient is 0.331 and is significant on 1 % statistical level. When we test the talents effects from other countries on developing countries and developed countries separately, we can get similar conclusions. But if these talents go to developing countries, their positive effects are much greater compared with going to developed countries. If they go to developing countries, their influence coefficient is 0.371. If they go to developed countries, their influence coefficient is 0.067. Because talents from developed countries can bring along advanced technology to destination countries, and these technology can be absorbed and applied widely in these countries, so their human capital levels will rise up remarkably. Also, the knowledge and technology level differences between developing countries and developed countries are large, so the introduction of senior talents from developed countries makes developing countries available to some new technologies and knowledge. The developing countries may have chance to reduce the gap with developed countries. From this point of view, international human capital outflow may increase human capital accumulation.

For all the countries in the sample, talents from developing countries will hinder the human capital levels in destination countries, and its influence coefficient is  $-0.010$ , but this effect is not significant on 1 % statistical level. The reason is that the absorbing capacities of destination countries are different. When human capital flows into countries of different levels, their influences on the destination countries are different. When they flow into developing countries, they will prompt the human capital levels of developing countries and their influence coefficient is 0.110. When they flow into developed countries, they will impede the human capital levels of developed countries and their coefficient is  $-0.135$ . Recently, more and more people go abroad to do some basic work and make investment. These people do not play important role in promoting human capital levels of destination countries. Take America and Australia for example, in 2007, the student proportion was only 0.099 % of all immigrants in America, and this

number is only 0.113 % in Australia, so in general, immigrant from developing countries will decrease the human capital levels of developed countries.

## 49.4 Conclusions

In the background of economic integration and world interdependence, we should pay more attention to the effects of international intelligence outflow on human capital levels of mother countries. They are not independent but are interactional and mutual complementary. On the basis of existing research results, we analyze the effects of international intelligence outflows on developing countries and developed countries separately. In this article, we choose 4 developing countries and 4 developed countries and use their panel data from 2000 to 2010 to test the effects made by human capital outflow. The conclusions are as follows: for both developing countries and developed countries, international brain outflow can prompt the human capital levels of mother countries remarkable. Human capital from developed countries is positive to prompt the human capital levels of destination countries, and human capital from developing countries is only benefit to prompt human capital levels of developing countries.

On the basis of conclusions above, we hold the idea that international exchanges of human talents are necessary and important. Only when we take part in the world talents flow, can we walk in the forefront of the world. But for developing countries and developed countries, their strategies are different. For developed countries, they should relax restrictions for talents. They should not only attract talents from other developed countries, but also set less limits to intelligence outflow. Because the intelligence outflow in developed countries can prompt the human capital levels of their own. For developing countries, on one side, they should reduce limits to intelligence outflow and permit more intelligence to join in the globalization. On the other side, they should take all kinds of measures to attract intelligence from other developing countries and developed countries, only in this way, can these countries improve human capital levels of their own countries.

As one of the fastest-growing developing countries, China should relax restrictions on international brain outflow, cultivate more and more high-tech talents and increase research and development investment to increase human capital levels. At the same time, we should encourage brain backflow and subsidize them to start their careers in mother countries. In addition, our country should provide more favorable policies for talents from other countries to increase the human capital level of our own country. This strategy is not only appropriate for China, but also for other developing countries. For developing countries, they should attract more talents from developed countries.

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# Chapter 50

## The Knowledge Deficit Economic Analysis of the Women in Rural Areas

Ju-ling Qiao, Li-juan Xin and Juan Wang

**Abstract** With the rapid development of society, more and more rural women to participate in economic activities. The skills rural women master plays an important role in the whole social development, especially in improving productivity, promoting employment levels and reducing the gap between rich and poor. At present, the education level of rural women is low and the lack of knowledge is an outstanding problem which impedes rural women's development in an all-round way. Insufficient human capital investment in the rural women is the primary cause for this phenomenon. This article aims to put forward some suggestions on improving the rural women knowledge level, upgrading rural women human resources quality through the cost and benefit analysis.

**Keywords** Cost benefit analysis · Human capital · Knowledge scarce · Rural women

### 50.1 Introduction

Currently, China's education development has provided more study opportunity for rural women, the education of rural women has the continuous improvement along with female education attention of the whole country, and the increasing education investment. But, the level of education and knowledge acquisition degree of women is still not optimistic in rural areas.

According to our country's higher education fairness research group released recently show that, the proportion of China's rural women's nine years of education is 42.3, 20.8 % lower than men; 8.8 % of the women has less than 6 years

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education, 21.9 % higher than men; female literacy rate is 13.6 %, which is 9.6 % higher than men. The education level of China's rural women is low, still has a large gap compared to men. China's rural population accounts for 65 % of the country's total population, but the quality is low, illiteracy and semi-illiterate population reached 219 million. In rural population, illiteracy and semiliterate accounted for 35.9 %, has the primary school culture is 37.2 %, per population for four college students, which, the number of women in illiteracy, semiliterate far more than men in rural area (Huang 2010).

## 50.2 The Cost-Benefit Analysis of Women Human Capital in Rural Areas

The human capital is the total of the skills, knowledge, health status and level which condensate in laborer through education, training, health care, Labor mobility, employment information. Rural women capital investment refers to the investment into rural women, which can improve the countryside of feminine human resource in the knowledge and skills, and can affect women workers future revenue of inputs (Yu and Suo 2009). American economist Gary S. Becker defined the human capital that by increasing the resources and influence future currency psychological income activities. The human capital investment is various, but education aspects of the human capital investment are considered the important one (Xu 2007).

### 50.2.1 The Cost Analysis

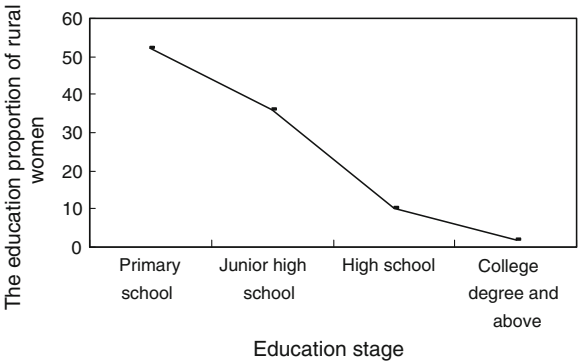
With the development of the economy and adjustment of human resources gender structure, the rural women have gradually become the force that promote social and economic development and which cannot be ignored. From the perspective of economics, only when the expected return present value investment over investment costs, then people will decided to invest. Practice proves the acquired through investment increase in rural women human capital investment, can bring higher than the expected return and can impact the earnings in the long-term.

The education investment is the most important one in rural women's human capital investment; education investment mainly includes two aspects that is the education of fixed cost and opportunity cost (Yan 2010).

$$RV = C1 + C2 \quad (50.1)$$

RV represents the value of human capital, C1 represents the education fixed costs, and C2 represents the opportunity cost.

**Fig. 50.1** The education figure of rural women. *Data sources* the second agricultural census data communiqué



Education of the fixed costs is to point to the education of changes in the cost of production changes. In our country, the education funds into education investment including construction and education funds, the former is the main component of fixed costs, mainly including fees, learning materials, school supplies cost, this part is not change for education. This part is not the main factors which influence human capital investment.

The opportunity cost of education is to point to in resources under the condition of limited, discusses how to effectively allocating resources, because resources are limited, so when to make decisions about the allocation of resources, people will be faced with a multiple choice, education is also related to the problem. Education opportunity cost refers to accept education training and give up revenue that because of the labor and others, opportunity cost is the main effect of the rural human capital investment (Yao and Hu 2009).

According to the survey, along with the improvement of education stage, the proportion of women education declined in rural areas (Fig. 50.1).

The following points out that women in rural areas have primary school culture is occupied 52 %, junior middle school culture is 36 %, high school culture is 10 %, above college culture is 2 %, most rural women only accept primary school education. The reason is that parents think the girl who have finished the elementary school has to do farm work have been paid in the labor market. Because the opportunity cost, in parents' opinion, rural women accept primary school of education costs after more, so as the education stage increases, the proportion of women in rural areas who accept education are declining.

**50.2.2 The Benefit Analysis**

Increasing the rural women's human capital investment will produce incremental income, including personal income and social returns. Personal income mainly reflects in economic monetary income, it is for women in rural areas of human

capital investment and increase the income of total, and personal economic benefits is huge compared to social benefits (Yang 2007).

About the individual economic benefit analysis, women individual and the family in rural areas is the direct beneficiaries, this is mainly embodied in two aspects:

First, women has the gender advantages and make the contribution and influence more depth than men in the family, women human capital investment in rural areas can obtain higher value-added earnings and return on investment.

Second, human capital investment of rural women can improve the productivity of the family, shorten the unpaid housework time, have more time and energy on high return rate labor market, to improve the rural women's labor force participation rate, and further improve the visible return rate in rural human capital investment, and increase the family income.

$$Y = f(S, IQ, F, \text{Age} \dots) \quad (50.2)$$

Y represents person's income, S represents the amount of education, IQ represents innate quality, F represents the family background, and Age represents work experience (Yao and Zhang 2008). Using regression analysis and income function on household income measured which can be perceived that innate quality can only explain rural women additional income nearly 20 %, education is the heaviest single factor that decided to income. Gaza LuoPuLuo card, the research shows that, accept education namely on the human capital of the inputs can influence the personal income about 80 % (Qiao and Liu 2008). Rural women, only to have the higher cultural quality and skill levels to improve labor productivity and increase income.

About the social benefit analysis, to increase the rural human capital investment, not only has the individual families produce incremental effects and promote the development of the agricultural economic stability, even has the great significance to the development of the whole society economic growth, so it is can be said women human capital stock is the important factor to the quality of the whole human resources. Schultz think: "a year of each employee improve education level can brought wage growth that is education yields and women than men, this means that the female labor productivity increase was larger than men, so increasing the female human capital investment to the economic and social development is useful" (Sun 2008).

The change rate for women in rural areas of the human capital investment benefits can use lever coefficient that is human capital leverage coefficient = benefits change rate/investment change rate

$$DHL = \frac{\Delta P/P}{\Delta I/I} \quad (50.3)$$

$$\text{Benefits change rate} = (P1 - P)/P \quad (50.4)$$

$$\text{Investment change rate} = (I1 - I)/I \quad (50.5)$$

Among them, DHL represents human capital leverage coefficient; P1 and P refer to report period benefits and the base period benefits; I1 and I refer to report period investment and the base period investment respectively (Zhang 2008).

By the above formula we can see, rural women human capital investment although is individual human capital increasing, will improve the rural women human resources about the acquisition and application of information and knowledge. In the cost-benefit analysis, the rural human capital investment of women bring the individual economic benefits less significant than social benefits, and the influence of social benefit is profound for narrowing the gap between the urban and rural areas, promoting the balanced development of three major industry, playing an important role on promoting the construction of socialistic harmonious society.

### **50.3 Suggestions on Rural Women Human Capital Investment**

Through the cost benefit analysis of women human capital investment in rural areas, more reasonable human capital investment can play a big role of incremental and use cost and benefit analysis, we know that only when yields greater than costs can receive the expected investment effect (Tan 2006). Therefore, to improving the rural women human capital investment have to reduce costs and increase the profit, then can achieve the expected effect of the delta.

#### ***50.3.1 Lower Opportunity Cost; Promote the Rationality of the Family Investment***

Through the human capital cost analysis, we can know that, because of the existence of opportunity cost, making with the continuous improvement of the education stage the proportion of women in rural areas who accept education are going down, the current most rural economy is relatively backward, even have no ability to take the human capital investment. In addition sex reason, women human capital investment is to save on many aspects, the evaluate and select that a family investment behaviors directly affect women can or not can accept all stages of the obligation to education, sex education investment significant difference in rural family.

By table one we can not only say, parents has a great influence on the degree of rural women's education, but also we can understand that the opportunity cost of investment has decisive role in rural women human capital investment, because of the opportunity cost of investment, the degree of rural women's education is low (Table 50.1).

**Table 50.1** Did not accept the education cause analysis

The reason of dropped out	Male (%)	Female (%)
Parents don't agree	24.4	35.9
Oneself not willing to	45.8	42.1
Failed to enter	26.2	19.7
No schooling	3.7	2.3
Total	100	100

*Data sources* the statistical abstract of 2009

First of all, from rural women's perspective, there are quite a number of women in rural areas is still not aware of the importance of education and the consciousness of the importance of capital investment. This requires the rural women to renew the idea, build up the scientific development view of their own, clear the idea obstacle and misunderstanding, accept education and active skills training, take efforts to achieve their own human resources to the human capital of change and improve their comprehensive quality.

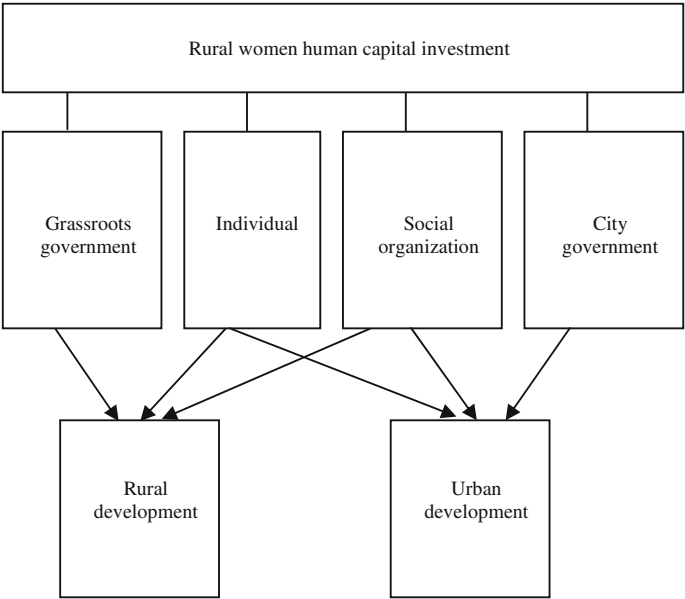
Second, from a government perspective, the government should focus on long-term benefits of rural education, especially women education investment. Adopted a policy to reduce the strength of the education investment in the direct costs of the family investment and reduce family education investment to the burden.

Finally, in the cost and benefit analysis, the government is not only the human capital investment of the main body, and is income main body (Ou 2008). In the long run, on the rural human capital investment of women, not only can help the rural women human pursue personal effectiveness maximization, promote the development of national economy.

### 50.3.2 Promote Rural Women Capital Investment Diversity

In the construction of new socialist countryside era background, we should set up new rural women human resource investment ideas. Building a road of women human resources development to China's national conditions and finally enhances the comprehensive quality of labor women in rural areas (Xu 2008).

According to the discussion about the human capital investment theory, it is known that the investment in women human resources are diversity in the form, polarized about interest, the diversity form makes rural women investment in human resources of the main body has the diversity characteristics (Ren 2008). Women in rural areas of human capital investment subject mainly includes: family, enterprise and government. The diversity main body of investment makes the investment funded and way different, this diversity no matter from the individual itself or from the state's point of view can raise the level of human capital stock (Fig. 50.2).



**Fig. 50.2** The main body of rural women human capital investment frame

From the above we can see, the main body of women investment in rural areas mainly including personal, government and social organization two aspects.

First, because the rural women investment in human resources has the very strong externality characteristics, needs the government investment, besides the rural local economic development level is limited, personal resources supply conditions also shortage, many women in rural areas can't get the human resources investment and development effectively (Li and Liu 2006). But the government as the main body of investment can reduce this situation of personal loss and the rural economic and social development loss. Therefore, the government should also have a responsibility to be main body of rural women human capital investment, improve the rural women human resources quality, for the rural economic and social development providing more effective labor force.

Second, the enterprise is not only the investors of human resources development, also is the attempt of human resources directly, as subject of women human capital investment compared to personal investment, rural women investment in human resources is mainly focus on vocational training. At present countryside female migrant workers most concentrates in low content of technology or labor intensive industry, but enterprise for women in rural areas of human resources investment is still play a very significant positive role (Zhou and Ceng 2007). So, no matter from the point of the enterprise or society, the enterprise investment on human resources of rural women will get high capital stock, driving the development of urban and rural integration.

## 50.4 Conclusions

The rural female labor is the main part of the surplus rural labor force. There is a variety of reasonable factors that restrict the development of rural women which cause the rural human capital without effective use; the reason is the weakness of rural women capital. Improving the rural women human capital investment can change the present situation of women in rural areas especially the lack knowledge. To promote the development and utilization of rural female labor and realize the sustainable economic and social development, also narrowing the income gap between urban and rural areas can promote the construction of the socialist harmonious society.

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# Chapter 51

## An Empirical Study on Relationship Between Diversification Strategy and Research and Development Investment

Yu-feng Wang and Fan Yang

**Abstract** Based on the data of A-share listed companies in Shanghai and Shenzhen Stock Exchanges from 2008 to 2010, this paper theoretically analyzes different diversification strategies affect the choice of different internal control mechanism models, and then affect the department managers of research and development investment willingness. Empirical evidence shows that compared with the single business company, diversification strategy inhibits research and development investment of the company; in addition, compared with related diversification, unrelated diversification strategy inhibits research and development investment of the company; moreover, research and development intensity in diversified firms will be negatively related to a continuous measure of diversification.

**Keywords** Department manager · Diversification strategy · Internal control mechanism models · Research and development intensity

### 51.1 Introduction

Since the 1960s, diversification strategy has become the first choice for the company's growth strategy in Europe and the United States, as an emerging economy of business development mode, many companies have implemented the diversification strategy in China. There are countless researches on the relationship between diversification and firm value at home and abroad. In order to analyze the transmission pathways of diversification influencing firm value, foreign scholars have begun to pay attention to the effect of diversification on research and

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development (below with the representatives of R&D) investment. Because as an internal innovation activity, R&D can enhance the core competitiveness of enterprises to maintain long-term development, which becomes the important source of company value (Zhang et al. 2010). And whether diversification level will have an impact on the company's R&D intensity? How significant will this impact be? This is a problem which can directly affect corporate sustainability innovation. Hoskisson and Hitt (1988) argued that the degree of diversification is negatively related to the R&D intensity. Baysinger and Hoakisson (1989) provided empirical evidence that choice of diversification strategy systematically affects R&D intensity in large multiproduct firms. R&D intensity in dominant business firms was found to be significantly higher than in related and unrelated business firms and was also higher in related business firms than in unrelated business firms. Chatterjee and Wernerfelt (1991) believed that in related diversified companies, the positive relationship of R&D expenditures and the firm performance is more significant. Rogers (2002) and Miller (2004) empirical test also found that specialized companies have higher density of R&D investment than the diversified companies. In contrast, there are few domestic researches on diversification strategy and R&D investment, and the conclusions are not consistent. The empirical results of Yong-hua and Gong-min (2005) showed the private enterprises in China have no significant correlation between R&D intensity and corporate diversification, and there is no evidence showed that the diversified company's R&D intensity is lower than single business company; Wei and Gan (2008) found that the diversified companies invest less money for R&D projects than the specialized companies; Zhang et al. (2010) believed that unrelated diversification strategy inhibits the company's technological innovation activities, while related diversification strategy promotes the company's technological innovation activities.

Based on the above summary of the previous studies, it is easy to see that domestic academic researches on the relationship between diversification and R&D investment have not come to the same conclusion. This may be because the degree of diversification of the domestic companies is generally not high and the investigators did not get a continuous measure of total diversification; besides, the data collection of R&D costs channels are inconsistent, which cause the data are incomplete or not authoritative. The reason is accounting standards did not make a mandatory requirement on disclosure of R&D expenses before 2007 and listed company generally did not disclose the expenses. Then the differences from formerly research design include the following: Above all, we only use the R&D data from the Corporate Annual Reports in 2008–2010 years after the implementation of the new accounting standards, and the unified collection of caliber to ensure R&D data are more realistic and reliable; Second, we adopt entropy method to measure the degree of diversification accurately by the continuous measurement way, rather than the number of companies involved in the industry to indicate the degree of diversification.

## 51.2 Theories and Research Hypotheses

Different types of the diversification strategy could bring different economic effects for enterprises (Porter 1987). The economic effect of the low diversified company (such as the dominant business company) take advantage of synergy effect and resource sharing mechanism to obtain economies of scope, while the highly diversified company pursue the interests of the internal capital market, which generates financial synergy effect, and then gets governance gains (Hill and Hoskisson 1987). The different economic effects will lead to the different internal controls. Many foreign studies have shown that diversified types have a major impact on the internal control system, such as Williamson (1975) believed the implementation of the diversification should take appropriate internal controls in order to rationalize the relationship between corporate headquarters and divisions (Williamson 1975). The executives of the low diversified company emphasize cooperation and integration between the divisions in order to ensure the smooth flow of the company resources among the various business units for achieving economies of scope and require each department manager must focus not only the performance of the sector but also attach importance to the overall performance of enterprises. Therefore, the executives of the low diversified company prefer strategic assessment rather than financial assessment to examine the business units, evaluation of whether the operations of each business unit in line with the company's overall strategy. It is not from the indicators of short-term profits, but from the long-term consideration of the company's development. While highly diversified company's operating purpose is to obtain financial benefits and reduce business risk (Xue 2008). Each of its departments operates independently, there is no synergistic effect. For these companies, choosing unrelated industry is particularly important because the company only enters unrelated industry can reduce the operational risk of the industry portfolio, so they are called unrelated business companies. With the implementation of the diversification to involve in various unrelated industries and to increase the business units, the size of the company are expanding, and even a good high level manager is unlikely to master all the business of the company, so such companies usually take decentralization policy. The department managers get strategic and operational decision-making power as a result of mastering business. Meanwhile, they are responsible for the department performance. Company executives do not participate in the daily management of the divisions, but they mainly use the objective of financial indicators (such as ROI) to evaluate the performance of the department managers, that is to say the unrelated companies tend to adopt financial control instead of strategic control. Hoskisson and Hitt (1988) thought that along with the improvement in the level of business diversification, the company's internal control mechanism model will change from the strategic control mechanism to the financial control mechanism.

According to Wrigley's classification (1967) (Jin Zhou 2008), he divided the enterprises into four types based on the business activities of the correlation: single business ( $SR > 95\%$ ); dominant business ( $70\% < SR < 95\%$ ); related business

**Table 51.1** Degree of emphasis on strategic versus financial controls

Internal control mechanisms	Types of the company			
	Single	Dominant	Related	Unrelated
Strategic control	High	High to moderate	Moderate to low	Low or none
Financial control	Moderate to low	Moderate	Moderate to high	High

( $SR \leq 70\%$  and the business is relevant), unrelated business type ( $SR \leq 70\%$  and there is no correlation between the business). SR means Specialization Ratio, namely the largest business in annual sales divided by total sales of the company, and business relevance mainly refers to the correlation of every business activities in terms of product portfolio, technology, market and so on. Generally speaking, from the single business company to the unrelated business company, the decline in the specialization ratio means that the level of corporate diversification getting higher and higher. Combined with the above analysis, Table 51.1 shows the different types of company headquarters in favor of the choice of strategic control mechanism to financial control mechanism.

The low diversified company stresses strategic control of the company as a whole, which contributed to the formation of long-term concept of department managers. In order to achieve long-term interests of the company, they are willing to take on more risk, and will be more active in investment in R&D projects, because as an internal innovative activity, R&D is the key to the formation of the core competitiveness of enterprises. While highly diversified company takes strict financial controls, the department managers are easy to form the short-term perspective, they would rather reduce expenses in order to meet short-term ROI goals. Therefore, they try to avoid the risk of R&D investment, even if those investments promised to give the absolute net profit expectations. Since there is a correlation between businesses, they encourage department managers to seek synergies between the divisions. Corporate headquarters need more centralized information flow for the strategic plan, and thus they understand more business situation. Compared with the decentralized management of unrelated firms, they prefer “centralization-based, decentralization-supplemented” model, their R&D investment will be also between the dominant business firms and unrelated business firms.

Based on the above theoretical analysis, the author proposes the following three hypotheses:

**Hypothesis 1** Compared with the single business company, diversification strategy inhibits R&D investment of the company;

**Hypothesis 2** Compared with related diversification, unrelated diversification strategy inhibits R&D investment of the company;

**Hypothesis 3** R&D intensity in diversified companies will be negatively related to a continuous measure of diversification.

## 51.3 Study Design

### 51.3.1 Sample Selection

This paper chooses companies which disclosed the 2008–2010 R&D expenditures in Shanghai and Shenzhen Stock Exchanges, Samples screened by the following principles: (1) Excluding the ST and PT companies each year; (2) This research does not consider service innovation, the object of study is product development and innovation, so we exclude the service-oriented industries; (3) excluding the companies which lose financial indicators; (4) Department information is the foundation of a measure of diversification level, so we exclude the companies without department information. The screening sample consisted of 787 sample observations, the annual sample observations are 206, 288, 293. R&D expenditures data come from the Report of the Directors of the company's Annual Report in Cninfo network and the diversified data, financial data come from the CSMAR database.

### 51.3.2 The Calculation of Diversification Level

This article is based on *The industrial classification guidelines* (SFC 2001) issued by the SFC in 2001, it use the Shannon index to calculate the corporate diversification, so entropy method is needed. Based on industry (Amit and Livnat 1988) classification and product category, it could be broken down into two components, an unrelatedness component and a relatedness component, namely (Amit and Livnat 1988)

$$DT = DU + DR \quad (51.1)$$

where DT is total diversification, DU is defined as unrelated diversification between industry groups. DR is defined as the related diversification arising out of operating in several segments within an industry group, whereas

$$DU = \sum_{j=1}^M P^j \ln(1/P^j). \quad (51.2)$$

$P^j$  is the share of the  $j$ th group sales in the total sales of the firm,  $M$  is the number of company's business units.

$$DR = \sum_{j=1}^M \left[ \sum_{i \in j} P_i^j \ln(1/P_i^j) \right] P^j. \quad (51.3)$$

It represents the entropy within the industries and reflects the degree of related diversification, where  $P_i^j$  is defined as the share of the segment  $i$  of group  $j$  in the total sales of the group.

### 51.3.3 Model Building

Previous studies have shown that the size of the company, the level of the liabilities of the company and the assets of the company's profitability will affect R&D investment, the company's size and profitability of the company's assets are positively related to R&D intensity, while the company's debt level is negatively related to R&D intensity. The natural logarithm of the total assets represents the size of the company (SIZE), asset-liability ratio means the debt levels (LEV), ROA measures the corporate profitability. Therefore, they are used to analyze the impact of these factors on the R&D investment as control variables. So we can build the following model based on the assumptions:

$$RDI = \alpha + \beta_1 DIVER + \beta_2 SIZE + \beta_3 LEV + \beta_4 ROA + \varepsilon \quad (51.4)$$

$$RDI = \alpha + \beta_1 UNRELATED + \beta_2 SIZE + \beta_3 LEV + \beta_4 ROA + \varepsilon \quad (51.5)$$

$$RDI = \alpha + \lambda_1 DT + \lambda_2 SIZE + \lambda_3 LEV + \beta_4 ROA + \sum IND_i + \varepsilon \quad (51.6)$$

RDI (R&D intensity) is R&D expenditure divided by the total sales revenue, it should be noted here that the dependent variable we used is meant to reflect only what it measures, namely the intensity of investment in the inputs supporting the innovation process, rather than innovation itself. DIVER represents the diversified enterprises, when a company belongs to any class of dominant business, related business or unrelated business enterprises, the DIVER value to "1", otherwise the value is "0", UNRELATED represents unrelated business enterprises, when a company belongs to unrelated type, the value is "1", if it is a related company, the value is "0". IND means the industry dummy variable. According to the listed companies Industry Classification Guidelines for the classification criteria, this study samples contain a total of 26 industries.

**Table 51.2** Descriptive statistics of main variables

Variables	Measurement values			
	Means	Min	Max	Standard deviation
DT	0.09	0	0.6	0.1357
SIZE	2.1189	1.872	2.6156	0.9724
LEV	0.4064	0.030	0.9695	0.1885
ROA	0.0649	−0.353	0.4638	0.0677

51.4 The Empirical Results and Analysis

51.4.1 The Descriptive Statistics of the Main Variables and R&D Investment

Table 51.2 is the descriptive statistics of the main variables. It can be seen that the maximum value of DT is 0.6, the minimum value is 0, difference between them is small and standard deviation is also small. These data suggest that the diversification level of sample companies is similar and the diversification of business community is generally not high on the whole. Moreover, the mean of DT is 0.09, the main reason is that many companies in the sample belong to the single business company and their values of DT are 0, their values greatly pull down the overall level of the DT. Therefore, the mean is not representative. Moreover, the mean of the LEV is 0.4064. From the perspective of Finance, Chinese enterprises idealized asset-liability ratio is 40 %. The ratio of listed companies is slightly higher, but not more than 60 % under normal circumstances, so the debt levels of the overall sample are reasonable.

Table 51.3 is the distribution of R&D investment levels in different sample groups. First of all, in the total samples of 787 listed companies, there are 568 single business firms and 219 diversified firms. It shows that although the diversification strategy has become the development trend in China, the implementation of diversification strategy of enterprises is not that much. Second, the sample average R&D intensity is 3.376 %, it indicates that R&D intensity of Chinese enterprises is not high at present, the awareness of independent innovation of the

**Table 51.3** Descriptive statistics of R&D investment

Company types	R&D investment				
	Means	Min	Max	Standard deviation	N
Total samples	0.0338	$6.0 \times 10^{-7}$	0.0871	0.0448	787
Single	0.0381	$1.2 \times 10^{-5}$	0.0871	0.0498	568
Dominant	0.0187	$6.0 \times 10^{-7}$	0.1191	0.0186	101
Related	0.0337	$8.5 \times 10^{-5}$	0.1624	0.0371	45
Unrelated	0.0209	$6.4 \times 10^{-5}$	0.1188	0.0221	73

**Table 51.4** Variable regression results

Variables	Models		
	1	2	3
Constant	0.116*** (3.225)	0.121* (1.604)	0.132*** (3.588)
SIZE	−0.03* (−1.726)	−0.004 (−1.023)	−0.003* (−1.752)
LEV	−0.39*** (−3.666)	−0.02 (−0.883)	−0.035*** (−3.298)
ROA	0.4 (1.473)	0.044 (0.918)	0.039 (1.437)
DIVER	−0.012*** (−3.348)	–	–
Unrelated	–	−0.011* (−2.093)	–
DT	–	–	−0.02* (−1.718)
R <sup>2</sup>	0.077	0.093	0.162
Adj. R <sup>2</sup>	0.073	0.061	0.13
F	16.393***	2.889*	5.036***

*Annotation* this table only lists the main variables. The number in parentheses is the *T* test value. \*\*\* by the 10 % level of significance test, \*\* by the 5 % level of significance test, \* by the 10 % level of significance test

company is not enough. R&D investment mean of the dominant business company is significantly lower than that of other type company of R&D investment, and R&D intensity mean of other types company have little differences.

### 51.4.2 Multiple Regression Analysis

Table 51.4 shows the empirical test results of these three models. The descriptive statistics shows that the mean of R&D intensity in the single business company is higher than that of the diversified company, but it does not appear obvious differences. The results in Table 51.4 confirm this conclusion, although the DIVER through the 1 % level of significant test, the regression coefficient is just −0.012, so the results show that compared with the single business type, diversification strategy inhibits R&D investment of the company. We can clearly see from the Model 2 that the regression coefficient of the UNRELAED is −0.011, also it passes the 10 % level of significance test, which shows that different types of diversification have different effects on the R&D investment, compared to related diversification, the implementation of unrelated diversification strategy inhibits the company's technical innovation activities. Model 3 utilizes all of the samples, the test results show that the DT through the 10 % level of significance test, the regression coefficient is −0.02, which supports the assumption 3 of this article, that is, there is a negative relation between the degree of diversification and R&D intensity.

In addition, Table 51.4 shows the impact of the control variables on the R&D intensity. The SIZE in model two and three passes the 10 % level of significance test, however, the results of SIZE is in contrary to expectations; it negatively related to R&D intensity. The results of LEV pass the 1 % level of significance test

in model two and three, these show that the higher the debt levels, the lower the R&D investment. And the results are in line with expectations. It can be seen accordance with the three models that there is no significant relationship between the rate of return on total assets and R&D intensity.

## 51.5 Conclusion

The results reported above reveal that different types of company, different R&D investment density. Although this paper did not measure the internal control mechanisms attributes of the different diversification business strategy directly, the theoretical part and empirical results are both in line with previous research on company strategy and business level strategy implementation. The empirical studies of this paper have shown that all else being equal, R&D intensity in diversified firms will be negatively related to a continuous measure of total diversification. It is worth mentioning that R&D intensity have no significant relationship with the degree of diversification before joining the industry control variables.

In addition, there is no significant relationship between the rate of return on total assets and R&D intensity, the main reason may be that affected by the debt crisis in Europe the last few years, Chinese stock market performance of listed companies has been affected. The SIZE is negatively related to R&D intensity, it may be because that there is an appropriate scale of the R&D for enterprise itself, if the R&D scale exceed the moderate scale and the company once get the monopoly power, it will lose the power of technological progress, the willingness of the company R&D will be reduced. What exactly the most appropriate scale of corporate R&D activities is? This article do not discuss, it remains to be further study for validation.

The inadequacy of this article is the lack of considering efficiency and effectiveness of R&D activities, we only discuss the beginning of the R&D activities, namely, research and development investment elaborate technological innovation. In the assessment of the type of diversification strategy a company implements, Williamson (1975) suggested that it is important to consider issues of both efficiency, with respect to a given goal; and effectiveness, with respect to the choice of goals. Finally, because this research uncovered a comparison of R&D intensity between four types of the company, the obvious next step should be a field research that the intensity of spending on research and development differs, across firms with different types of companies. From the hypothesis one, we can further prove whether R&D intensity of the specialized company is significantly higher than that of the diversified company. We can also further demonstrate whether R&D intensity in the related business company is higher than the unrelated business company according to hypothesis two.

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## Chapter 52

# An Empirical Study on the Endogeneity of Corporate Governance Mechanisms and Firm Performance

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**Abstract** The relationship between governance mechanisms and firm performance is always a focus problem in the corporate governance. The existed studies ignored many mechanisms' integrated effect and its endogeneity, only established one equation to study relationship between governance mechanisms and firm performance. Consider about endogeneity, simultaneous equations model were presented to capture the interrelationships between the six control mechanisms and firm performance. Then, ordinary least square and two-stage least square estimated the equations with data of two exchanges during the period 2002–2004 in a sample of 1,721 firm years. The results showed that there were endogeneity issue in the relationship between governance mechanisms and firm performance. In the end, the conclusion is applied to suggest policy implications of China's economic reform.

**Keywords** Endogeneity · Firm performance · Governance mechanisms · Simultaneous equation

## 52.1 Introduction

Since Jensen and Meckling applied the agency theory to the modern corporation, a study on corporate governance had been about thirty years. As corporate governance mechanisms may reduce these agency problems, many governance mechanisms were addressed. Many researchers have investigated the relationship

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between corporate governance mechanisms and firm performance but the views and empirical methods that they studied result findings mixed.

Most previous studies that estimated the valuation impact of corporate governance concentrated on specific aspects of corporate governance in isolation. However, the existence of alternative corporate governance mechanisms may lead to a missing variables bias and spurious correlations. Recent studies have investigated the mutual relationships among corporate governance mechanisms and the relationships between these mechanisms and firm performances.

In the recent oversea literatures, Jensen et al. (1992) examined the simultaneous relationship between insider ownership, debt, and dividend policies. Bathala et al. (1994) examined the interrelationships among institutional ownership, managerial ownership, and debt. Agrawal and Knoeber (1996) examined the interrelationships among seven control mechanisms. Stefan et al. (2006) developed a system of simultaneous equations and apply three-stage least squares to the relationship between five corporate governance mechanisms and firm performance. In the recent domestic literatures, Bai and Joe (2005) treats firm performance as a dependent factor of control mechanisms and studied the relation between the control mechanisms and firm valuation. Zhong and Li (2006) found there were the substitution effect between the board supervisors and other mechanisms. Hua and Zhijun (2006) examined the interrelationships among equity ownership, boards of directors and firm valuation.

However, most existing studies focused on the developed country, and the empirical research about China was rare. Different study used different corporate governance mechanisms, and results were often mixed. Two major features are presented. First, the theoretical ground is a contingent view of the firm. This view argues the examining governance mechanisms in an isolated context are not effective. Following the previous study, six key mechanisms of corporate governance control is identified. They are ownership concentration, institutional shareholdings, board of directors, managerial compensation, debt finance and actual controller, then an interrelation between six key mechanisms and firm valuation is examined. The second major feature is approach. Corporate governance mechanisms and firm performance are interrelated. Control mechanisms and firm performance is endogenously determined, and thus affecting each other. A system of simultaneous equations is developed and apply two-stage least squares (2SLS) to the relationship between corporate governance mechanisms and firm performance.

## 52.2 Theory Analysis of Hypotheses

According to the previous corporate governance literature, the key mechanisms of corporate governance control were identified. These included internal and external governance. Due to the absence of a market for corporate control mechanism and the managerial labor market in China, six corporate governance mechanisms that they are

ownership concentration, institutional shareholdings, board of directors, managerial compensation, debt finance and actual controller are considered in this paper.

**Ownership concentration:** ownership structure is a central and distinguishing theme in the corporate governance literature. Typically, two issues of shareholding are addressed in Chinese research. One is different types of shareholders, the other is ownership concentration. Large shareholders have the incentive to monitor firm management, and that the presence of large shareholders enhances firm performance. Specifically, they relate the behavior of large shareholders to takeover-related monitoring, and contend that the presence of a large stockholder is necessary for value-increasing takeovers to occur.

**Hypothesis 1** ownership concentration is significantly positively related to firm performance

**Institutional shareholdings:** institutional investors are long-term investors with significant incentives to actively oversee managers. Institutional investors are becoming more active in monitoring, as the cost of selling their holdings is getting higher. There are increasing numbers of cases where institutional investors apply pressure on the corporation and seek a seat on the board of directors

**Hypothesis 2** institutional shareholdings are significantly positively related to firm performance

**Board of directors:** boards of directors are involved in solving the agency problems inherent in managing any organization. Independent directors possess two characteristics that enable them to fulfill their monitoring function. These are their independence and their expertise. They exert effort on behalf of shareholders because they want to maintain their reputations in the external labor market. In general, the evidence shows that independent boards provide some form of control on firm activities

**Hypothesis 3** there is unknown relationship between Percentage of independent directors and performance

**Managerial compensation:** managerial compensation can be used to reduce the agency conflict between managers and shareholders. Agency theory argues that there should be a positive relationship between CEO pay and financial performance, and empirical studies have sought to confirm this association

**Hypothesis 4** there is positive relationship between managerial compensation and firm performance

**Debt finance:** The cost of leverage plays a role in the control mechanism as it affects the manager's control and flexibility in making resource allocation decisions. Specifically, in debt contracts, lenders can request borrowers to make payments as specified by a contract. In such cases, some form of control of cash flow relocates from the debtor to the lender, and managerial discretion over resources is reduced

**Hypothesis 5** there is negative relationship between debt and performance

Actual controller: a listed company in China is typically owned by five groups of shareholders. They are the state, legal persons (or institutions), employees, individuals (for A-shares), and foreign investors (for B-shares). State shares are shares owned by the government. Legal person shares are owned by domestic institutions such as corporations, financial institutions, and mutual funds. A- and B-shares are tradable shares that are mostly held by individuals. A-shares are owned by locals and B-shares are owned by foreigners. The central government and the local governments own the state shares, and the ultimate control of these shares is in the hands of the State Council. In many cases the government is the major shareholder of listed firms. The government also retains control over the appointment of senior management

**Hypothesis 6** when actual controller is state shareholdings, firm performance is weaker than other is

Relationship between governance mechanisms and Firm performance: ownership and corporate governance mechanisms and firm performance are interrelated. However, empirical evidence yields conflicting views on the relative importance of their relationships. The mixed results are due, in part, to the substitutability of one corporate governance mechanism for another

**Hypothesis 7** there is interactive among various governance mechanisms. When consider the endogeneity, the empirical results will changed

## 52.3 Research Design

### 52.3.1 *Choice of Sample and Data Source*

The source of director pay, board size, and board composition are used China Stock Market and Accounting Research Database. The rest of the data including shareholding structure, operating risk, and state ownership is obtained from Wind financial data. In line with prior studies, after eliminating companies in the financial sector, and observations with missing data, there are 1,721 firm-year observations for the analysis.

Table 52.1 provided description for the variables.

### 52.3.2 *Model Established*

Following Firth et al. (2002) framework, we allow for interdependence between these corporate governance mechanisms by specifying a system of simultaneous equations, where each governance mechanism is the dependent variable in one of

**Table 52.1** Description of variables

Governance Mechanisms Variables	
HSF	Ownership concentration, sum of the squares of the proportionate shareholdings of the ten largest shareholders in the company
LegalP	Institutional shareholding, proportion of legal person shares
IND	Board composition, percentage of independent directors on the board
Pay	Average of the three largest CEO compensation, pay is the natural log of the cash compensation
Debt	Book value of long term debt/book value of shareholders' equity
Ltype	Actual controller, 1 when the state holding is greater
ROA	Return on assets adjusted by the median return of the industrial sector
Control Variables	
Size	Firm size, natural log of the book asset value of the company
Risk	Firm risk, standard deviation of monthly returns on the firm's stock estimated from the monthly returns for the year
FS	Foreign shareholdings, 1 when the company also issues B shares and/or H shares
Board	Board size, the number of directors on the board
Nopay	Nopay board, nopay board proportion of the board
Mshare	Executive shareholding, the sum of top management shareholdings in the end year
Rich	The rich region, 1 for firms registered in the cities of Beijing, Shanghai, Tianjin, and Zhejiang, Guangdong provinces
MRich	The medium rich region, 1 for firms registered in the Liaoning, Jilin, Heilongjiang, Jiangsu, Fujian, Shangdong, and Hebei provinces, plus Xinjiang Autonomous Region
AvROA	Average ROA for 2002, 2003, and 2004
Ndts	Non-liability tax avoidance, depreciation of fixed assets/Total assets
Volty	Avails fluctuation, standard deviation of the company's prime operating revenue
Growth	Average annual growth of net profit for 2002, 2003 and 2004

the equations. The choice of any of the corporate governance mechanisms may depend upon choices of all other mechanisms as well as other factors (Zuobao Wei et al. 2005).

To examine the relationship between the governance mechanisms and firm performance, the dependent variable in the first equation of system is ROA. Following the previous literatures, two variables were included to control for growth opportunities: Size and Growth (Du Ying and Liu Liguó 2002).

$$ROA = \beta_{10} + \beta_{11}HSF + \beta_{12}LegalP + \beta_{13}IND + \beta_{14}Pay + \beta_{15}Debt + \beta_{16}Ltype + \beta_{17}Size + \beta_{18}Growth + \varepsilon \quad (52.1)$$

In the second equation of the system, using an ownership concentration factor captured the effect of concentration ownership. Size and Risk were included as an independent variable in the equation and expect that it will be positively related to concentrated shareholding. The second equation of the system is:

$$HSF = \beta_{20} + \beta_{21}LegalP + \beta_{22}IND + \beta_{23}Pay + \beta_{24}Debt + \beta_{25}Ltype + \beta_{26}ROA + \beta_{27}Size + \beta_{28}Risk + \varepsilon \quad (52.2)$$

In the third equation of the systems, LegalP is used as institutional shareholding effect. Equation included the other six governance control variables in the equation as the choice of LegalP depends on the other six variables. In addition, Risk, FS, and Size were also included in the equation. It was expected that these exogenous variables are positively related to LegalP. The third equation of the system is:

$$\begin{aligned} \text{LegalP} = & \beta_{30} + \beta_{31}\text{HSF} + \beta_{32}\text{IND} + \beta_{33}\text{Pay} + \beta_{34}\text{Debt} \\ & + \beta_{35}\text{Ltype} + \beta_{36}\text{ROA} + \beta_{37}\text{Size} + \beta_{38}\text{Risk} + \beta_{39}\text{FS} + \varepsilon \end{aligned} \quad (52.3)$$

In the fourth equation of systems, the board of directors is used as the dependent variable, and using independent board composition captures the board of directors. Prior studies use the proportion of outside directors on the board as a proxy for board control. However, there was statutory requirement for independent directors in listed firms in China from the year 2002 (Wang Yuetang et al. 2006). The proportion of independent directors was used as a proxy for the board control. As the proportion of independent directors is directly related to Size, board size, and the presence of Nopay chairman these factors were included in the equation (Mak and Li 2001). The fourth equation of the system is:

$$\begin{aligned} \text{IND} = & \beta_{40} + \beta_{41}\text{HSF} + \beta_{42}\text{LegalP} + \beta_{43}\text{Pay} + \beta_{44}\text{Debt} \\ & + \beta_{45}\text{Ltype} + \beta_{46}\text{ROA} + \beta_{47}\text{Size} + \beta_{48}\text{Board} + \beta_{49}\text{Nopay} + \varepsilon \end{aligned} \quad (52.4)$$

In the fifth equation of system, the managerial compensation is used as the dependent variable, and CEO compensation deals with the managerial incentive variable. Managerial pay is a key factor in the principal-agent relationship. The other variables are Size, Mshare, Rich and MRich. To control for the potential geo-economic location effects, China's region was classified into three regions based on the average GDP per capita for the period 2002–2004: rich (Rich), medium rich (MRich), and poor regions. Dummy variables were assigning to firms located in different regions. Rich equals one if a firm is headquartered in the top 25th percentile and zero if elsewhere; MRich equals one if a firm is headquartered in the middle 50th percentile and zero if elsewhere. The fifth equation of the system is:

$$\begin{aligned} \text{Pay} = & \beta_{50} + \beta_{51}\text{HSF} + \beta_{52}\text{LegalP} + \beta_{53}\text{IND} + \beta_{54}\text{Debt} + \beta_{55}\text{Ltype} \\ & + \beta_{56}\text{ROA} + \beta_{57}\text{Size} + \beta_{58}\text{Mshare} + \beta_{59}\text{Rich} + \beta_{60}\text{MRich} + \varepsilon \end{aligned} \quad (52.5)$$

In the sixth equation of systems, the capital structure is used as the dependent variable, The debt-equity ratio was used as a proxy for capital structure (Anderson et al. 2009). The debt level was expected to depend on the Size, Ndts, Volty and AvROA. The sixth equation of the system is:

$$\begin{aligned} \text{Debt} = & \beta_{60} + \beta_{61}\text{HSF} + \beta_{62}\text{LegalP} + \beta_{63}\text{IND} + \beta_{64}\text{Pay} + \beta_{65}\text{Ltype} \\ & + \beta_{66}\text{ROA} + \beta_{67}\text{Size} + \beta_{68}\text{AvROA} + \beta_{69}\text{Ndts} + \beta_{70}\text{Volty} + \varepsilon \end{aligned} \quad (52.6)$$

In the seventh equation of systems, Ltype proxy state ownership effect. Equation included the other six governance control variables in the equation as the

choice of *Ltype* depends on the other six variables. In addition, *Size* was also included in the equation. It was expected that the exogenous variables are positively related to *Ltype*. The seventh equation of the system is:

$$Ltype = \beta_{70} + \beta_{71}HSF + \beta_{72}LegalP + \beta_{73}IND + \beta_{74}Pay + \beta_{75}Debt + \beta_{76}ROA + \beta_{77}Size + \varepsilon \quad (52.7)$$

## 52.4 Empirical Results

### 52.4.1 Descriptive Statistics

Table 52.2 provides summary statistics for the variables. Performance statistics of the firm show that the mean (median) adjusted ROA are  $-0.585(-0.323)$ , and range from  $-53.54$  to  $21.77$  %. The HSF factor ranges from 0.00 to 0.70 with average (median) values of 0.228(0.203). The average proportion of Institutional shareholding is 17.1 % with a maximum of 84.8 %. The proportion of independent directors is about 30.1 % in the sample companies and this is comparable to the ratio of non-executive directors on Western boards. For example, Core et al. report 43 % of outside directors in U.S. companies and Ezzamel and Watson report 43 % of non-executive directors in their U.K. sample (Liansheng et al. 2010; Fehr

**Table 52.2** Descriptive statistics

Variable	Mean	Median	Std. Dev.	Max	Min
HSF	0.228	0.203	0.138	0.70	0.00
LegalP	0.171	0.085	0.203	0.848	0.0
IND	0.301	0.333	0.077	0.667	0.00
Pay	11.744	11.775	0.829	14.67	8.72
Debt	0.476	0.489	0.181	0.96	0.01
Ltype	0.73	1	0.442	1	0
ROA	-0.585	-0.323	5.653	21.77	-53.54
Size	12.105	12.063	0.84	15.24	9.71
Risk	1.234	1.007	0.831	7.7	0.17
FS	0.11	0.00	0.317	1	0
Board	9.90	9	2.254	19	5
Nopay	0.318	0.333	0.232	1	0
Mshare	0.044	0.016	0.145	2.38	0
Rich	0.2	0.00	0.401	1	0
MRich	0.5	1	0.5	1	0
AvROA	4.796	4.642	4.587	27.47	-17.07
Ndts	0.156	0.127	0.118	0.911	0.0007
Volty	0.265	0.225	0.205	1.72	0.02
Growth	-0.598	0.059	6.793	43.35	-108.8

et al. 2009). In natural log terms, Pay ranges from 8.72 to 14.67. The average long-term debt to equity ratio is 47.6 %. The state controlled firm in China is average 31 %.

Approximately 11 % of the sample companies issue shares to foreign shareholders. The proxy for Size is the natural log of book assets, and the value ranges from 9.71 to 15.24. Risk ranges from 0.17 to 7.7 and AvROA ranges from  $-17.07$  to 27.47 % for the sample. The average board size is 9.909. On average, about 89.9 % of the board chairpersons also hold positions as general managers. The average Nopay board is 31.8 %. Non-liability tax avoidance ranges from 0.911 to 0.0007. The average avails fluctuation is 26.5 %. The average annual growth of net profit of three years is  $-59.8$  %.

### 52.4.2 Regression Results

Empirical analysis proceeded in three steps: First, ordinary least squares (OLS) regressions were estimated where firm performance depends only on a single corporate governance mechanism. Second (1) was estimated using OLS to examine the effects of all governance mechanisms simultaneously. And third, to avoid incorrect inferences due to possible endogenous relationships between the different governance mechanisms themselves as well as between the governance mechanisms and ROA, (1) along with (2)–(7) was estimated in a system of simultaneous equations using 2SLS. A comparison of the 2SLS estimates with the OLS estimates of (1) allows a direct inspection of the differences that arise from any possible endogeneities.

Table 52.3 shows the OLS regression estimates with ROA as the performance indicator. The results show that HSF, LegalP, IND, Pay, Debt and Ltype are all significant factors in the performance relationship. Large shareholdings (HSF) and Institutional shareholdings (LegalP), higher percentage of independent directors (IND) and compensation (Pay), and lower debt (Debt) and state shareholdings (Ltype) are significantly associated with good performance (Li et al. 2009; Elyasian and Jia 2010). The interpretation of the linear regression results is that each control mechanism has an effect on firm performance when the interdependencies of the other control mechanisms are ignored.

Following Agrawal and Knoeber, all ownership and governance control factors were entered into the model as shown in (1) and the OLS and 2SLS estimation results of the model in Table 52.4 were presented. Table 52.4 shows that performance is significantly related to HSF, LegalP, IND, Pay, and Debt as well as the control factors Size and Growth. These results are similar to the results in Table 52.3. The different is that the significance of Ltype in Table 52.3 disappears in Table 52.4. But the factor sign is not changed, and state shareholdings (Ltype) are associated with good performance. Similar to the former, these factors are significantly related to the performance in the 2SLS estimation. However, the sign of IND is reverse in the 2SLS, and the factor IND is significantly related to the

**Table 52.3** Coefficient estimates from OLS regressions

Independent Variables	Dependent variable = ROA					
Constant	−15.668*** (0.000)	−17.493*** (0.000)	−17.393*** (0.000)	−27.401*** (0.000)	−15.785*** (0.000)	−15.894*** (0.000)
HSF	1.842** (0.040)					
LegalP		2.007*** (0.001)				
IND			6.508*** (0.000)			
Pay				1.448*** (0.000)		
Debt					−5.701*** (0.000)	
Ltype						−1.065*** (0.000)
Size	1.228*** (0.000)	1.385*** (0.000)	1.243*** (0.000)	0.826*** (0.000)	1.495*** (0.000)	1.345*** (0.000)
Growth	0.331*** (0.000)	0.330*** (0.000)	0.328*** (0.000)	0.322*** (0.000)	0.315*** (0.000)	0.328*** (0.000)
Adj. R <sup>2</sup>	0.203	0.206	0.209	0.241	0.233	0.208
F-value	147.024	149.736	152.302	183.506	175.340	151.469
P value	0.000	0.000	0.000	0.000	0.000	0.000

The numbers in parentheses are probability values for two-sided tests. \*\*\*/\*\*/\* denotes statistical significance at the 1 %/5 %/10 % level

**Table 52.4** Coefficient estimates from OLS and 2SLS

Independent variables	OLS estimates	2SLS estimates
Constant	−29.061*** (0.000)	−56.704*** (0.000)
HSF	3.425*** (0.000)	42.271*** (0.000)
LegalP	2.433*** (0.006)	45.339*** (0.000)
IND	4.615*** (0.003)	−27.623*** (0.000)
Pay	1.355*** (0.000)	2.221*** (0.000)
Debt	−5.801*** (0.000)	−33.266*** (0.000)
Ltype	−0.318 (0.414)	−4.721** (0.022)
Size	1.086*** (0.000)	3.331*** (0.000)
Growth	0.298*** (0.000)	0.161*** (0.000)
Adj. R <sup>2</sup>	0.286	0.567
F-value	87.420	291.594
P value	0.000	0.000

performance in Table 52.4. Lower percentage of independent directors is associated with good performance. The results support the argument that control mechanisms interact with each other and there is an optimal choice among them. This paper think that independent directors are significantly negatively related to firm performance in the 2SLS estimation more fit for the current China. Consider about the current conditions of Chinese capital market, three interpretations of the findings: firstly, because independent director system just founded in China, there is not systems to guard the realization of independent director. Secondly, because of the independent director oneself knowledge background restricting and the company's operating revenue gradually complicated and specialization, they have no time to know about listed company in deeply. Thirdly, under shortage of marketplace supervision and oneself credit system, effect of independent director will weaker. With the capital market strengthened, higher independent director will be associated with good performance.

## 52.5 Conclusions

In the application, these findings have the policy implications in the Chinese corporate control context. Results indicate support for the opening statement that there is no convincing relationship between corporate governance and firm performance. The Chinese government is working hard to incorporate a corporate governance structure comparable to the developed economies. However, it is demonstrated that governance structure has no direct relationship with firm performance (Li and Zhang 2006). The focus of any effective governance structure is the protection of investors instead of the maximization of firm performance.

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# Chapter 53

## Government Intervention, Ownership Structure and Diversification

Zhi-xiong Ling and Zhu-yun Zheng

**Abstract** This paper examines the impacts of government intervention and ownership structure on the level of corporate diversification. Using the income data of Chinese listed companies between 2008 and 2010, we find that the diversification of listed companies is caused by the government internalizing its public objects such as employment and revenue into its local enterprises. We also find that the stake of the largest shareholder and diversification degrees are conversely relevant, and shareholders play a regulatory role for government intervention in corporate diversification only in the non-state-owned enterprises. These findings further support the institution-based view of business strategy.

**Keywords** Diversification · Government intervention · Government objects · Ownership structure

### 53.1 Introduction

Corporate diversification is a hot topic within the field of economic management. Due to the establishment of market economy, a large number of enterprises in China have chosen diversification since early 1990s. Take 2008–2010 A-share listed companies collected in this paper as an example, there are 41 % of the companies adopting a diversification strategy. But when the large diversified companies of the West have stripped unrelated sectors and returned to the core

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business, why are enterprises in the transitional economy of China so keen on diversification? This paper aims to explore a possible explanation.

Under developed-market economies, there are three classical corporate diversification theories: the-market-power theory, the resource view theory and agency theory. However, no matter what theories are taken, the diversification of China's listed companies is not fairly convincing. They did not consider the impact of macro-institutional frameworks on corporate behavior. Peng (2002), Peng and Heath (1996), believes that the institutional frameworks should not just be a background condition when we are analyzing business strategy but should be a direct factor to drive strategic choices. Considering Corporate behavior, including the diversification, it's not so accurate unless we take the enterprise external environment into account.

Among the domestic researches on diversification, a number of related literature findings argue that agency problem would cause companies to develop diversification. Jang Fuxiu (2005) found managers' pursuit of individual interests would trigger diversification; Zhang et al. (2005), Xiao-hui and Xiang-mei (2008) believe that diversification is a way for controlling shareholder to infringe the right and interest of minority shareholders (Zhang et al. 2005; Xiao-hui and Xiang-mei 2008). These researches haven't considered the impact of China's characteristic system on the listed companies' decision-making. In China, while the role of government in the economy has weakened, it still can intervene in the enterprise's strategic choices in many aspects (Yu and Xie 2008). Inspired by the multi-task objects theory, this paper believes that the diversification of the listed companies are more likely to be caused by governments intervention. Given that the diversification can help the government to achieve some objects such as increasing the local employment levels and taxation levels, the government has a motive to intervene in the enterprises to develop diversification, which makes Chinese listed company may have to take on more tasks. It turns out that enterprise efficiency is not the first and inefficient diversification to be necessary. In recent years, many domestic scholars begin to study diversification from the institution-based view of business strategy. Xinyuan and Jun (2007) argue that the listed companies controlled by the government are more likely to develop diversification, and the more serious the government intervention is, the more likely the diversification will be; Liu (2009) found that the possibility of diversified investment blunders making by the state-owned company is higher than the non-state-owned ones; Yu kexin believe that the more enterprises depend on government, the more common diversification will be. Unfortunately, these articles just indicate the government has positive effects on corporate diversification, but did not explain the exact causes of diversification and not take government intervention and China's characteristic ownership structure "One Big Share Alone" into consideration simultaneously.

On the base of analysis and study of existing researches, we try to analyze how the government and ownership structure affect the level of corporate diversification. The differences from formerly research design include the following: (1) it examines the relationship between exact government objects and corporate

diversification empirically. And it proves that diversification of Chinese listed companies is significantly related both to the local employment levels and to the local revenue levels; (2) we interact government intervention with ownership structure, so that we can explore the influence of government intervention across different ownership property companies. It turns out that big shareholder plays a regulatory role for government intervention and significantly lowers the diversification level only in the non-state-owned companies.

## 53.2 Theoretical Motivation and Hypotheses

### 53.2.1 *Government Intervention and Diversification*

The allocation of our country's government power have gone through a process from centralization to decentralization, which makes the local government get greater fiscal autonomy and jurisdiction on economy. Simultaneously the local government has to take on the responsibility of implementing the public objects such as promoting the local employment and increasing the revenue (Hongbo et al. 2008) with the decentralization of power, "political promotion tournaments" occurred among Chinese officials. So in order to improve political achievement, the government will internalize its public objects into the local companies, especially the listed ones. As a result, based on the economic and political dual purpose, the government has motive to intervene the local companies. Fortunately, corporate diversification is a perfect way for the government to realize these objects. On the one hand, diversification can help to expand the corporate scale, provide more jobs and increase the taxation (Xinyuan and Jun 2007), which are beneficial to the realization of economic purpose. On the other hand, the political promotion tournaments will cause repeated construction (Zhou 2004). And the diversification strategy such as merging and purchasing can shape industrial clusters or group companies with a listed company at the core in a short time. Even though all these are inefficient repeated construction, it is worth once if it can prevent officials in other administrative region from promotion (Honghui and Zhongjun 2010), in this way, which make the government's political purpose realize. Therefore, the heavier burden the government takes, and specifically, the higher unemployment rate is and the more serious the fiscal deficit is, the stronger motivation the government has to intervene in the local companies to develop diversification. Based on the analysis above, we put forward the following hypothesis:

**Hypothesis 1:** the heavier burden the government takes, the deeper degree corporate diversification will be.

### ***53.2.2 Ownership Structure and Diversification***

Since the ownership in China's listed companies is highly concentrated, so on the one hand, from the point of principal-agent problem of large shareholders and minority shareholders, the decision-making of listed companies in fact becomes weighing benefits of control rights for controlling shareholder (Xiao-hui and Xiang-mei 2008). According to the classification of the Barclay and Holderness, the benefits of control rights include shared benefits and private benefits. When controlling shareholder holding a lower ratio of shares, there are less shared benefits of control and controlling shareholder has a strong impulse to expand the size of the company to increase the control of resources as a result. In this way, making diversified investment will be a good choice, though it may be detrimental to corporate performance. But with the rise of stakes of controlling shareholder, the shared benefits of control rights are thereupon rising. When the shared benefits over private benefits, the possibility, which controlling shareholder reduce the free cash flow returned to the minority shareholders by making diversified investment, declines. So the holding rate of the largest shareholder and diversification are conversely relevant. On the other hand, from the point of principal-agent problem of large shareholders and management, the highly concentrated ownership structure makes the big shareholder have more incentive to supervise management. Accordingly, for corporate diversification, it will force management to make decisions more sensible rather than build Business Empire by diversification. Hence, large shareholder plays a positive role in reducing the degree of diversification. Based the analysis above, we put forward the following hypothesis:

**Hypothesis 2:** the stake of the largest shareholder and diversification are conversely relevant.

### ***53.2.3 Government Intervention, Ownership Structure and Diversification***

The power and intervention motive of the government will vary with the change of negotiation partner. Meanwhile, different nature of equity face varied property right restriction. So it is necessary to take the government intervention and ownership structure into consideration simultaneously. According to the nature of ultimate controller, we divided the sample into two groups: non-state-owned company, state-owned company, so that we can capture the difference when the shareholders face the government intervention between the two kinds. For state-owned ones, on the one hand, administrative order may exert greater impact than the corporate governance because the local government maybe one of the shareholders. As a result, some of the decision-making cannot reflect the function of corporate governance. On the other hand, shareholders' rights of the state-owned company are implemented by local or central SASAC, but the executives are

appointed by the Local or Central Organization Department. The separation of the authority make the shareholder cannot effectively supervise the board of directors, and the board of supervisors cannot exert successful management restraint and incentive (Ma and Cao 2011). Therefore, for the state-owned companies, the diversified investment cannot be effectively restricted. Meanwhile, as for non-state-owned companies, controlling shareholders also have capacity and motive to infringe the interest of minority shareholders. But the infringement is much weaker than the state-owned ones (Xia and Fang 2005). It is because government power is hard to be restricted by legal restriction in China's characteristic system. It's indirectly that the non-state-owned companies receive government intervention. And the controlling shareholder has more room for negotiation with the local government. So the following hypothesis is offered:

**Hypothesis 3:** big shareholder of the non-state-owned companies significantly plays a regulatory role for government intervention and lowers the diversification level compare to the state-owned ones.

### 53.3 Research Design

#### 53.3.1 Sample Selection

We select listed firms issuing A-shares on Shanghai and Shenzhen Stock Exchanges. In the article, we removed the following companies: financial firms; the companies with abnormal financial status; the company which cannot be traced to the nature of its controlling shareholder; the company also issued B-shares and H-shares; ST, PT companies. After removing, 3,912 observations from 2008 to 2010 remain. Each year's observation is 1,047, 1,225, 1,640, separately. Annual operating income data are from Wind, others are all from CSMAR.

#### 53.3.2 Proxy Variable and Data Sources

1. *Diversification*: Based on "Industrial Classification Guideline" issued by the CSRC in 2001, this article uses the entropy measure, which is commonly used in industrial organization studies, to calculate the corporate diversification. The entropy measure of diversification was defined as follows:

$$DT = \sum_{i=1}^n p_i \ln(1/p_i),$$

where  $P_i$  is the sales attributed to segment  $i$  and  $\ln(1/p_i)$  is the weight for each segment  $i$  or the logarithm of the inverse of its sales. We use three-digit industrial codes to define the industry segments. The higher this entropy measure is, the more diversified the corporation is.

2. *Government intervention*: I follow Hongbo et al. (2008) and use the local fiscal deficit, unemployment rate, and intervention index to measure the degree of government intervention. First, we take unemployment rate as an index of government intervention, as it is closely related to the local stability and economic development and has been taken into the evaluation system of administrative achievement. This paper uses the Registered Unemployment Rate in Town from China Statistical Yearbook. Second, the budget deficit affects the vital interests of the local government directly, so it is also a suitable index to measure intervention. It is created by subtracting the revenue from fiscal expenditure. Third, we adopt the index of Reduce government intervention in business from the book of *The Chinese market index report* (2009) written by Fan Gang and Wang Xiaolu as intervention index.

### 53.3.3 Model Design and Variable Definition

Based on the analysis above, our model is designed as follows:

$$\begin{aligned}
 DIVERS = & \alpha_0 + \alpha_1 TOP1 + \alpha_2 INDEX \\
 & + \alpha_3 INDEX * TOP1 + \alpha_4 ROE + \alpha_5 TRAN + \alpha_6 LEV \\
 & + \alpha_7 SIZE + \alpha_8 CON + \sum IND + \sum YEAR + \varepsilon
 \end{aligned} \tag{53.1}$$

where  $TOP1$  is the stake of the largest shareholder;  $INDEX$  denotes the government intervention,  $ROE$  is a rate of return on common stockholders' equity,  $TRAN$  is a ratio of fixed assets to total assets which indicates the transferred extent of assets,  $LEV$  is defined as the ratio of the book value of debt to the book value of equity,  $SIZE$  is measured by the natural logarithm of total assets,  $CON$  is an indicator variable which is one if a firm is finally controlled by government,  $\sum IND$  and  $\sum YEAR$  are variables to control for companies' Industry and year, is an error term.

We take the fiscal deficit, unemployment rate, and intervention index of the company's registered province as proxy variable of government intervention. As the three proxy variables have strong co linearity, we put only one of them into regression models each time. As the number of fiscal deficit is too large, we then put the natural logarithm of deficit into models when we make regression analysis.

## 53.4 Empirical Results

### 53.4.1 Descriptive Statistics of Diversification

Table 53.1 reports means, standard deviations and the distribution ratio of diversification. As Table 53.1 shows, about 40 % of China's listed companies employ diversification strategy. And across this 40 % sample, the entropy measure DT is concentrated in the 0.1–0.3 range, which indicates that the corporate diversification strategy remain, though common, at low level relatively. In addition, we divided the samples into two groups according to the nature of the ultimate controller (Liu et al. 2003). We can see that the degree of diversification of State-owned ones, (2), is significantly higher than the other ones. It, to some extent, shows that the government intervention exists in corporate diversification.

### 53.4.2 Empirical Results

#### 1. Government intervention and Diversification

In this section, we use OLS regressions to empirically investigate whether the level of diversification increased with the increase of the government intervention. The results are presented in Table 53.2.

According to *The Chinese market index report* (2009), written by Fan gang and Wang xiaolu, the number of intervention index will be high when the government intervention is weak. That is, this index and government intervention is conversely relevant. To make the sign of coefficient for intervention index consistent with the other two indexes, we multiply the value of this index by  $-1$ . As the table show, the regression coefficient for intervention index is significant and positive. It suggests that the intervention from government significantly increase the degree of diversification. However, it still not indicates what makes the government intervenes and what can the government benefit from corporate diversification. In the following analysis, this paper makes specifically analysis and reveals that the incentive of government intervention is affected by the local

**Table 53.1** Descriptive statistics of diversification

	All firms mean difference					0.1 (%)	0.1–0.3 (%)	0.3–0.6 (%)
	Mean	S. D	(1)	(2)	(1)–(2)			
2008	0.12	0.16	0.11	0.14	–0.031***	58	27	13
2009	0.12	0.16	0.11	0.14	–0.026***	57	28	12
2010	0.11	0.15	0.09	0.13	–0.046***	61	27	10

Notes 1 Asterisks indicate statistical significance at the 1 % (\*\*\*), 5 % (\*\*), or 10 % (\*). 2 The third column, (1), indicates the sub-sample of non-state-owned companies; the fourth column, (2), indicate state-owned

**Table 53.2** Variable regression results

	(1)	(2)	(3)	(4)	(5)
C	0.232*** (4.364)	0.250*** (4.674)	0.123** (2.235)	0.046 (0.544)	0.128** (2.346)
Top1	−(0.001)*** (−7.804)	−(0.001)*** (−6.743)	−(0.001)*** (−7.249)	−(0.001)*** (−7.605)	−(0.001)*** (−7.225)
Inter		0.002* (−1.929)			
Unem			0.024*** (7.296)		
Fisc				0.026*** (2.837)	
Unem* Fisc					0.003*** (7.168)
Na	0.029*** (5.313)	0.027*** (4.680)	0.027*** (4.956)	0.028*** (5.236)	0.027*** (4.919)
lev	0.025** (1.774)	0.022* (1.904)	0.015 (1.102)	0.021 (1.513)	0.015 (1.053)
Size	0.006 (1.053)	0.006 (0.559)	0.009 (1.575)	0.007 (1.257)	0.009 (1.615)
Roe	−0.121 (−1.127)	−0.011 (−1.620)	−0.013 (−1.177)	−0.012 (−1.110)	−0.012 (−1.164)
Tran	−0.027*** (−2.774)	−0.028*** (−3.708)	−0.031*** (−3.186)	−0.030*** (−3.017)	−0.032*** (−3.242)
Ind	Control	Control	Control	Control	Control
Year	Control	Control	Control	Control	Control
Adj R <sup>2</sup>	0.094	0.095	0.106	0.095	0.105

Notes 1 Asterisks indicate statistical significance at the 1 % (\*\*\*), 5 % (\*\*), or 10 %(\*)

unemployment rate and fiscal deficit. The coefficient for unemployment rate is significantly positive, which shows that the higher pressure of local unemployment, the higher degree of corporate diversification. Meanwhile, the fiscal deficit coefficient is also positive, and through a significant test. It indicates that the government has more motives to guide the local corporate to diversification, when the fiscal deficit is high. In model (5), we interact with unemployment and rate deficit. As before, the coefficient is positive. That is, the two variables can simultaneously affect corporate diversification and increase its degree. All these can suggest that the companies, locating in province where the government suffer serious burden, take on more tasks besides economic benefits and employ higher degree diversification more commonly. So the hypotheses (1) can be proved. Through corporate diversification, on the one hand, for increasing GDP, job opportunities and fiscal revenue, it alleviates the economic burden the local government takes on. On the other hand, even though the diversified investments maybe repeated construction, it can prevent the performance of the same industry in other provinces from increasing relatively, which can realize the government’s political target.

**Table 53.3** Variable regression results

	State-owned			Non-state-owned		
Model	(1)	(2)	(3)	(4)	(5)	(6)
C	0.490*** (6.605)	0.324*** (−2.929)	0.404*** (3.410)	−0.012 (−0.137)	−0.277*** (2.51)	−0.148 (−1.072)
Top1	−0.002*** (−2.928)	2.124E-5 (0.021)	−0.001*** (−3.071)	−0.002*** (−4.081)	0.001 (0.525)	−0.002*** (2.646)
Inter*	−7.19E-5 (−1.163)			−0.177** (−2.143)		
Unem*		−0.097 (−0.908)			−0.208* (−1.805)	
Fisc*			0.006 (0.334)			−0.255*** (−4.722)
levy	−0.030 (−1.442)	−0.045** (−2.166)	−0.034 (−1.640)	0.063*** (3.287)	0.064*** (3.343)	0.064*** (3.343)
Size	−0.011 (−1.402)	−0.006 (−0.809)	−0.009 (−1.230)	−0.035*** (3.878)	−0.036*** (4.019)	−0.035*** (3.844)
Roe	−0.008 (−0.606)	−0.009 (−0.723)	−0.009 (−0.649)	−0.040** (−2.060)	−0.042** (−2.190)	−0.041** (−2.099)
Tran	−0.042*** (−3.427)	−0.046*** (−3.694)	−0.044*** (−3.55)	−0.007*** (−0.428)	−0.006 (−0.380)	−0.009 (−0.556)
Adj R <sup>2</sup>	0.112	0.123	0.112	0.105	0.106	0.107

Notes 1 Asterisks indicate statistical significance at the 1 % (\*\*\*), 5 % (\*\*), or 10 % (\*)

## 2. Government intervention, Ownership structure and Diversification

In model (1) within Table 53.2, we can see the coefficient for is negative and statistically significant at the 1 % level. This result suggests that the holding rate of the largest shareholder and diversification are conversely relevant, a finding supportive of Hypotheses 2. The highly concentration ownership of

China's listed companies reduced the degree of diversification. In order to capture the difference on nature of equity, we divided all samples into two groups and the results were shown in Table 53.3. The sub-sample is state-owned companies in models (1)–(3), but is non-state-owned ones in models (4)–(6). In all the models within Table 53.3, we include our interaction term and desire to explore the influence made by the different largest shareholder on government intervention. In models (1)–(3), the coefficients are all not statistically significant. So the regulator role of large shareholder is not validated in state-owned companies. In contrast, in models (4)–(6), the coefficient for, and are negative and significant at, and levels, respectively. It suggests the large shareholder in non-state-owned companies plays a positive role in regulating local government intervention and significantly reduce the degree of diversification. All these above are in accord with the Hypotheses 3. Since the government is one of the shareholders, it can intervene in the decision making of state-owned ones directly by shareholder rights. But for non-state-owned ones, though the government can, to a large extent,

affect the external constraints for these companies, the kind company suffers lower intervention from government compare to the state-owned ones. And it is indirectly that the non-state-owned companies receive government intervention. The large shareholder has more room for negotiation with the local government. So the largest shareholder of this kind company can play a role in corporate governance and reduce the diversification caused by government.

### 53.5 Conclusion

This paper provides insights into what makes corporate employ the strategy of diversification. We find that the diversification of China's listed company was, to some extent, driven by local government. Through diversification to expand the scale, the corporate can create more jobs, which help the government relieve the unemployment pressure; in the same way, diversified investment can bring more taxation to reduce the fiscal deficit. Hence, diversification is beneficial for the government to realize its economic task. Meanwhile, due to the evaluating of political achievement including increasing revenue and job opportunities, the diversification can also improve the performance of local government and prevent officials in other province from promotion. So it is helpful for government to achieve its political goals. In addition, when we take ownership structure and government intervention into consideration simultaneously, we find only in non-state-companies the large shareholder plays a role in reducing diversification. Hence the diversification of China's listed company is caused by the government internalizing its public objects such as employment and revenue into its local company, and the intervention is more serious in state-owned companies.

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# Chapter 54

## Leadership Skills Training Model of NGO Executive Leaders Based on the Lifecycle Theory

Lai-bin Wang

**Abstract** Whether in the formal or informal public interest organization, leadership has a crucial role for organization's establishment, survival and development. However, NGO development in China is still in the initial stage, lack of good leadership groups, especially lack of leadership. Combination of organizational life cycle theory and NGO characteristics, life cycle of NGO can be divided into six stages, that is exploration stage, start-up stage, development stage, mature stage and Decline and recovery stage. After analyze NGO Executive Leaders characteristics at different stage of lifecycle, the article have come up with a couple of principle of selecting executive leaders of NGO that are perhaps worth considering, then point out four selection channels. Finally, this paper from the perspective of life cycle theory explores how to scientifically select the NGO leader and leadership skills systematic training model and training pattern, self-growth and hatch.

**Keywords** Executive leader · NGO · Skill · The lifecycle theory · Training model

### 54.1 Introduction

NGOs in China, there are two kinds; one kind is top-down NGOs, they are generally established by the government and have a long history and the semi-official character, the other is the so-called bottom-up grassroots NGOs, multi-spontaneously formed by private persons, mostly after the 1995 World Conference on Women NGO Forum, its activities focus on environmental protection, poverty alleviation, women and other fields. Compared with the former, the latter has a strong independence and autonomy.

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According to statistics of the State Administration of civil society organizations by the end of 2009, the various public interest organizations registered are about 425,000, and at the rate of 10–15 % of growth. These public organizations are active in various fields, with a huge number of grassroots civil society organizations, most organizations face the problems such as abilities insufficient, resource shortages, not only need financial and material support, but also need improvement of organize operational capability and integrity level of service. Due to lack of resources, especially lack of funds, coupled with strategic planning, human resources, financial management, marketing, operational efficiency and other aspects of deficiencies, lack of capacity for sustainable development, these severely hamper the public organizations to carry out public interest project and public service.

Whether in the formal or informal public interest organization, leadership has a crucial role for organization's establishment, survival and development. However, NGO development in China is still in the initial stage, lack of good leadership groups, especially lack of leadership. This paper from the perspective of life cycle theory explores how to scientifically select the NGO leader and leadership skill training model.

## **54.2 Organization Life Cycle and Characteristics**

### ***54.2.1 Organization Life Cycle***

Churchill N. C and Lewis V. L described the characteristics of companies in various stages of development from the enterprise scale and management factors two dimensions, and proposed a five-stage growth model, that is the enterprise life cycle, including existence stage, survival stage, success stage, take-off stage and resource maturity stage (Churchill and Lewis 1983). According to this model, companies will generally show the overall development of the temporary or permanent status quo, sustainable growth, strategic shift, out of business sale or bankruptcy, and other typical characteristics.

L. E. Greiner thinks that the enterprise can constantly develop alternating forward through evolution and revolution. The company's history is more decisive than the external forces to the future of business (Greiner 1972). Based on sales and number of employees, according to their different performance on organizational scale and age, he structured a five-stage growth model, which is the foundation stage, guidance phase, decentralization stage, coordination stage and cooperation stage. The model highlights the process of decision-making of founder or operator in business growth and the process of change of management mechanism to build. Each growth stage is made up of the early evolution and the late change or crisis, and these changes can directly related to the smooth growth of business continuity issues.

Adizes can be regarded as the most representative figures of corporate life cycle theory (Adizes 1979). In his “Corporate Life Cycle”, the business growth process is divided into ten stages, gestation, infancy, toddlers, adolescence, prime, aristocrat, the early bureaucracy, the late bureaucracy and death, each stage can reflect in two indicators, flexibility and controllability. When the company firstly built, full of flexibility, to make changes is relatively easy, but less controllable, the behavior is difficult to predict; when companies enter the aging period, a strong business-to-control behavior, but the lack of flexibility, until finally death (Quinn and Cameron 1983).

### 54.2.2 Life Cycle of NGO

Combination of the organizational life cycle theory and NGO characteristics, life cycle of NGO can be divided into six stages (Fernley 1996).

- *Exploration stage.* Organization activities is still in the conceptual stage, but organized by a few like-minded people, no formal organizational structure and management systems, organizational systems are imperfect, there is no clear division of responsibilities, decision-making is essentially a few personal co-decision. There have too many meetings to be open, just a very casual get together to discuss; there is no room and no formal record of the meeting. Participants can together, strong cohesion. There is no stable source of income at this stage, participants raise funds to support activities carried out.
- *Start-up stage.* This stage is characterized by entrepreneur-ship training, information gathering, hard starting and low returns. This is the organization’s infancy, small scale, people cohesion, simple relationship, leadership team decisions. In this stage, the organization determines the articles of association, the basic financial system, management system, specifically the initial division of responsibilities, but the organizational system is not perfect. A lot of grass-roots NGOs are in this phase.
- *Development stage.* From this stage, organization enter into a sustained growth, with the functional organizational structure, established financial system, as well as fund management, incentives mechanism, and management systems, the organization has become more diverse and complex. This is a youth organization, the organization have some extent impact within a certain range, quickly growing, expanding, employees and members has a strong sense of belonging.
- *Mature stage.* This is the middle period of the organization, there is considerable scope to increase the number of business activity and influence, more perfect organization system, rules and regulations, procedures and formalities relatively fixed, the senior leadership focus on supervision and coordinate internal and

external relations between the various departments, strengthen strategic planning, and guide the organization to a more mature direction.

- *Decline and recovery stage.* Because organizational structures, procedures, personnel and so on enter into the institutionalization phase, running for some time, may become rigid or updated into the organization. Business rules and regulations are numerous, but some problems are obvious, such as contradiction and shirk responsibilities between departments, low morale, going through the motions of the meeting, unresponsive, and not meet the social needs. Major work of organization is to cope with, and deal with the advent of crisis, corporate image has become the past. However, if the organization can improve the existing problems, take advantage of existing strengths, or can be on track again.

### 54.3 Selection of NGOS Executive Leaders

#### 54.3.1 NGOS Executive Leaders Characteristics

(Table 54.1)

**Table 54.1** NGO executive leaders characteristics at different stages of lifecycle

NGO life cycle	Executive leaders characteristics
Exploration stage	Prophet foresee ability, the ideal driver, with new and different ways to see the world and the opportunity, challenge existing institutions and conventions
Start-up stage	Fighter/barbarian. They preserve and disseminate NGO's ideals, make organization into a disciplined structure, and focus on controlling organizational structure
Development stage	Explorer/creator. They focus on responding to the needs of society, investing more capital, improving and updating, organization structure and management system, recruitment of new employees and to enter new areas
Maturity stage	Managers at this time focusing on control and efficiency, to improve and strengthen the organization's existing products, services, structure, and system effectiveness. Then pay attention to distinguish between effective and excessive management
Decline and recovery stage	Bureaucracy/innovator no innovation, no improvements, just to make a passive response to external environmental stress. Forget the concept of need-oriented, stifle new ideas and practices. But after organizational change, organizations can cross this stage, maintain or regain competitiveness and development

### 54.3.2 Executive Leaders Selection Principle

- *Suitable principles.* An important selection principle of NGO leaders is to bring leadership style into correspondence with the organizational requirements (Smillie and Hailey 2001). We take exchanged type leadership and transformational leadership as an example. Transformational leadership are suitable for innovation, high risk and open organization, that is the organization in start-up period or decline period, but exchanged type leadership suit for structural stability and coherent organization, that is the organization in a mature period. Transformational leadership emphasize how to change, innovative and cast a new times spirit, with high need to mobilize the enthusiasm of subordinates, and exchanged type leadership tend to use low need to meet the subordinates. Thus, according to different stages in the life cycle of NGOs, should choose a different leadership style.
- *Skill principle.* To some extent, leadership determines the survival and development of NGO. On the one hand, NGO leaders should have a higher level of ability, on the other hand, should have a wide range of capabilities, such as finance, finance accounting, marketing ability, must also have good interpersonal skills, creativity, the ability to see development patterns and opportunities from the surface in the chaos (Lewis 2001).
- *Oriented to the future.* For China's non-profit organizations, there are some problems facing, such as how to improve the effectiveness of organizational leadership and management to complete the mission of the organization, have a positive impact on society and services objects and so on. NGO strategic planning will help the organization continue to develop. Leadership choices have long-term strategic planning based on the needs of future development, rather than just immediate needs, such as international perspective.

### 54.3.3 Select Channels

#### 1. Successful business people

Now the founder of China Private Foundation Forum are mostly successful people, who accumulate a large number of knowledge, experience and wisdom about modern business management, development planning, financial operations, governance structure, has conditions and initiative to apply the knowledge and techniques to the charitable field.

#### 2. Teacher in University

Particularly, those teachers engaged in social work specialize in teaching the theory in many years; conceive the desire to engage in practice. Hong Kong,

some women leaders of civil society organizations, come from the universities, they take turns in office between schools and communities.

3. *Young college students*

Their specialty is sociology, social work or public relations. In school, by participating in some projects or internships, they access to the NGO, inspired to do public service, willing to plunge into the cause, after the exercise in the NGO, they may grow into NGO stars in the future.

4. *Internal middle management*

Currently in this regard, it exist possibility only in theory for China's NGO, for in the use of full-time staff, just changing from management to the professional level, also unconditionally selected leaders from the middle staff. With the first generation of leaders out of leadership positions in succession, selection and training of NGO successors will become increasingly prominent as an issue of NGO development.

## 54.4 NGOS Leadership Skill Training Model

### 54.4.1 Skills Needs

1. *Professional skills*

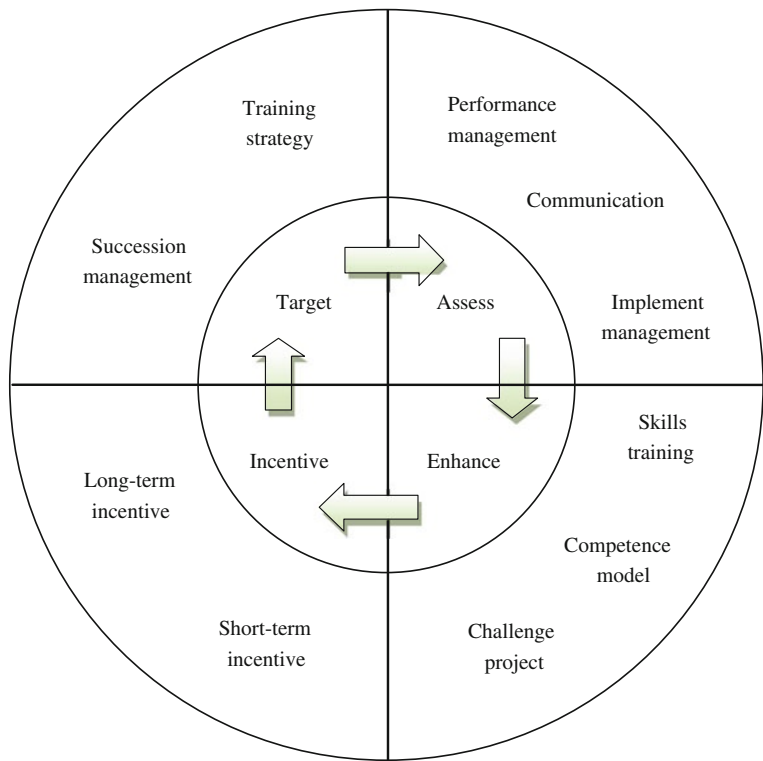
Each NGO has a different position, serve different populations, and thus have different professional requirements. Many successful NGOs, its leaders is professional experts, can be more smooth into the field, stand firm and continue their development.

2. *Modern management skill*

Chinese NGOs have grown from start-up stage into the growth stage; an important sign is from the past of man rule, or not up to management standard to standard management. As a leader, he needs to understand modern management theory and methods, introduce the concept of business management, so as to achieve the institutionalization, standardization, and open up a new situation, implement democratic decision-making, lead the team to the established direction (James et al. 2005).

### 54.4.2 Training Model

Firstly, it is the most important step to develop strategic objectives of NGO leadership skill training, but precisely domestic NGOs are lack of strategic planning, lack of strategic planning awareness and strategic planning ability. Second is



**Fig. 54. 1** NGO executive leaders systematic training model

to assess, when we determine the target audience, the need to do is communicate with them and see how they do the kind of performance, and then assess their well or not. When the assessment is completed, we know their problems where are. The next step is to the stage to enhance skill by building leadership competency model, performing some challenging projects. Finally, from the perspective of human resources management, incentive systems can be able to improve personnel competence in leadership positions, which is an important impact factor of leadership development (Hailey and James 2004) (Fig. 54.1).

**Training modes: self-growth and hatch**

Self-growth SERVE model: first, to see and shape the future (See); second, cohere and culture others (Engage); third, continuously renew (Renew); fourth, cherish outcome and process (Value); fifth, live out the values (Evangelize). Excellent leaders must have excellent character and values, but not proposing the values or writing. Practice what they preach, set himself an example to others, understand, share and live out the values, only in these ways can a leader be excellent and lead to an outstanding business.

### Leadership skills can hatch out?

**Case 1** The French L'Oreal Group has a complete human resources personnel selection and training system, that train personnel at all levels to ensure a stable supply of various business talents. To sum up, the system generally consists of three fields, seedling project, the backbone of managers to develop and shape the global leader, relying on the strategic ladder human resources development strategy, L'Oreal always maintain the overall steady growth in different regions ups and downs economic development in the world.

**Case 2** Green leadership partner, a training program for youth leaders of environmental protection NGO, was launched in 2010, short-term closed-end certification training, approach to case teaching and student interaction as the main training tool, training course rich, explain the actions of Chinese folk history and environmental development, social transformation and citizen participation, private environmental protection action strategies and techniques, and set up training courses focusing on psychological training of personal growth, leadership training and capacity enhancement and environmental initiatives case. The program will focus on training 4–5 times, systematically enhance the vision of young leaders about environmental protection strategy, private environmental mobility and team leadership capabilities, by providing annual scholarships to support the exchange of visits, communication and learning between different regions youth leaders, create the possibility to collectively participate in environmental protection action, thus promote public participation in environmental protection action, by one year, the youth leaders mutual support relationship network can be established, which help youth leaders to grow (Hailey and James 2002).

## 54.5 Conclusion

NGO Leadership skills training is a long-term, systematic, progressive work, according to local conditions and the time, to continuously improve the leadership skills system, and actively seek work innovation model, in order to make the NGO leaders to meet development needs at this stage.

Chinese NGOs are still in the early stages, most leaders are more like public relations or fund-raising agency commissioner, busy attending various meetings and visits, no time and attention to the organization's strategic planning and staff support. In addition, various kinds of NGOs lack specialized awareness, do not attach importance to the professional equipment, leading to low management levels, institutional development of strategic positioning, public service brand management and project design almost at random, and extensive use of funds is a common problem with many private foundations. NGOs have grown up in China for ten years, yet it is most anxious to see emerging NGO talent.

Although some projects are continuing to transfer outstanding NGO leaders, some of these projects are not enough preparation for the future needs. As more and more NGO leaders and middle managers retirement, this problem will gradually apparent. To this end, should recognize the reality of the NGO leadership skills needs are changing, distance exists between previously received training and work they are about to face. A guiding principle must be established to help determine whether a person has appropriate skills required for leadership positions. On the one hand, the principle guide the selection of the best leader, on the other hand, be able to help people in leadership positions better adapt to the opportunities and challenges on the NGO transitional period.

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## Chapter 55

# Linking Paternalistic Leadership and Organizational Creativity: A Multilevel Model

Bozhang Ge

**Abstract** Despite the increasing number of leadership-creativity studies and the fact that paternalistic leadership is a demonstrated popular leadership style in Chinese organizations, few studies have investigated the relationship between paternalistic leadership and organizational creativity. Meanwhile, the psychological processes underlying the leadership-creativity link remain unclear, at either the team level or the individual level. Drawing upon the componential theory of individual creativity, the input–process–output model of team creativity and the interactionist perspective, this study theoretically develops a multilevel model for understanding the influence of paternalistic leadership on creativity. Summarized by six testable hypotheses, the results provide important insights into the mechanisms linking paternalistic leadership and creativity in the Chinese context.

**Keywords** Intrateam conflict • Organizational creativity • Paternalistic leadership • Psychological empowerment

### 55.1 Introduction

Given the increasingly dynamic environment facing today's organizations, creativity is recognized as the key to organizational innovation and effectiveness, and the capacity to foster creativity has become a feature of contemporary leadership (Tierney et al. 1999; Tierney and Farmer 2006). Recently, researchers have been paying more and more attention to the leadership-creativity link, with many studies reflecting the recognition that leadership is quite instrumental in advancing the creativity of today's organizations (Zhou and Shalley 2008). However, this direction of research is still in its nascent stage and many issues of this topic need further and closer research.

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Firstly, previous studies examining the leadership-creativity link mostly focused on the organizations from the US or other Western nations (Zhou and Shalley 2008). The paternalistic leadership-creativity link has been noticeably missing from current research attention, even though prior work has suggested that paternalistic leadership is a demonstrated popular leadership style in Chinese organizations (Farh and Cheng 2000), and employees may behave differently in non-Western organizational cultures (Westwood 1997). It may be necessary to explore what paternalistic leadership means to creativity and how it relates to creativity of the Chinese workforce.

Also, because of the complex social-psychological forces characterizing creative performance (Amabile 1988), it is important to delve more deeply into the complex patterns that underlies the leadership-creativity relationship. Further research should also lead us to consider more closely how, and under what conditions, these effects might take place in Chinese business organizations.

Finally, even though a substantial number of scholars have been calling for more multilevel investigations of organizational creativity (Zhou and Shalley 2008), leadership-focused studies of this kind remain quite limited in the extant literature.

The primary purpose of this article is to address these specific issues. By building a multilevel model of the relationship between paternalistic leadership and organizational creativity, we make at least three important contributions to the literature. Firstly, the conceptual model can advance our understanding of how Chinese employees react differently to the three elements of paternalistic leadership. Secondly, this study deepens our understanding of the psychological processes underlying the effects of paternalistic leadership on organizational creativity. Thirdly, from a practical perspective, the findings can advise managers of the potential consequences when exercising the three types of paternalistic leadership.

## 55.2 Literature review

### 55.2.1 *Organizational Creativity*

According to Woodman, Sawyer, and Griffin, organizational creativity is “the creation of a valuable, useful new product, service, idea, procedure, or process by individuals working together in a complex social system” (Woodman et al. 1993). Research in this area began to be active during the late 1980s and more and more emphasized the importance of social and contextual influences, at either the individual level or team level. Most studies in this area have been guided by the following frameworks (Zhou and Shalley 2008).

At the individual level, researchers are largely guided by the componential model of creativity. Building on her work on the social psychology of creativity, Amabile proposed a theory-based componential framework to understand what

factors can facilitate or inhibit employee creativity (Amabile 1983, 1988, 1996). According to Amabile, there are three key components of creativity, namely, domain-relevant skills, creativity-relevant processes and intrinsic motivation. And the model is often considered an intrinsic motivation perspective of creativity because of its emphasis of intrinsic motivation.

At the team level, researchers usually follow an input–process–output model of creativity (Hülshager et al. 2009; West and Anderson 1996; Cheng 1995). For example, based on the IPO model, Hülshager and Anderson (West and Anderson 1996) reviewed many group and organizational factors that could influence team creativity, including input variables such as team composition and structure, and team process variables such as intrateam conflict, team vision, safety of participation, support for innovation, and task orientation. It is also suggested that leadership moderates the relationship among team inputs, team processes and team creativity (Hülshager et al. 2009; Cheng 1995).

Meanwhile, Woodman, Sawyer, and Griffin (1993) proposed an interactionist perspective of organizational creativity. They argued that creativity was an individual level phenomenon affected by the interaction of personal and organizational factors. They also stressed the influences across levels of analysis, and argued that cross-level impacts were critical in identifying and understanding group and organizational factors that could facilitate or stifle creative behavior in a complex social system (Zhou and Shalley 2008; Woodman et al. 1993).

### 55.2.2 *Paternalistic Leadership*

Building on the work of Silin, Farh and Cheng (2000) developed a Chinese indigenous theory of paternalistic leadership and defined it as a leadership style “that combines strong discipline and authority with fatherly benevolence and moral integrity in a personalistic atmosphere”. According to Farh and Cheng (2000) (Cheng 1995), paternalistic leadership is composed of three dimensions, namely, authoritarian leadership, benevolent leadership, and moral leadership.

Authoritarian leadership can be depicted as a style that maintains complete authority and control over subordinates and requires indisputable obedience. Benevolent leadership refers to a leader’s behavior that gives individualized, holistic concern for subordinates’ personal or familial wellbeing. Moral leadership can be seen as a leadership style showing personal virtues, self-discipline, and unselfishness. From Farh and Cheng’s perspective (Cheng et al. 2000, 2002a, 2004), authoritarian leadership may lead to subordinates’ compliance and dependence, benevolent leadership may result in subordinates’ gratitude and reciprocation, whereas moral leadership may increase subordinates’ respect and identification.

Despite the three seemingly paradoxical components of paternalistic leadership (Cheng et al. 2000; Cheng 2002), it’s suggested that from the duality view of Chinese culture, the three dimensions actually all exert differential effects on

subordinates' perceptions and outcomes, meanwhile coexist, interact, and form paternalistic leadership as a whole (Cheng et al. 2002b; Farh et al. 2006). While transformational leadership is considered to be most prevalent in Western organizations, evidence indicated that paternalistic leadership is the popular leadership style in Chinese organizations, which is effective because it fulfills the demands for leaders in the Chinese context (Westwood 1997).

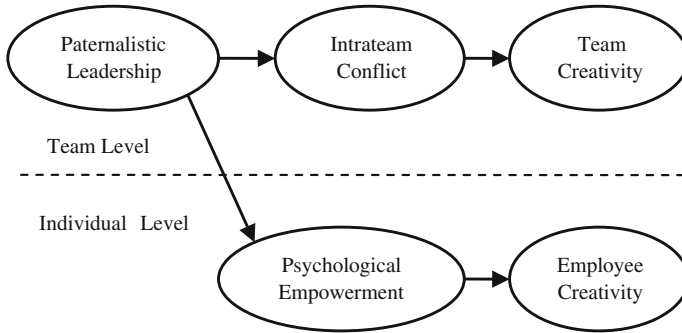
During the past decade, paternalistic leadership has been researched by more and more scholars (Farh et al. 2000; Pellegrini and Scandura 2008). It is generally suggested that authoritarian leadership is negatively related to both benevolent leadership and moral leadership, and also negatively related to subordinate outcomes. Whereas, benevolent leadership and moral leadership were positively related to each other, as well as subordinate outcomes (Cheng et al. 2002a, b; Farh et al. 2000).

### 55.2.3 *Paternalistic Leadership and Creativity*

Many theoretical models have suggested that leadership style plays an important role in influencing employees' creativity by affecting their intrinsic motivation (Amabile 1996; Spreitzer 1995). Some empirical studies have also examined such effects of transformational leadership on organizational creativity. In view of the considerable evidence that leadership may affect organizational creativity, scholars have been calling for deeper investigations of leadership styles that might fundamentally address the nature of creativity (Zhou and Shalley 2008; Paulus and Nijstad 2003).

Surprisingly, one of the most lacking research areas lies in paternalistic leadership (Pellegrini and Scandura 2008). Whether paternalistic leadership enhances or inhibits creativity in the workplace? And how does it take place? There is much promise of paternalistic leadership to influence creativity in the Chinese work context. For example, given the motivational effects of empowering, it is reasonable to presume that the autocratic-style authoritarian leadership may negatively relate to creativity. Paternalistic leadership thus deserves more attention from researchers of organizational creativity.

At the same time, although several studies have focused on the relationship between paternalistic leadership and organizational creativity, they only provided a conceptual or uncompleted relationship model (Zhou 2006; Wang and Cheng 2010). For example, Zhou (2006) developed a model concerning effects of paternalistic organizational control on team creativity. This model assumed that paternalistic organizational control enhances work team creativity for teams in the East and the impact of paternalistic organizational control on team creativity is mediated by teams' intrinsic motivation while moderated by national cultures. Yet empirical evidence of these arguments has been lacking. Similarly, Cheng and his colleagues (Wang and Cheng 2010) investigated the relationship between benevolent leadership and individual creativity. In view of the dual influence of



**Fig. 55.1** A multilevel model of paternalistic leadership and creativity

benevolent leadership on creativity, they assumed that benevolent leadership might be a neutral predictor of individual creativity. However, the results indicated that benevolent leadership was positively related to creativity, inconsistent with their argument (Wang and Cheng 2010).

Furthermore, research investigating the psychological mechanisms through which the paternalistic leadership dimensions affect organizational outcomes, including creativity, remains quite limited (Chen et al. 2011). There is a strong need for more sophisticated examination of the complex ways in which paternalistic leadership influences creativity, both at the team level and the individual level.

To address these issues, this article draws upon the componential theory of individual creativity (Amabile 1988), the input–process–output model of team creativity (West and Anderson 1996), as well as the interactionist perspective (Woodman et al. 1993), to respectively investigate the potential mediating effect of intrateam conflict at the team level and psychological empowerment at the individual level. Specifically, we presume that the three dimensions of paternalistic leadership may affect team creativity through its effect on intrateam conflict at the team level and may affect subordinates’ creativity through its effect on employees’ psychological empowerment at the individual level. Figure 55.1 depicts the conceptual model of this study.

## 55.3 Theory and Hypotheses

### 55.3.1 *Paternalistic Leadership, Intrateam Conflict, and Team Creativity*

Intrateam conflict is defined as the process resulting from the tension among team members that is induced by real or perceived differences (Jehn 1994, 1995). According to Jehn (1995), intrateam conflict can be differentiated between task

conflict and relationship conflict. Task conflict refers to disagreements about the content of the tasks being performed within a team, including differences in viewpoints, ideas, and opinions, whereas relationship conflict refers to emotional conflicts induced by interpersonal disagreements (Jehn 1995).

Theoretically, there are several reasons to expect that paternalistic leadership may affect intrateam conflict. On the one hand, under authoritarian leadership, subordinates are most likely to comply with their leader, instead of conflict with or even challenge them in public, which is detrimental to the emerging of task conflict within a team (Cheng et al. 2002a). Meanwhile, it is unlikely that interpersonal relationships within such teams would be really harmonious and team members are more likely to conflict for relational reasons (Cheng 2002; Cheng et al. 2002b).

On the other hand, benevolent leaders are considerate; they would respect the dignity of their subordinates, tolerate the errors and conflicts, and seldom criticize them publicly. Similarly, moral leaders always make a clear distinction between public and private interest (Cheng et al. 2004; Farh et al. 2006). They can make decisions impartially and accept different points of view. All of these are good for the generation of task conflict within a team. Furthermore, both benevolent leadership and moral leadership are in favor of the formation of harmonious relationships within the team (Farh et al. 2006), which would increase job satisfaction within a team, promote cooperation of the members, and improve the quality of communication, especially the communication between team members and their supervisor (Chen et al. 2011). All of these are inclined to reduce relationship conflict within a team. We thus hypothesize:

*H1a: Authoritarian leadership is negatively related to task conflict, while positively related to relationship conflict.*

*H1b: Benevolent leadership is positively related to task conflict, while negatively related to relationship conflict.*

*H1c: Moral leadership is positively related to task conflict, while negatively related to relationship conflict.*

With regard to the conflict-creativity relationship, it is reasonable to assume that task-related conflict of team members may lead to deeper consideration of different points of view, trigger information exchange, in-depth discussion, reassessment of the situations of their tasks (Jehn 1995; De Dreu and Weingart 2003). These in turn may promote the generation of new ideas and better solutions, and finally improve problem solving within a team.

Whereas, it has been suggested in social-psychological theories that relationship conflict confines the scope of attention, leads to rigid thinking, and also diminishes cognitive complexity of people (Jehn 1995; De Dreu and Weingart 2003). Relationship conflict is thus detrimental to information processing and obstructs the cognitive functions of team members. Furthermore, since anger and frustration inhibits effective communication within a team and would inevitably make team members less receptive to each other's ideas, relationship conflict is supposed to negatively influence team functioning, and finally team creativity (De Dreu and Weingart 2003).

Taken together, task conflict is expected to facilitate team creativity, whereas relationship conflict is supposed to be detrimental to team creativity. We thus hypothesize:

*H2: Task conflict positively relates to team creativity, whereas relationship conflict negatively relates to team creativity.*

Based on the above discussion, it is also logical to expect that paternalistic leadership affect creativity at the team level through the mechanism of intrateam conflict, when observing from the input–process–output model of team creativity as interpreted earlier (Hülshager et al. 2009; West and Anderson 1996; Cheng 1995). Taken together, it brings us to the following hypothesis:

*H3: Intrateam conflict mediates the relationship between paternalistic leadership and team creativity.*

### ***55.3.2 Paternalistic Leadership, Psychological Empowerment, and Employee Creativity***

Psychological empowerment is defined as “intrinsic motivation manifested in four cognitions reflecting an individual’s orientation to his or her work role”, which are meaning, competence, self-determination, and impact (Spreitzer 1995; Thomas and Velthouse 1990). According to the definition, psychological empowerment can be viewed as a type of intrinsic motivation.

There are many reasons to expect that paternalistic leadership may relate to psychological empowerment. Firstly, authoritarian leaders who maintain complete authority and control over subordinates and demands indisputable obedience (Farh and Cheng 2000; Cheng et al. 2000), are most likely to cause a low level of psychological empowerment from subordinates (Pellegrini and Scandura 2008). Whereas, benevolent leadership generally signals a leader’s recognition of a subordinate both as an exemplary role and a valuable person (Farh and Cheng 2000; Cheng et al. 2000). Therefore, as a typical form of supervisory support in Eastern cultures, benevolent leadership will probably cultivate a psychologically safe climate, and results in psychological empowerment of employees. Lastly, considerable evidence has been provided in the transformational leadership literature that moral leadership is positively related to psychological empowerment. In the same vein, prior studies of paternalistic leadership have also provided some preliminary support for the same arguments (Wei and Shi 2010).

Consistent with these ideas, we expect that the three dimensions of paternalistic leadership may influence employees’ psychological empowerment in different ways:

*H4a: Authoritarian leadership is negatively related to psychological empowerment.*

*H4b: Benevolent leadership is positively related to psychological empowerment.*

*H4c: Moral leadership is positively related to psychological empowerment.*

In considering the role of psychological empowerment in facilitating employee creativity, we can turn to the literature of intrinsic motivation, which refers to the degree to which an individual is inner-directed, is interested in or fascinated with a task, and engages in it for the sake of the task itself (Amabile 1996; Deci and Ryan 2000).

According to Amabile's componential model of creativity (Amabile 1983, 1988, 1996), intrinsic motivation is considered to be one of the most critical and powerful influencing factors on employee creativity. It plays an important role in the interactional process of social context and individual creativity. Considerable research has reported the positive relationship between intrinsic motivation and employee creativity (Gagné and Deci 2005; Gagné et al. 1997; Oldham and Cummings 1996). At the same time, psychological empowerment can be viewed as a type of intrinsic motivation as stated earlier. Taken together, we hypothesize:

*H5: Psychological empowerment is positively related to employee creativity.*

Theoretically, the potential influences of contextual factors on intrinsic motivation can be explained by self-determination theory (Deci and Ryan 2000). According to self-determination theory (Deci and Ryan 2000; Gagné and Deci 2005), people who are involved in the autonomy-supportive social contexts, are more likely to display intrinsic motivation and positive work-related outcomes, including employee creativity.

Following this logic, it is reasonable to presume that paternalistic leadership influence employee creativity by affecting intrinsic motivation. Specifically, benevolent leadership, and moral leadership, as supportive and noncontrolling styles, are expected to facilitate intrinsic motivation, and promote employee creativity, whereas authoritarian leadership, which is essentially controlling, is supposed to diminish intrinsic motivation, and stifle employee creativity (Sun et al. 2011; Farmer et al. 2003; Zhang and Bartol 2010). We thus hypothesize:

*H6: Psychological empowerment mediates the relationship between paternalistic leadership and employee creativity.*

## 55.4 Conclusion

Building on the extant literature, this study provides a theoretical model of the relationship between paternalistic leadership and creativity. Mechanisms of this link are investigated at both the team level and the individual level. We argue that the three dimensions of paternalistic leadership may affect team creativity through its influence on intrateam conflict at the team level and may affect subordinates' creativity through its effect on employees' psychological empowerment at the individual level.

Even though the model is rigorously built on theoretical basis and empirical evidence, few studies have systematically examined these potential effects, and little empirical evidence has been directly provided by the extant literature.

Therefore, there is a significant need for further work to investigate the model systematically and empirically. Besides, research of the potential moderating variables is strongly required to provide deeper understanding of the conditions of these potential effects.

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# Chapter 56

## Organizational Innovation Climate and Performance: Based on the Intermediation of Innovative Behavior

Hong Zhao

**Abstract** This paper studies the impact mechanism between the organizational innovation climate and the business performance. Then it explores the intervening variable—the innovative behavior through the buffering effect model. The innovative behavior is a direct impact on business performance. Except the staff characteristics, organizational innovation climate is also an important influencing factor. This paper reveals that organizational innovation climate impacts more on performance through the intermediation of employee innovative behavior.

**Keywords** Innovative behavior • Intervening variable • Organizational innovation climate • Performance

### 56.1 Introduction

In today's economic global world, the increasing development of enterprises in China not only meet threats by domestic enterprises, but also continue to face cross-border competition from foreign companies, and how to maintain their competitive the advantage in the social context of this intense competition is still a problem.

In order to improve corporate performance and have a strong capital to compete with rivals, the companies will be repeatedly asked to enhance the climate for innovation, foster a spirit of innovation, and improve the innovation capacity so that they can advance the transformation of the enterprise, and are willing to accept high-risk, high reward program with a positive attitude in the face of the opportunity. Their ultimate goal is to obtain continuing competitive advantage. The study found that the climate for innovation has a significant effect on firm

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performance. But how this force is driven by? Studies are continued by a number of scholars, most of which are starting from a psychological point of view. This paper studies the individual employees, focusing on individual innovative behavior which is regarded as a mediating variable. We discuss and analysis the relationship between organizational innovation climate, employee innovative behavior and corporate performance to improve business performance and achieve sustainable development of enterprises based on the theory study.

56.2 Definition

56.2.1 The Climate for Innovation

There are three paths for the climate for innovation: (1) organizational attribute theory: it emphasizes the differences in business environment which ultimately lead to differences in the climate for innovation; (2) attraction-selection-attrition concept: namely, to attract similar, individual factors determine the climate for innovation; (3) patterns of socialization: emphasis on the interaction between the employees and the enterprise environment (Wang and Zhu 2005). Although these three paths look there are differences in the understanding of factors which affect the climate for innovation, in conclusion the climate for innovation is a cognitive. Foreign scholars have a different definition of the climate for innovation, as shown in Table 56.1.

This paper combines the definition of innovation made by the domestic and foreign scholars and believes that organizational innovation climate is a social mode which is formed in the daily operations of the enterprise. Organizational

Table 56.1 Definition of the innovation climate

Researchers	The definition of the climate for innovation	Formation
Amabile et al.	Organizational innovation climate exists in the creative and innovative organization, which includes the commitment to challenge goals, freedom and autonomy, to encourage creativity, to ensure full creative time, appropriate feedback, understanding and the return of creative work	Organizational attribute theory
Tesluk (1997)	Innovative organizational climate is an individual cognitive of organizational policies, practices and processes, as well as a kind of environmental atmosphere which can specific innovation goals into the development of new products and services, reengineer the process, and enhance the overall organizational innovation capability	Attraction- selection- attrition concept
Bharadwaj (2000)	Organizational climate for innovation is used to encourage members to be creative through the proper ways, tools, and appropriate resources	Patterns of socialization

innovation climate will play an active role in the performance of the enterprise after forming an innovation-oriented corporate policy, management and process.

56.2.2 The Innovative Behavior

With the growing concern of society for innovation, researchers also begin to pay more attention to individual-level innovation, namely the innovative behavior. Regarding the current research status of employee innovative behavior, there are many influencing factors including individual factors, leadership factors, organizational factors, job characteristics factors, relationships and social networks, and so on (Yang et al. 2011). In this paper, we study it from an organizational atmosphere perspective.

The majority of the scholars defined it from the process point of view of individual innovative behavior (Gu and Peng 2010), as shown in Table 56.2.

Amabile’s (1993) the definition of innovation behavior has been widely recognized. The innovative behavior is product, ideology or program that the employee produced and is potentially valuable to the organization. According to the two-stage theory, this paper gives its own definition: innovative behavior is the process that employees generate innovative ideas at work through all aspects of support, as well as their own efforts to push the idea into practice, and ultimately make valuable behavior.

56.2.3 Enterprise Performance

Enterprise performance refers to business efficiency and results of operators during certain operating period (Zhou et al. 2001). Generally following the classification of Dyer and Reeves, enterprise performance will be divided into four categories: the performance of human resource management, such as employee turnover rates, employee satisfaction, etc.; organizational performance such as productivity, quality, and customer satisfaction, etc.; accounting measurement performance such as return on assets, the rate of profit, sales revenue, etc.; market price performance, such as stock market prices, etc. (Wang and Li 2002).

Table 56.2 The definition of innovative behavior

Researchers	The process of innovation behavior
Scott and Bruce (1994)	Three-stage theory: (1) The establishment of the problem and the generation of ideas or solutions; (2) Seek support for the idea; (3) Complete its innovative ideas by spreading and manufacturing vastly based on the standard or model of innovation
Kleysen and Street	Five-stage theory: Look for opportunities, generate ideas, do the survey, support and apply.
Xiaojun Lu and Guoliang Zhang	Chinese context of two-stage theory: the behavior of generating innovative ideas and the behavior of implementing innovative ideas (Lu and Zhang 2007)

56.3 The Mechanisms

56.3.1 Relationship Between the Climate for Innovation and Enterprise Performance

The business climate for innovation is the deepening to the corporate atmosphere and it can effectively predict organizational performance (Hughes and Morgan 2007). At present, many scholars at home and abroad make the related research between the climate for innovation and business performance (Wang and Zhu 2005), as shown in Table 56.3.

56.3.2 The Introduction of the Mediating Variables: Employee Innovative Behavior

The researches of organizational innovation climate are often from three different mechanisms: the main effects model, interaction model, and buffering effect model. At present, most researches focus on the buffering effect model (Wang and Zhu 2005)—the climate for innovation impacts performance and work efficiency through certain mediating variables. We study the impact of climate for innovation on performance by introducing the mediating variable innovative behavior.

(a)Organizational innovation climate and employee innovative behavior

A large number of studies have shown that the organizational innovation climate and employee innovative behavior are positively correlated. Domestic and foreign scholars have had some related research results (Mei et al. 2011) as shown in Table 56.4.

It can be seen from the table above that innovation climate has a significant positive effect on employee innovative behavior. Innovative behavior requires the support of a series of special resources, and whether enterprises can meet the individual needs lies in the structure of the enterprise. When the innovation requirements are placed in a priority position, the employees may have more

Table 56.3 The relationship between organizational innovation climate and performance

Researchers	Results
Lee et al. (1994)	There is significant correlation between higher degree of support and organization innovation performance. Higher the degree of support is, better organizational innovation climate is and higher the organizational innovation performance will be
Tidd (1997)	Organizational innovation characteristics are significant predictors of the improvement of organizational innovation performance
Bessant et al. (1997)	Staff participation has a direct relationship with innovation performance, and it represents the organization’s competitive advantage

**Table 56.4** Organizational innovation climate and employee innovative behavior

Researchers	Results
Bharadwaj	Organizational innovation climate can effectively predict innovative behavior and innovative performance of the work team
Hunter & Mumford	Organizational innovation climate is an important factor of the organization for the advancement of innovative behavior
Ramamoorthy & Flood and Zeng Xiang Quan, Zhou Yu	Organizational pay incentives, the fairness of the reward system has important implications on innovative behavior

opportunities for innovation. Whether staff’s innovation is encouraged will affect the expression and motivation of staff’s abilities. This paper summarizes researches at home and abroad, and analyses mechanism of innovation climate for employee innovative behavior respectively from the corporate structure, leadership and incentives (Sethia 1989).

1. Corporate structure

There will be quite large unpredictability and a series of barriers in the innovation process, and innovative employees require a lot of freedom and flexibility. So the autonomy of the solution to the problem is best left to the employees. Corporate structure, policies, and procedures are the decisive factors for enterprise innovation, and also corporate structure will affect the availability and usability of the resources. Material and human resources are usually shared by many individuals or work teams, but the corporate structure is the determinant to the possibility and convenience of such sharing. Formal or informal organizational structure also has an important effect on information exchange and communication, and has apparent obstacles to the quality, the speed and timing of information passed between people. So do the generation and implementation of innovative ideas.

2. Leadership

Executives’ strategic goal not only decides the employee’s ordinary behavior, but also determines the purpose of innovative behavior. If the leader focuses on innovation and is interested in all new ideas, then it will give those members challenges and opportunities to innovate. If a leader himself is innovative, he would become influential leaders and role models to promote the innovative behavior of employees (Amabile 1988; Zuckerman 1977). The values of the leader have great significance to the individual innovative behavior, and resources which support the innovative behavior will drastically affect the leadership decision-making.

3. Incentives

Many companies are interested in innovation, some of which may also require their employees to innovate. But here is the problem. We need to know the right number of incentives to reward innovative behavior. An article on the incentives written by

Kerr (1975) reminds us about this organization sensitivity that “A stupidly felt hopeful about the incentives, but eventually B got the reward” (Kerr 1975). It is not enough to be hopeful to innovation, more importantly, it needs reward. From the motivation point of view, the driving force to innovate is the intrinsic motivation. It means that the strict constraints or emphasis on extrinsic rewards incentives could easily undermine the innovative behavior of employees. Sharing of resources and knowledge, cooperation and control will be influenced by incentive mechanisms. If an enterprise takes personal achievements as the only reward measure, employees will hide resources and information. Under such an environment, it is not conducive to innovative behavior, so the incentive mechanism should also be reasonable.

#### (b) Employee innovative behavior and enterprise performance

Damanpour and Evan pointed out that organizational operating performance is indeed higher than others if it takes management and technological innovation (Damanpour et al. 1989a, b). Effective innovation can make enterprise more dynamic, so that enterprise performance can be improved (Song et al. 2011). If the innovative behavior has been recognized by the enterprise and generates a good performance in practice, the innovative behavior will be encouraged by the better performance of the innovative behavior. Employees may innovate more actively, and communicate with each other more frequently to build harmonious relationship between superiors and subordinates. At last, a virtuous cycle is formed and then enables enterprises to obtain continuing competitive advantages (Wang and Zhu 2006).

This paper explores the mechanism between innovative behavior and performance based on the Chinese context of a two-stage theory. It starts from the formation process of innovation behavior. In the process of innovation generation, employees will find opportunities for innovative products, ideas or procedures. Then they begin to seek solutions for these opportunities and take a series of tests for the feasibility. In the implementation phase, the behavior of employees should be put into practice mainly to obtain the resources and support from others, and ultimately the innovative ideas should be implemented with the innovative behavior becoming part of the daily operation of enterprises. We can find that innovative idea is the basis of innovative behavior, and the implementation of innovative ideas is also an integral part of the innovative behavior. The two processes will impact innovation performance at the same time.

## 56.4 Conclusion

Through the above theoretical studies, we find innovative behavior acts as an intermediary variable between organizational innovation climate and business performance, and also plays an absolutely vital role as a bridge.

Good organizational innovation climate has a good effect on innovation behavior. Innovative behavior also has a direct role in promoting the performance.

After enterprises provide their employees with a suitable innovation climate, employees in such an environment will strengthen their innovative behaviors so that the performance can be improved.

The theoretical study of these three has the guiding significance in practice: to maintain the vitality and innovation, we must create innovation climate so that employees have sufficient room to express their ideas and then contribute to enterprise performance. Only if the company constantly improves the innovation capacity will it obtains more competitive advantages and gets a place in the market competition.

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# Chapter 57

## Organizational Learning, Ambidexterity, and Firm Performance

Jun Zhou and Qiu-zhi Xue

**Abstract** Based on the theories of organizational learning and organizational ambidexterity, this paper puts forward some theoretical propositions and conducts empirical tests. The results indicate that organizational ambidexterity plays partially mediating roles between organizational learning and firm performance. This research illustrates another kind of contextual ambidexterity which is different from what Gibson and Birkinshaw (2004) depicted, clarifies the mechanisms of action the organizational context has on organizational ambidexterity, and enriches empirical evidence on the relationship between organizational ambidexterity and organizational performance.

**Keywords** Contextual ambidexterity · Organizational ambidexterity · Organizational learning

### 57.1 Introduction

Nowadays, a typical organization is confronted with paradoxes, which are revealed and intensified by the technological revolution, global competition, and workforce diversity. With regard to the paradox management, scholars hold two opposite viewpoints, i.e. ambidextrous view and trade-off view. Traditional trade-off view

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believes that the organization has to resort to the “either this or that” strategy because it’s impossible for an organization to successfully and simultaneously manage two opposite targets. On the contrary, ambidextrous view believes that the manager must have the capacity to identify and adapt to paradoxes, and even benefit from the tension produced by these paradoxes. The organization can effectively chase two coexisting different and even opposite targets by taking advantage of the tension existing within the paradoxes. According to organizational ambidexterity view, a successful organization should be equipped with certain kind of ambidexterity. Ambidexterity refers to the capacity that the organization possesses to manage and realize opposite targets at the same time. Some scholars vividly describe ambidexterity the organization possesses as “the capability of people to use their right and left hands with same dexterity” (Gibson and Birkinshaw 2004).

The construction of suitable contextual ambidexterity is one of the ways to cultivate organizational ambidexterity. So far, there are only a few researches focusing on the topic of contextual ambidexterity, and the only existing several researches differ in some respects. Gibson and Birkinshaw (2004) point out that organizational context emphasizing on both performance management and social context can strengthen the ambidexterity of the organization by enabling ambidextrous individual to display ambidextrous behavior. However, some scholars hold doubt, even opposite opinion towards Gibson and Birkinshaw’s so-called “contextual ambidexterity”. They believe it’s almost impossible to achieve contextual ambidexterity (Gupta et al. 2006). As Miriow et al. (2008) argue, contextual ambidexterity doesn’t even exist at all. This paper holds the opinion that, under certain circumstance, the contextual ambidexterity depicted by Gibson and Birkinshaw is very likely to exist. But, the possibility depicted by Gibson and Birkinshaw is only one of the forms of contextual ambidexterity. From the perspective of organizational learning, this paper discusses the construction of contextual ambidexterity, aims to broaden and deepen people’s understanding of organizational context which fits for the cultivation of contextual ambidexterity, and clarifies the mechanisms of impact the organizational context has on organizational ambidexterity. Besides, this paper also aims to further explore the relationship between organizational ambidexterity and organizational performance, so as to clarify the mechanism of impact and enrich relevant empirical evidence.

Based on the theories of organizational learning and organizational ambidexterity, this paper explores the relationships among organizational learning, organizational ambidexterity and organizational performance, and concludes that organizational ambidexterity plays partially mediating roles between organizational learning and firm performance. On the basis of literature review, this paper puts forward the presumption about hypothesized relationships among three variables, tests the concerning hypotheses by using data obtained from survey, and finally the findings are discussed.

## 57.2 Literature Review

The study of organizational ambidexterity involves many levels and perspectives (Raisch and Birkinshaw 2008). This paper, from the perspective of organizational learning, explores the antecedents and outcomes of organizational ambidexterity at firm level. In the field of organizational learning, organizational ambidexterity can be defined as “the capacity to organize the high level exploration and exploitation simultaneously”. “Exploration” refers to the behavior of finding new opportunity and creating new business, including searching, varying, adventure, experiment, finding, innovation and so on; while “exploitation” refers to the behavior of copying and applying prior knowledge to the same or similar field, and creating organization’s reliability and stability by reaping prior knowledge and inheriting tradition, involving refining, selecting, efficiency and execution (March 1991). If one organization pays excessive attention to explore but neglect exploiting, it has to pay the cost of experiment but fails to get any benefit. If one company pays excessive attention to exploit but neglect exploring, it may find itself fall into second-best stable equilibrium. Therefore, to maintain suitable balance between exploration and exploitation is of vital importance to an organization’s survive and prosperity (March 1991). However, it’s not easy to realize exploring and exploiting the balance between activities. Certain tension exists between these two activities. Firstly, exploration and exploitation strive for the rare organization resources. The increasing of resource inputting in exploring activity may lead to the reduction of resource left for exploiting activity, and vice versa. Secondly, exploration and exploitation has the characteristic of self-reinforcing. In the short term, “exploration” usually leads to more “exploitation”, and “exploitation” may produce more “exploitation” (Gupta et al. 2006). Finally, “exploration” and “exploitation” need different organizational structure, process, strategy, capability and culture. According to March (1996), exploitation must depend more on resource investment, depth, and cohesive force, but less on careful consideration, scope and openness which are more needed by exploration; and exploitation needs the support of mechanical organization structure, while exploration needs organic organization structure.

Though exploration and exploitation contradict with each other in the three aspects depicted above, both of them can be well integrated into one organization with reasonable organizational design. Scholars have so far put forward four types on the cultivation of organizational ambidexterity, i.e. structural ambidexterity, contextual ambidexterity, leadership-based ambidexterity and network-based ambidexterity. Structural ambidexterity refers to creating the dual structures which are spatially separated, i.e. producing different structural mechanism within different space at the same time to meet the competitive requirements from exploration and exploitation. Gibson and Birkinshaw (2004) have introduced the concept of contextual ambidexterity, believing structural ambidexterity is neither the best nor the only way to cultivate organizational ambidexterity. Contextual ambidexterity cannot only help to construct ambidexterity but also reduce

coordinating cost in structural ambidexterity. They points out that the staff of organization should be “generalist”, who is capable of carrying out both explorative and exploitative activities, and the task of organization design is to create supportive atmosphere, encourage and help ambidextrous members make their own choice and take explorative and exploitative activities independently and autonomously. At present, theoretical or empirical studies focusing on contextual ambidexterity are still rare. Arguments for and against contextual ambidexterity are coexisting in academia. Though Mom et al. and Adler et al. have provided evidence in favor of Gibson and Birkinshaw (2004), some scholars still hold doubtful and even opposing viewpoint towards it. March (1991) believes that cognitive limitations make it difficult for people to simultaneously take both explorative and exploitative activities. Gupta et al. (2006) point out explorative and exploitative activities at the level of individual are usually mutually exclusive. Miriow et al. (2008) hold the view that contextual ambidexterity is mere a game of words on paper and exploitation is usually in a dominant position because people are usually short-term interest-oriented. This research believes that those opinions doubting and even opposing what Gibson and Birkinshaw (2004) have described reveal the tension, at the individual level, between exploration and exploitation, and the tension makes it difficult for individual to carry out ambidextrous behaviors. But this isn't adequate evidence to deny Gibson and Birkinshaw's (2004) description on contextual ambidexterity. Of course, the contextual ambidexterity described by Gibson and Birkinshaw (2004) may be only one form of contextual ambidexterity. Consistent with Gibson and Birkinshaw (2004), this paper argues that organizational context, including rules, process, and beliefs (Ghoshal and Bartlett 1994), which shapes individual-level behaviors is one resource of organizational ambidexterity. However, this paper holds viewpoints different from Gibson and Birkinshaw (2004) on the understanding of mechanism of impact of organization context on ambidexterity. In our opinion, organizational context helps to build ambidexterity not necessarily under the precondition that the organization staff must be generalists. We believe that an organization mainly made up of specialists can also successfully cultivate organizational ambidexterity in suitable organizational context, which helps the organization effectively identify various paradoxes and realize paradoxical objectives. Efficient and effective organizational learning is one of the supportive factors for building contextual ambidexterity because it can enhance organizational ambidexterity by strengthening organization's paradoxical thinking and paradoxical executive capacity.

Aside from the exploration on the cultivation mechanism of organizational ambidexterity, scholars have also analyzed the effect organizational ambidexterity has on organizational performance. So far, empirical researches about the relationship between organizational ambidexterity and performance are very limited and differ in conclusions. Though some evidence proves that ambidexterity can successfully improve organizational performance (Gibson and Birkinshaw 2004; He and Wong 2004), other studies indicate that ambidexterity fails to significantly improve (Venkatraman et al. 2007), and even deteriorates (Atuahene-Gima 2005) the performance of sample firms. Besides, some scholars deem that the relationship

between ambidexterity and performance may be nonlinear (Venkatraman et al. 2007). Yang and Atuahene-Gima (2007) find that the relationship between organizational ambidexterity and organizational performance is inverted U-shaped. This study intends to explore the mechanism of impact of organizational ambidexterity on organizational performance, and provide some relevant empirical evidence.

## 57.3 Theoretical Hypotheses

### 57.3.1 *The Relationship Between Organizational Learning and Organizational Ambidexterity*

This study adopts the framework of Hult and regards organizational learning as a multidimensional construct, including learning orientation, system orientation, team orientation and memory orientation. Learning orientation reveals the organization understands of the importance of learning. System orientation measures that the organization can, to what extent, have overall view of the internal and external relations. Team orientation refers to the cooperative spirits among group members. Memory orientation refers to the degree that the organization stores and uses existing knowledge.

Four dimensions in organizational learning—learning orientation, system orientation, team orientation and memory orientation, are interrelated and supplementary. They are helpful for the organization to identify, confront with and deal with paradoxes. Therefore, this paper puts forward:

**Hypothesis 1** Organizational learning is positively related to organizational ambidexterity.

### 57.3.2 *The Relationship Between Organizational Ambidexterity and Performance*

It's of great significance for an organization to keep balance between exploration and exploitation (March 1991). Explorative activities are helpful to the achievement of long-term goal, and the improvement of organization's adaptability to great change of the environment. However, if only explorative activities are carried out, the organization won't be able to get the corresponding return, which may lead the organization into financial trouble. Exploitative activity has close relationship with the organization's short-term target and can provide resource and knowledge to the organization. But, if only exploitative activity is carried out, the organization will fall into risk of obsolescence and can't get used to dynamic changes of the environment. According to Levinthal and March, one basic task that

an organization should take is to conduct sufficient exploitation to guarantee today's survival, and meanwhile, vigorously explore new opportunities to increase the success opportunity in future. Sustainable competitive advantage can't be achieved unless the organization carries out both explorative activity and exploitative activity adequately and simultaneously.

On the basis of above analysis, this paper believes:

**Hypothesis 2** Organizational ambidexterity is positively related with organization performance.

### ***57.3.3 The Mediating Role of Organizational Ambidexterity***

In the dynamic and complex environment, organizational learning is an important way for the organization to gain competitive advantage. Existing evidences prove that organizational learning has positive effect on organizational performance. Existing study reveals two mechanisms of impact that organizational learning has on performance. These two mechanisms take innovation and adaptability as the mediator, respectively. This paper believes, another mechanism of impact that organizational learning has on performance takes organizational ambidexterity as the mediator. In an organization emphasizing learning orientation, system orientation, team orientation and memory orientation, organization members can systematically identify, accept, confront with and transcend the tension in paradoxes. With the passage of time, the organization has to face various paradoxes. Through learning from experiment, learning from doing, learning from trial and error, and learning from improvisation, a series of effective organization routines that balance element of paradoxes gradually come into being, thus organizational ambidexterity is enforced. The organization with strong ambidexterity can simultaneously carry out both the exploration and exploitation at high level and reap the long-term benefit brought by exploration and short-term benefit brought by exploitation, therefore obtaining sustainable competitive advantage. On the basis of that, this paper points out:

**Hypothesis 3** Organizational ambidexterity plays a mediating role between organizational learning and organizational performance.

## **57.4 Data Source and Measurement**

### ***57.4.1 Data Source***

This study conducts questionnaire survey to collect data. Criteria for selecting samples are as follows. Firstly, the organization has been in operation for at least 3 years. Secondly, the organization must be a complete independent operational entity instead of a branch of a company. Thirdly, the organization must be manufacturing enterprise. The way to do the survey includes: (1) to contact teachers and require MBA and EMBA students from Fudan University, Jiangxi University of Finance and Economics, and Soochow University to fill forms in classroom; (2) to ask Changshu science and Technology Bureau to distribute questionnaire to enterprises in Chang Shu; (3) to do survey through private relationship. The survey period is from July 2008 to December 2009 and divided into two periods.

### ***57.4.2 Variable Measurement***

Organizational learning scale comes from Hult et al. The exploration and exploitation of scale come from He and Wong (2004). In accordance with Gibson and Birkinshaw (2004)'s measurement method, organizational ambidexterity also takes the interactivity of exploration and exploitation as measurement. Enterprise performance scale comes from Jiao et al. Control variables adopted in this paper includes the natural logarithm of numbers of enterprise employees and the time of establishment.

### ***57.4.3 Common Method Variance Test***

Every questionnaire in this survey is filled out by the same person. However, the same data source is one of the important reasons leading to common method variance. In order to reduce the seriousness of common method variance, this study adopts procedural control. In order to reduce questionnaire respondents' guess of the purpose of measurement, this study doesn't explicitly explain the purpose of survey, and hide the full name of measured variables. Besides procedural control, this paper also adopts statistical control. We adopt confirmatory factor analysis to conduct Haman's single factor test. All items in the survey are put together for factor analysis. The first factor got when not rotating reflects the seriousness of common method variance. This paper takes data offered by 155 questionnaires for the test of hypothesis for factor analysis. The first factor extracted explains 39.9 % of the total variance. According to Haman's suggestion, this study doesn't involve serious common method variance problem.

## **57.5 Data Analysis and Hypotheses Test**

### ***57.5.1 The Test of Reliability and Validity***

We make an exploratory factor analysis based on the data provided by 119 effective questionnaires collected from July 2008 to December 2008. The factor loadings of the item “improving flexibility in production” in the scale of exploitation are found to be 0.453 and 0.546 corresponding to exploitation and exploration, respectively. Both of these loadings are digital close and bigger than 0.4. This indicates that there is obvious cross-loading problem. According to the result of exploratory factor analysis, this item is deleted.

Revised questionnaires were distributed from March 2009 to December 2009 and 155 were effective. All data collected are applied for the test of reliability, validity and hypothesis. The corresponding Cronbach's  $\alpha$  values of dimensions of multi-dimensional constructs and single-dimensional constructs are all larger than 0.7, this indicates that reliabilities are acceptable. Confirmatory factor analysis shows that KMO values of all the scales meet the criteria of “KMO value should be no less than 0.5”, and Bartlett's sphere test's Chi square values are significant. All the observable indicators' factor loadings are more than 0.4, and there are no obvious cross-loading phenomenon, which indicates that convergent validities of these scales are high enough. What's more, the average variance extracted (AVE) of organizational learning, exploration, exploitation, and firm performance are 0.538, 0.668, 0.678, and 0.891, respectively, and the AVE of the four dimensions (incl. team orientation, system orientation, learning orientation, and memory orientation) of organizational learning are 0.586, 0.510, 0.567, and 0.478 in succession. As can be seen from above, except the dimension of memory orientation, AVE of all constructs and other dimensions are larger than 0.5, showcasing convergent validities of all the scales are good.

### ***57.5.2 Descriptive Statistics and Correlation Analysis***

Years of establishment are between 3 and 59, and the average is 13.6 years. Number of employees' ranges from 4 to 5,000, and the average number are 426. The natural logarithm of number of employees is positively related with years of establishment ( $r = 0.238$ ,  $p < 0.01$ ). The average values of organizational learning, firm performance, exploration, exploitation, and ambidexterity are all moderately high. Wilcoxon test shows that exploration is significantly higher than exploitation in the sample enterprises. Organizational learning, firm performance, and organizational ambidexterity are significantly positively related with each other, which is consistent with the theoretical hypothesis.

### 57.5.3 Hypothesis Testing

According to theoretical hypothesis, organizational ambidexterity plays mediating roles between organizational learning and firm performance. In order to test the mediating effect, this paper adopts the method recommended by Baron and Kenny. The testing process is as follows. To begin with, we decide whether the changes in organizational learning can significantly explain changes in firm performance; and then determine whether the changes in organizational learning significantly explain changes in organizational ambidexterity; and finally see whether the impact of organizational learning on firm performance is significantly reduced after controlling organizational ambidexterity. This paper tests whether the above relationship exists by means of linear regression. The control variables of all the three models are years of establishment and natural logarithm of number of employees.

In order to judge whether sample data are suitable for linear regression, this study analyzes the presence of influential point and multi-collinearity problem. To examine whether the influential point of this study exists, we output the maximum and minimum values of the standardized residuals, using statistical software. The maximum of the absolute value of the standardized residuals for the three models are 2.096, 2.228 and 2.705, respectively, which are all smaller than the critical value of 3.0. This shows that there is no strong point of impact which has a significant impact on the regression results. To test multi-collinearity problems in regression equations, this study examines the variance inflation factors (VIFs) for each variable in the equation. The maximum value of VIFs in the three models are 1.063, 1.062 and 1.583, respectively, which are all far below the critical value of 5.0 or 10.0. Based on VIFs, the three regression equations have no obvious multi-collinearity problems.

In model 1, the standardized coefficient of organizational learning is 0.476 ( $p < 0.001$ ), indicating that organizational learning has a significant impact on firm performance. In model 2, the standardized coefficient of organizational learning is 0.599 ( $p < 0.001$ ), which is significantly positive, indicating that organizational learning can significantly explain change in organizational ambidexterity. Thus, hypothesis 1 is supported. On the basis of model 1, model 3 increases the explanatory variable of organizational ambidexterity, the standardized coefficient of organizational ambidexterity is 0.303 ( $p < 0.01$ ), which is significantly greater than 0, therefore hypothesis 2 is supported too. The standard coefficient of organizational learning decreases from 0.476 ( $p < 0.001$ ) to 0.278 ( $p < 0.01$ ). Whether the decline of the coefficient is statistically significant? This paper adopts the  $t$  statistics put forward by Freedman and Schatzkin.  $t(153) = 3.422$ . According to  $t$  value, we reject the null hypotheses of “no significant change” at 1 % significance level. Therefore, the Standard coefficient of organizational learning in model 3 decreases significantly compared with that in model 1. Based on the analysis above, it can be concluded that organizational ambidexterity plays mediating role between organizational learning and firm performance. Thus, hypothesis 3 is supported. In summary, the proposed three

hypotheses are all supported. As the standardized coefficient of organizational learning in model 3 is significantly different from zero, the mediating effect of organizational learning is partial.

## 57.6 Discussion and Conclusion

Based on the theories of organizational learning and organizational ambidexterity, this paper puts forward some theoretical propositions and conducts empirical tests. The results indicate that organizational ambidexterity plays partially mediating roles between organizational learning and firm performance. This research deepens our theoretical understanding in the following three aspects.

Firstly, contextual ambidexterity has at least two types. Secondly, exploration and exploitation are not necessarily completely contradictory. Thirdly, organizational ambidexterity is another mediating variable between organizational learning and firm performance.

Researches on organizational ambidexterity are growing rapidly and many hard problems are yet to be solved. Future study should pay attention to questions in the following aspects. Firstly, the contingent effect of organizational ambidexterity on firm performance should be further studied. Secondly, studies may focus on the conditions under which exploration and exploitation are mutually promoted.

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# Chapter 58

## Research on ERP Customer Capability Maturity Model Based on PEMM

Zhen-zhen Liu and Hao-yu Wen

**Abstract** Enterprise Resource Planning (ERP) systems dominate information technology landscape of many companies. Due to the implement of ERP system for enterprise in different levels, a comprehensive and principled method for evaluating the maturity of ERP customer is eagerly needed to determine and control the risks. As a result, based on the framework of Process and Enterprise Maturity Model (PEMM), which conducts assessment of process management and organizational maturity, and the characteristic of ERP customer, the ERP Customer Capability Maturity Model is discussed in this paper. It has two dimensions, one for process maturity and another for enterprise maturity. In addition, it has four areas, which are initial, managing, standardized and optimizing. It is used to qualitatively describe the maturity of the ERP customer and aims to offer an assessment tool for ERP customer, ERP vendor and consultant firm before they implement ERP system.

**Keywords** Business process maturity model (BPMM) · Capability maturity model integration (CMMI) · Enterprise resource planning (ERP) · Process and enterprise maturity model (PEMM) · Software capability maturity model (SW-CMM)

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## 58.1 Introduction

Enterprise Resource Planning (ERP) systems dominate the IT infrastructure in many organizations of all sizes and industry types. It is regarded as indispensable for companies to determine their ability to overcome the challenges associated with globalization and external market competition. Today, ERP system has applied in nearly all industry. Complete success of ERP system implementation needs the concerted efforts of ERP customer, ERP vendor and the consultant firm.

In the past 20 years, to improve the success rate of ERP implementation, some authors devoted to research the ERP implementation methodology and focused on the management and control of ERP implementation process, such as Accelerated SAP (ASAP), ERP Implementation Capability Maturity Model and so on. In addition, some other authors paid close attention to the capability maturity of system vendor and provided Software Capability Maturity Model (SW-CMM) which can be used to evaluate the maturity of ERP system vendor. For ERP customer, some authors paid close attention to the maturity of business process and created many process maturity models, such as Business Process Maturity Model (BPMM), Capability Maturity Model Integration (CMMI) and so on. However, the single process doesn't instead of the overall success and maturity of company. Therefore, according to the process maturity model, we develop the ERP Customer Capability Maturity Model to provide a needed standard to evaluate the maturity of ERP customer before they implement ERP system.

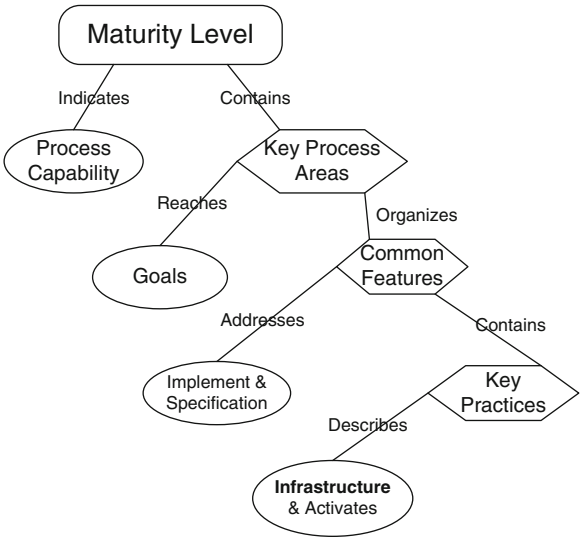
## 58.2 Development of Maturity Model

### 58.2.1 *Software Capability Maturity Model*

The SEI firstly developed the Software Capability Maturity Model as a tool to assess the ability of government contractor's processes which used to perform software project in 1987 (Li 2010). The model consists of five aspects and provides a standard research framework for the various subsequent development of maturity model. The five aspects are maturity levels, key process areas, goals, common features and key practices. Figure 58.1 shows their relationships.

This model has five levels (1) Initial—organization uses a new or undocumented repeat process, (2) Repeatable—organization can make development plan and forecast software function, the processes are at least documented, (3) Defined—organization has a set of standard and defined processes, (4) Managed—processes are quantitatively managed and controlled, (5) Optimizing—process optimization can be done easily (Jalote 2000). An enterprise's process maturity can be developed from one level to the next and not allowed to skip.

**Fig. 58.1** The structure of CMM



**58.2.2 Capability Maturity Model Integration**

Capability Maturity Model Integration (CMMI) is a more comprehensive model compared to CMM (Jalote 2000). According to the SEI, CMMI helps organization integrating traditional separate organizational functions, setting process improvement goals, guiding quality processes and appraising current processes. It consists of three areas of interest that are Product and service development (CMMI-DEV), Service establishment, management and delivery (CMMI-SVC) and Product and Service Acquisition (CMMI-ACQ). It has sixteen process areas which are named CMMI core process areas and assigned to different levels, such as Decision Analysis and Resolution (DAR) is the Defined level, Measurement and Analysis (MA) is the managed level and so on.

CMMI also has five levels: (1) Initial—processes are unpredictable, poorly controlled and reactive, (2) Managed—processes are characterized for projects and often reactive, (3) Defined—processes are characterized for the organization and proactive, (4) Quantitatively Managed—processes are measured and controlled, (5) Optimizing—organization focus on process improvement. It can be used to evaluate the process maturity of any organization and provide a statement of current state. However, you can not get a specific roadmap from CMMI evaluation.

**58.2.3 Business Process Maturity Model**

The Object Management Group, Inc. (OMG) provided Business Process Maturity Model (BPMM) in 2008 (Lee et al. 2007; Rosemann and de Bruin 2005; Hammer

2007; Melenovsky and Sinur 2006). It references the level of CMM and provides a framework to improve end-to end business processes. It also divided into five levels: (1) Initial—business processes are inconsistent and difficult to predict, (2) Managed—business processes can be performed reputably in local organization units, (3) Standardized—organization synthesized standard business processes from best practices of work groups to support different business needs, (4) Predicated—business processes are managed statistically in workflow and managers can predict the process outcomes, (5) Innovating—managers focus on both proactive and opportunistic improvement actions to seek innovation that can close gaps between the organization’s current capability and required capability. It incorporates various improvements over the CMMI standard, but it has not been adopted by any organization.

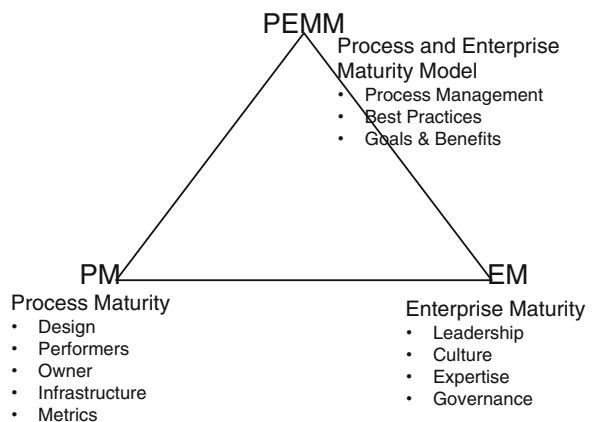
### 58.3 Discussion of ERP Customer Capability Maturity Model

#### 58.3.1 Process and Enterprise Maturity Model

Besides of CMM, CMMI and BPMM, there is another process maturity model—Process and Enterprise Maturity Model (PEMM) developed by Michael Hammer in the April 2007 (Power 2007). It contains two groups index of consistent business process improvement, one is for performance of a process to assess process maturity and another is for enterprise capability to assess enterprise maturity.

As shown in Fig. 58.2, Michael Hammer select five process enablers of maturity based on the importance, which are design, performers, owner, infrastructure and metrics (Curtis and Alden 2007). Each enabler contains various variables: design consists of purpose, context and document; performers consists

Fig. 58.2 Michael Hammer’s PEMM



of knowledge, skills and behavior of people; owner consists of identity, activities and authority; infrastructure consists of information systems and human resource; metrics consists of definition and uses. For enterprise maturity, he selects four capability based on the importance, which are leadership, culture, expertise and governance. Each capability can also be broke down into various variables: leadership consists of awareness, alignment, behavior and style; culture consists of teamwork, customer focus, responsibility and attitude toward change; expertise consists of people and methodology; governance consists of process model, accountability and integration.

Compared to other maturity models, PEMM provides managers a very simple and straightforward framework to understand, express and evaluate the outcomes based on the business process transition (Curtis et al. 2004; Rosen 2010; Fisher 2004). However, it has some potential weaknesses in the categories of analysis. Firstly, business impact is not considered to be in an assessment of process management maturity. Secondly, it lacks a linkage between maturity levels and business outcomes. Thirdly, it does not contain the degree of strategic adjustment between process activities and the organization's strategy. At last, its levels structure is a stage-gate approach, which required all factors must be on the save level (Spanyi 2004; Jeston and Nelis 2010).

### ***58.3.2 ERP Customer Capability Maturity Model***

In fact, what's the most important thing is that Hammer's PEMM generates a conversation. In ERP implementation process, Business Process Reengineering (BPR) is the most important and primary for the ERP customer. The maturity of process management has a great influence on the success of ERP project. But the performance of that single process cannot instead of the overall success and maturity of company. Because someone's heroic efforts can improve process maturity despite relative enterprise immaturity. The attitude of the senior leaders and staff is equally important to assess the ERP customer's maturity. So a company must have or create the organizational capacity to provide a supportive environment to business processes since the maturity of the enterprise is prerequisite of the process maturity. PEMM provides a suitable framework to discuss ERP Customer Capability Maturity Model, which is used to qualitatively describe the maturity of the ERP customer before ERP implementation process.

Due to the relatively lower success rates of ERP implementation in China, many scholars dedicated to the research on critical influence success factors. Here, six factors influencing ERP customer maturity is summarized by the relevant theoretical analysis and combined with the current environment, which are design, performers, infrastructure, leadership, culture and governance. With the application of the framework of PEMM, six factors are assigned to two dimensions in the ERP Customer Capability Maturity Model, one for process maturity, which looks at three enablers (design, performers, infrastructure) and further broke down into 9

elements (purpose, context, documentation, knowledge, skills, attitude, information systems, human resource, master data), and another for enterprise maturity, which focus on three capabilities (leadership, culture, governance), also further broke down into 9 elements (awareness, behavior, style, teamwork, responsibility, attitude toward change, process model, accountability, integration), as shown in Fig. 58.3. With the index system, we can evaluate the capability maturity of ERP customer and get two marks, one represents process maturity and another represents enterprise maturity. They can be applied to determine which area it is. Also the advantage and disadvantage of ERP customer can be discovered.

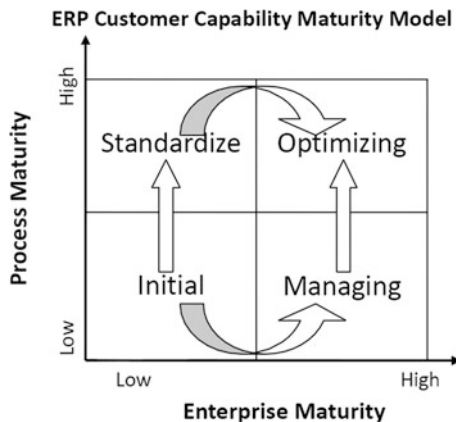
As displayed in Fig. 58.4, there are four areas, which are initial, managing, standardize and optimizing. These four areas have a closely relationship and determine where we go from there. The two-dimensional map is guidance on determination the type of action to improve capability maturity and the primary work of ERP implementation progress.

The firm currently at standardize area has higher process maturity and relatively lower enterprise maturity, which represents organization needs to be more focus on developing an enabling leadership team attitude. Education and senior leadership sessions should be taken seriously attention to create a shared understanding of ERP process management fundamental and the organizational culture. The project performers must devote to have clear demand and improve the level of governance.

**Fig. 58.3** The index system of ERP customer capability maturity model

<b>Process Maturity</b>	<b>Design</b>	<ul style="list-style-type: none"><li>● Purpose</li><li>● Context</li><li>● Documentation</li></ul>
	<b>Performers</b>	<ul style="list-style-type: none"><li>● Knowledge</li><li>● Skill</li><li>● Attitude</li></ul>
	<b>Infrastructure</b>	<ul style="list-style-type: none"><li>● Information System</li><li>● Human Resource</li><li>● Master Data</li></ul>
<b>Enterprise Maturity</b>	<b>Leadership</b>	<ul style="list-style-type: none"><li>● Awareness</li><li>● Behavior</li><li>● Style</li></ul>
	<b>Culture</b>	<ul style="list-style-type: none"><li>● Teamwork</li><li>● Responsibility</li><li>● Attitude toward Change</li></ul>
	<b>Governance</b>	<ul style="list-style-type: none"><li>● Process Model</li><li>● Accountability</li><li>● Integration</li></ul>

**Fig. 58.4** Four areas of ERP customer capability maturity model



Conversely, the firm currently at managing area, which has higher enterprise maturity and relatively lower process maturity, need increasingly focus on rapidly standardizing business process by means of Business Process Reengineering (BPR) or Business Process Management (BPM). Here, the company will focus on the development of consistently repeatable skills in achieving process improvement to make progress on the road to quantify performance improvement and management. This will likely involve training of staff to improve their quality, installing the IT infrastructure for ERP system, and standardizing the master data of ERP business process.

For the firm currently been positioned at initial area, which has lower maturity on both process and enterprise, there are two roads to improve organizational position as shown in Fig. 58.3, one through improving process maturity to standardize area then to optimizing area, another through improving enterprise maturity to managing area then to optimizing area. The company will find it really challenge to move continuously on business management and need to achieve progress in the two dimensions.

The firm currently at optimizing area, which has higher maturity both on process and enterprise, pays attention to fully utilize commitment to consistent improvement and use business-focused metrics to achieve new level of both efficiency and effectiveness. Not only the managers focus on continues innovation to improve the core competitiveness of organization, but everyone throughout organization have deeply plunged the concept of continuous into innovation.

## 58.4 Conclusion

Complete successful ERP system implementation process needs the concerted efforts of ERP customer, ERP vendor and the consultant firm. We can use CMM to evaluate the maturity of ERP vendor, however, no tool for ERP customer. As the

reason of the irreplaceable role in ERP implementation process, it is extremely useful to evaluate the maturity of ERP customer. On the other hand, Michael Hammer's Process and Enterprise Maturity Model provided a framework to assess maturity, which has two views, one for process maturity and another for enterprise maturity. Therefore, based on the PEMM, ERP Customer Capability Maturity Model is proposed, which has two dimensions (process and enterprise) and four areas (initial, standardize, managing, optimizing). Each of dimensions has three indexes and further broke down into 9 different elements. The model qualitatively assesses the maturity of the ERP customer and aims to offer an assessment tool for ERP customer, ERP system vendor and consultant firm before they implement ERP system.

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# Chapter 59

## Research on Selection of Enterprise Management-Control Model Based on Mahalanobis Distance

Wei Guo, Rui-zhi Yin, Gang Li and Nan Zhao

**Abstract** Objectivity deficiency always takes place during the selection of management control model for enterprise groups. Mahalanobis Distance is introduced in this article in order to solve this problem. Initially, the existing research results are summarized and shortcomings of researches on hand are pointed out. Ultimately, based on the different characters of each model, this paper has focused on the matching relationship between the model and influencing factors, and put ideal points forward to each of the three control models. Finally, with the discussion of the introduction of Mahalanobis Distance, this article has figured out that, instead of using a single certain model, an enterprise group should take the mixed control model into consideration, which can be suitable for both the integration of the whole group and the adaption of subsidiaries.

**Keywords** Enterprise group · Ideal point · Mahalanobis distance · Model of management control

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## 59.1 Introduction

With the ending of the era of industrial economy and the coming of the knowledge-based economy time, collectivization development in large enterprises has become a worldwide protruding problem. Enterprise group is a kind of advanced organization form which comes into being for the reason of the pressure in marketing competition and the internal evolutionary motivation within enterprise. According to the ‘provisional regulations of the administration management of enterprise group’ established by the National Administration of Industry and Commerce, enterprise group is defined as “The group corporation is mainly constituted by parent companies and subsidiaries that are linked by capital. It is the joint venture of legal person with certain scale which is composed by parent companies, subsidiaries, joint stock companies and other member enterprises or organizations that are commonly behaved under group regulation. Group enterprises do not have the status of enterprise legal person.” Judging from the definition, we can figure out the four characteristics of an enterprise group: Property coupling, Level organization, Having no legal person status and Organization scale (Chen 2010). Owing to its own characteristics, enterprise group has two obviously advantages overall strategy and synergistic effect compared with general companies. However, it also has two fatal shortcomings: many levels losses and many legal person conflicts. How to maximize the advantages of enterprise groups and minimize the deficiency has become the essential point in the development of an enterprise group. Known as group control problem, this phenomenon has become a social problem which attracts lots of attentions in both academic field and enterprise practice area.

A large amount of investigates have been arranged by scholars both at home and abroad during the 80s to 90s last century and the beginning of this century. Up to now, studies focusing on the relationships between the parent and subsidiaries, culture values, transaction costs, strategic management, content of group control and pattern of group control. Representative results can be seen in Table 59.1.

## 59.2 Disadvantages in Current Research

The study of group management control has achieved a lot. However, judging from the history view, there are still some biased ideas in the understanding of the nature of management control:

Governance theory: it emphasized that governance is the core of the group management control, the focus of its theoretical research is ‘how to straighten out the relationship between investors, board of directors and senior managers together with other stakeholders in accordance with the requirements of modern enterprise management system’. Judging from the interest of parent company, it mainly concern about ‘how to implement the investor strategic of the parent

**Table 59.1** Representative results in study of group control

Research standpoint	Representatives	The authors' point of view
Relationships between the parent and subsidiaries	Belig, Jaeger	Three relationships :common dependent model, result dependent model, reciprocity dependent model (Beliga and Jaeger 1984)
Culture values	Stede	Large similarities occurs in the management controlling system between each business unit in the same (Stede 2003)
	Bhimani	Different professional background sometimes means different cultural values even for the same food (Bhimani 2003)
Transaction cost	Hennart	Using the trade theory as a foundation, he proposed 3 ways: level control, personnel employment and social control, price control
	Voosselman	He divided controls into vertical type and horizontal ones
Strategic management	Bromwi, Simmons	System should provide company with both the cost and strategies of rival
Content of group control	Simons	Control systems are divided into four subsystems: belief system, boundary system, diagnosis system and interactive system
	Wu Li, Youmin Xi	Constructing a harmonious control theory (Li and Xi 2002)
	Su'e Zhu	Established a complete group financial controlling system in the subsidiary company management (Zhu 2002)
	Xu Wang, Guoshun Wang	They have made a comparative analysis for financial, strategic and operation management models together with marketing platform
Pattern of group control	Ouchi	Divided the subsidiary company controlling into three types: bureaucracy involved control, marketing ones and team type control (Ouchi 1979)
	Michael Goold	Divided the pattern of a parent company into strategic planning type, controlling type and financial controlling ones
	Qin Wang, Yunfeng Zhang	Divided the pattern into financial controls, strategic controls and management controls according to the allocation of headquarters right (Hu 2001)
	Qingle Zuo	Divided the pattern into centralized management mode, decentralized mode and household output-related mode according to the separation degree of the subsidiaries (Pound 2004)

company by the legal framework design of the parent and subsidiary companies'. This theory has complied with the great background of the establishment of Chinese Enterprise Group, disentangled the relationship between principal agents at the very beginning. People still need a more complete and comprehensive view to estimate the nature of the group control as the theory is not the entire content.

**Organization Pattern theory:** This theory has had the group control focused on the design of “mode of group organization and architecture” and can only solve organizational problems about levels. But the mode of organization and design of architecture are not meaning the entire work. How to realize the combination between the organizational structure and the applications of various functions to adapt to the strategic value creation has become a subject which attracts more and more attention of the senior managers.

**Budget central theory:** it emphasizes “budget is the core of a group control, a navigation in the operations, all the economic activities must obey and serve the budget.”; with the continuous advancement of the worldwide economy uniformity, more and more enterprise group has realized that even the best financial system won’t be able to cover all the dynamic characteristics in the operation of the group. Budget central theory is a typical kind of ‘strategic myopia,’ since budget can never be the ultimate goal of pursuit. In fact, it is only an approach.

**Centralization-decentralization theory:** The main idea of this theory is that the core of management control is the power and responsibility between parent and subsidiaries. Its foundation and essence is to distinguish the responsibilities and rights between group headquarters and subordinate companies. Being an updated version of the Organization Pattern theory mentioned above, it stressed four aspects: model of organization, structure of organization, system of responsibilities and power together with evaluation of performance’. Instead of being a final ultimate goal, it is just an external performance or reflection. If the enterprise group set it as the core and then the Chinese enterprise group control will transfer from evolutions to struggles.

**Risk and internal control theory:** This theory comes out after the establishment of ‘basic norms for the enterprise internal control’ and ‘guidelines about the comprehensive risk management of central enterprises’ which emphasizes the ‘risk-control-based group control’. This theory is biased. First of all, neither of the “standard” nor “guidelines” is used merely to adapt to the group enterprise. The former mainly aims at for the listed company, while the latter mainly focus on the central enterprise. Secondly, as modern China is still in the ‘compliant explore’ phase either ‘risk’ or ‘internal control’. If we set it beyond the control of “compliance explore”, it will make us neglect synergy of strategic value in the construction of control system, faced with the “strategic myopia” and finally out of control. Last but not least, it is just a kind of tool and is by no means to become a ultimate aim. It is not the foundation nor the only basis of group control, or it will put the group control construction reduced to become tools coped with external monitoring for stakeholders.

Biased ideas above occur because of the deviation in the understanding of the nature. The real purpose of group control is to ensure the accordance between the group and the implementation of the subsidiaries to achieve the strategic aim. Thus the essence of group control is to enhance the group’s capacity of strategic implementation, and to ensure the eventually realization. The selection of mode is then bear the brunt of work.

Based on the characteristics (poor scientific quantitative analysis and hybrid control modes) in the selection of control, this article has put forward to a new solution. It uses the analysis of the relations between the corresponding factors and the control mode to find out the benchmarks first, and then use the Mahalanobis Distance to figure out the gap between all affiliates and the ideal points, So as to determine the whole model of control.

59.3 The Determination of the Ideal Point

Combining with the previous research, this paper argues the characteristics in-depth in the aspects of headquarters ‘function, shared services from headquarters, group synergy, subsidiaries’ privileges, business correlation and level in subsidiaries, as shown in Table 59.2.

The selection of model is influenced a lot by the internal and external environment (strategy of subsidiaries, constructions of organization and enterprise culture, etc.) of the enterprise. Works about the different angle of the subject and object have been studied by ZhaoLiming, ChenZhijun and ChiGuohua (2009, 2007, 2004). In summarization, the factors can be divided into two kinds: external factors and internal ones. Results can be seen in Table 59.3.

Table 59.2 Comparison between different models

Models	Financial controls	Strategic controls	Management controls
<i>Characteristics</i>			
Headquarters’ function	Realize the operation of financial asset, planning, decision of investment and monitoring, small scales with less people	No large functional departments, used to make strategic plans, financial controls, important appointments and major decisions about investment	Centre of decision investment, management and coordination. Improved functional departments system with larger scale and numbers
Shared services	No shared services	Necessary shared services	All unified services
Group synergy	Not necessary	Demand higher level	All unified
Subsidiaries’ privileges	Highly decision-making and management autonomy	Have certain limit autonomy under the strategic guidance of enterprise	No business autonomy, in full accordance with the headquarters, only in charge of specific business management
Business correlation	Low correlation	High correlation	High correlation with special requests
Subsidiaries’ level	Lower derivative business	Lower core business and main business, higher derivative one	Higher core business and main one

Table 59.3 Matching table for selection factors and the control patterns

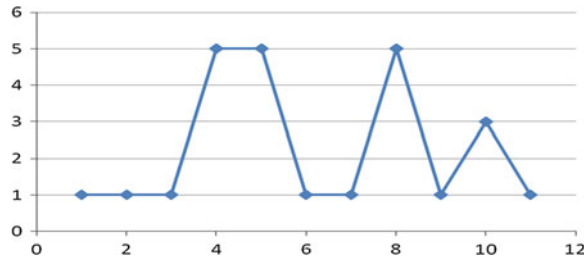
Selection factors	Eigenvalue	Controlling pattern		
		Operational	Strategic	Financial
External environmental uncertainty	Low	Widely used	Normally	Rarely
	Common level	Normally used	Widely	Rarely
	High	Rarely used	Normally	Widely
	Capital operational primarily	Normally used	Widely used	Widely used
Type	Management operational primarily	Widely used	Normally used	Rarely used
	Both above	Normally used	Widely used	Normally used
Strategy	Professional/leading diversification	Widely used	Normally used	Rarely used
	Related diversification	Normally used	Widely used	Normally used
	Unrelated diversification	Rarely used	Normally used	Widely used
Controlling extent	Wholly	Widely used	Normally used	Rarely used
	Majority shareholding	Widely used	Widely used	Rarely used
Informational level	Minority holding	Normally used	Widely used	Widely used
	High	Widely used	Widely used	Rarely used
	Normal	Widely used	Normally used	Normally used
Leader style	Low	Widely used	Normally used	Normally used
	Centralized type	Widely used	Normally used	Normally used
	Democratic style	Widely used	Normally used	Rarely used
Regional distribution of subsidiary	Club type	Rarely used	Widely used	Normally used
	Concentrated	Rarely used	Normally used	Widely used
	Widely spread	Widely used	Normally used	Rarely used
	Globalized	Rarely used	Normally used	Widely used
		Rarely used	Normally used	Widely used

(continued)

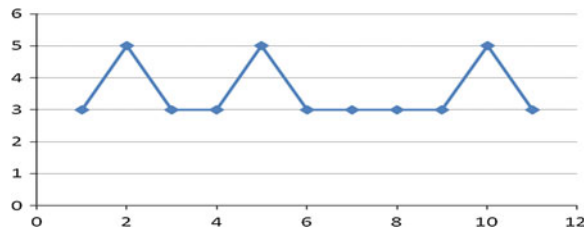
Table 59.3 (continued)

Selection factors	Eigenvalue	Controlling pattern		
		Operational	Strategic	Financial
Status and important degree of subsidiary	Very important	Widely used	Normally used	Rarely used
	Normal important	Normally used	Widely used	Rarely used
	Unimportant	Rarely used	Normally used	Widely used
Responsibility center	Cost center	Widely used	Normally used	Rarely used
	Profit center	Rarely used	Widely used	Normally used
	Invest center	Rarely used	Normally used	Widely used
Life cycle of subsidiaries	Beginning	Widely used	Normally used	Normally used
	Developing	Widely used	Widely used	Normally used
	Developed	Normally used	Widely used	Widely used
Culture differences between parents and subsidiaries	A little	Widely used	Normally used	Rarely used
	Normal	Normally used	Widely used	Normally used
	A lot	Rarely used	Normally used	Widely used

**Fig. 1** Ideal points under operational control model



**Fig. 2** Ideal points under financial control model



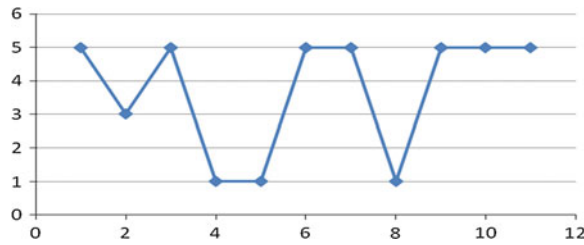
In this article, the author has scored each level of the influence factors using the Likert scale, then combined the matching status between the control pattern and factors in chart 3 and finally find the ideal points, which is shown in Figs. 59.1, 59.2 and 59.3.

59.4 Selection of Management Control Model

According to the degree of different influential factors, different weightiness are needed to give, this paper introduces the Mahalanobis-Taguchi System, (namely the MTS) to solve the problem (Zheng 2003; Zeng and Zeng 2006; Taguchi 1994). MTS is a kind of comprehensive method using in Markovian Space in 2D (or more) space to determine the benchmark points (origin) and unit of measurement.

Now set the dimension of data (eigenvector) as  $p$ , size of the sample as  $n$ , original data matrix as  $X = (x_{ij})_{p \times n}$ :

**Fig. 3** Ideal points under strategic control model



$$x_{ij} = \frac{1}{\sigma_i} (x_{ij} - \mu_i) \quad (59.1)$$

Then calculate the correlation matrix  $R$  of index data series after standardization,

$$R = \begin{bmatrix} 1 & r_{12} & \dots & r_{1k} \\ r_{21} & 1 & \dots & r_{2k} \\ \dots & \dots & \dots & \dots \\ r_{k1} & r_{k2} & \dots & 1 \end{bmatrix} \quad (59.2)$$

In the quotation above:  $r_{ij} = (\sum x_{ij} \times x_{ji})/n, i, j = 1, 2, \dots, k$

The index data of the know system  $k$  is  $X_1, X_2, \dots, X_k$ , after standardization, it is  $x_1, x_2, \dots, x_k$ , define the Mahalanobis Distance as:

$$D^2 = \frac{1}{k} X' R^{-1} X = \frac{1}{k} \sum_{i=1}^k \sum_{j=1}^k a_{ij} x_i x_j \quad (59.3)$$

and  $A = (a_{ij}) = R^{-1}$

First of all, calculate the Mahalanobis Distance  $M_x$  of the System under test using the survey data in realization of the influential factors. Secondly, compared it with all the ideal points, that is, origin  $M_{oi}$ , and calculate the relative comparison function  $f_{mi} = (M_x - M_{oi})/M_{oi}$ . Finally, according to the proximity principle in pattern recognition, the minimum of  $f_{mi}$  ( $|f_{mi}| = \min$ ) can be confirmed as the most suitable model.

## 59.5 Conclusions

This paper has studied the group enterprise management control model in three different patterns-the operation controls, strategic controls and financial controls-according to the management depth of subsidiaries. Although differs in some parts, these three kind of control models are all the reactions about the enterprise's strategy and the internal and external environment. Therefore, establishing ideal points for various patterns in the environment is an important starting point.

Different factors have different effects to the construction of group enterprise control models. The external environmental uncertainty, group type, group strategy can forma long-term stable influential mechanism; on the other hand, holding degree, the informational level and leadership style are strongly and easily to form short-term changes, so changes of weightiness in the distance measure is taken into consideration. Therefore, Mahalanobis-Taguchi System is introduced to measure the distance in space.

With the own regional distribution, importance, responsibility center, life cycle and cultural differences from parents companies, subsidiaries had decided the

special characteristics of each control object. Therefore, the leading group control model can be founded according to the group's strategy, the external environment, the group type, the holding degree and the information level established. In relation to specific subsidiaries, detailed control degree can be determined by the related affecting factors, some special affiliates can even use patterns totally different from the whole group. Thus, a hybrid control model which can be used not only to integrate the whole group but also to make the subsidiaries get fully adapted to the surrounding environment can be finally built.

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# Chapter 60

## The Evaluation of Employee on Enterprise Restructuring in China

Ming-ming Peng and Han-min Liu

**Abstract** The paper sets out to study the influence of restructuring on various enterprises in relation to the employee's understanding of restructuring. Based on data from the Chinese General Social Survey the article selects the personnel information about the employees working in the state-owned or collective enterprises who experienced the owner-ship reform from state ownership to private owner-ship. Factors such as the transformation of enterprise ownership, enterprises performance before restructuring, the employee's familiarity and involvement during the process of restructuring and the changes of their benefits are also presented. It is found that public employee's under-standing would be improved when the employee becomes involved and becomes a part of the public ownership after restructuring, as well as seeing the improvement of welfare benefits. The employee's working motivation and passion will also play an active role in the employee's participation in restructuring.

**Keywords** Effects of ownership reform • Employee involvement • Enterprise restructuring • Reform performance

### 60.1 Introduction

The reform and restructuring of the state-owned or collective enterprises in the 1990s is the most important economic phenomena in China in the past 2 decades. At present, the restructuring for the local small and medium-sized state-owned

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enterprises has been completed. Basically this has happened under the guidance of large enterprises who have adopted more flexible policies towards small companies during privatization. However, the restructuring of the large and medium-sized enterprises are still at a crucial stage. Recently, the report “China 2030: Building a Modern, Harmonious, and Creative High-Income Society” has been published by the World Bank and China State Council Development Research Center.

The recommendation about enhancing the reform for state enterprises in this book has attracted a great deal of controversy. With the reform of state enterprises, some group conflicts such as “Tong Gang Event” have attracted public concern. Hence the conflicts arising during the reform for state-owned enterprises have been listed as the key issues closely related to people’s livelihood and social construction in China national “12th Five-Year Plan”.

Enterprise restructuring brings great changes in the structures and organizational forms. Whether the employee is involved in the whole process and is respected as the stakeholder, whether their active participation has some significant impact on enterprise performance and whether the changes of work and benefits for the employee affect the employees’ evaluation for the restructuring is the focus of this paper. These questions will be answered in this article to provide a useful reference for the enterprise reform. The paper is based on the relevant literature review. It takes the employee’s perspective and other relevant factors into consideration, measuring their evaluation of the reform performance and recognition. Data from the micro survey on the reform of state-owned or collective enterprises were used.

## 60.2 Literature Review

Organization theory treats the organization as a whole unit and focuses on its constitute department and members (mainly the middle and senior management group), as well as the differences among the structures and actions (Daft 2011). The complexity theory which brings a new perspective to study the organization (especially the business organization) puts the organization in an open, dynamic complex system, focusing on the interaction, adaptation and co-evolution between organizations as well as on the organization and environment (Aguilera et al. 2008).

The organization (especially the large one) should regard the process as a complex adaptive system. The speed with which the organization adapts to the environment is mostly dependent on the internal communication (Cremer et al. 2007). So for the organization to reform or redesign it must consider not only the structure, but also the social, cultural, technical, political, economic and other relevant conditions (Mitleton-Kelly 2005). The New Institutionalism argues that the organizational structure can be determined by institutional environment in some extent.

The interaction between enterprise and environment is reflected not only on the factors such as technology and raw material, but also on the concept of corporate

culture, symbol and belief, therefore, the cognition on legitimacy from the organization member plays a key role (Suchman 1995). For the organization, whether it is to establish the self-leadership team or the organic management process and system, or the participatory culture, the efforts of sharing rights through the whole organization have been widely attempted during the process. Empowerment, i.e. to access the employee to rights, freedom and information, so as to make decisions and have full participation (Hollander and Offermann 1990), is not only an indispensable strategic measure to improve the products and services, but also the imitation of the others. Meanwhile, it's the basis to build a learning organization with outstanding performance ability, making the enterprises to maintain sustainable competitive advantages (Bowen and Lawler 1995). The reform and restructuring of state-owned enterprises (SOEs) in China serves as a typical experience for organizational change. According to the new organization theory, the restructuring and reconstruction of the enterprises should adapt to the environmental changes as well as make wise use of the working environment, paying enough attention to the employee's participation and assessment in order to improve the reform performance. Many scholars study the restructuring performance of the reform of the state-owned and collective enterprises from the macro and micro economic perspective.

Lu and Liu (2005) employ micro data to analyze the relationship between the reform mode and the firm performance. The finding shows that privatized firms have higher efficiency than those of public firms. Different types of privatization and their resulting ownership structures is an important determining factor in the firm performance. Specifically, the equity structure of operators holding majority of stocks is the most efficient, while equal division among the insider workers is the least. Liu and Li (2005) conducted a survey on the impacts of reform on enterprise performance in China on the basis of the 451 sample firms in competitive industries, the result indicates that the state ownership has significant negative impacts on enterprise performance while the non-state ownership has the significant positive relations on performance, of which the private ownership plays most significant roles of promoting enterprise performance. The research completed by Song and Yao (2005) proves that restructuring has a significantly positive impact on corporate profit, however, it has a weak or non-significant impact on unit cost and labor productivity. Jefferson and Su (2006) find that the conversion of SOEs to shareholding enterprises contributes to overall increases in both current productivity and innovative effort. Bai et al. (2006) combine the economic benefit of the firm with its social effect, it is found that the ownership reform improves firm performance mainly through reducing managerial expenses, and the social costs of ownership reform are limited compared to international experiences. Liu (2006) studies the business performance of state-holding listed company after the ownership reform, and the research shows that in addition to profitability, all performance indicators are improved significantly when the stockholding is purchased by the internal manager (including the staff). On the other hand, when the stock-holding is purchased by private enterprises, most of the performance indicators are improved significantly, this improvement also is partly

due to the transformation of main businesses and downsizing. Deng et al. (2007) argue how different reorganization modes affect controlling share-holder’s embezzlement of listed company’s funds after their post-IPO. The result reveals that compared to those restructured companies controlling shareholder group of incomplete reorganization has higher tendency to have embezzlement problem, resulting in significantly worse performance. Yang et al. (2009) employ the data from nation-wide collective enterprises to analyze the impact of the change from government control on the enterprise performance, employee welfare and tax. It is confirmed that the government control within the collective enterprises can reduce the production cost while bringing higher management and financial costs. It is also proved that through re-structuring and withdrawing the government control from the enterprise, the performance of the companies would be improved significantly.

Researches on the restructuring of state-owned enterprises conducted by the scholars mainly focus on the influence of the reform on enterprise performance and ignore the employee’s situation. Although some studies involve the selection of restructuring mode and the impact of reform on the labor market, factors such as the environment as well as the employee participation were ignored. Therefore, this article employs the theory of new organization to study the enterprise restructuring from the perspective of employee.

60.3 Data and Model Selection

Data from Chinese General Social Survey (CGSS) in 2006 co-host by Sociology Department of Renmin University of China and Hong Kong University are used in this article. Altogether 527 full-time staff under the age of 60 (including 60) who once experienced the ownership reform and now work in the state-owned or collective enterprises were selected by a systematic random sampling. The selected 527 staff from 28 provinces and cities nationwide is representative. Table 60.1 is about the owner-ship structure after the enterprise reform and restructuring.

As is shown in Table 60.1, through the restructuring of state-owned or collective enterprises, the SOEs account for the largest proportion of 41.37 %, followed by the external privatization of the enterprise, which takes 28.08 %.

Table 60.1 The ownership structure after reform and restructuring

Type of owner-ship	SOE	Collective holding	Foreign-owned	Internal privatization	External Privatization
Number of people	218	102	5	54	148
Percent	41.37	19.35	0.95	10.25	28.08

Meanwhile, the collective and collective holding achieves 19.35 %. All in all, after restructuring of the state-owned or collective enterprises, the proportion of state ownership has exceeded 60 %.

### 60.3.1 Employee Evaluation on Restructuring

As stakeholder, the employee evaluation on the restructuring can present the economic and social benefits brought from the changes. Table 60.2 offers information about enterprise performance before restructuring, the employee assessment and familiarity of the restructuring, involvement of the reform process. According to the data, the ratio of reform satisfaction is not high, for people with the highest satisfaction merely account for 1.5 %, and those with higher satisfaction account for 17.3 %, while 36.6 % of people enjoy a general satisfaction, 21.3 % has lower satisfaction and 23.3 % have lowest satisfaction.

Table 60.2 shows clearly that 39 % of people hold that the enterprise performance before restructuring is good or very good, while 20.1 % of people believe it is poor or very poor. It is believed that the poor performance is not the cause for restructuring. It has also proved the argument put forward by the institutional school in organization theory, namely. The structure change of the organization is mainly a response to the social and cultural stress rather than the demand for business, competition or efficiency. Therefore, the key force that determines the organization form is the social adaptability and legitimacy rather than the economic competition.

As for demanding, the institutional stress goes against the rational mode of organization. Hence it is believed that the changing economic environment and government policies have great influence on the enterprise reform.

**Table 60.2** The employee assessment and familiarity, involvement of the reform process

Satisfaction for reform		Highest	Higher	General	Lower	Lowest
Former performance	Number	8	91	193	112	123
	Percent	1.5	17.3	36.6	21.3	23.3
	Best	Better	General	Poorer	Poorest	
	Number	63	143	215	86	20
Familiarity with reform	Percent	11.9	27.1	40.9	16.2	3.9
	Most	More	General	Not very	Unfamiliar	
	Number	11	66	128	136	186
	Percent	2.1	12.5	24.3	25.8	35.3
Involvement for reform	Full	Much	General	Less	Never	
	Number	11	26	69	62	359
	Percent	2.1	4.9	13.1	11.8	68.1
	Assignment	5	4	3	2	1

When it comes to familiarity with the reform method or procedure, only 14.6 % of the participants show it is what they are quite familiar with, on the contrary, the percentage of those who believe they are unfamiliar with or know nothing about it reaches 61 %. It can be concluded that most workers are not quite familiar with the method or procedure of restructuring, so is the involvement of restructuring implement. It can be seen that the employee involvement in enterprise restructuring is relatively low. Actually most even don't enjoy the right to know.

Whether factors such as the ownership change, the former performance, the employee's familiarity and their involvement in the restructuring will affect the employee's evaluation of the reform need further empirical test.

To handle this problem, construct econometric models, OLS and rank-based model (Oprobit and Ologit) are employed to make empirical analysis. Least square method is used to do regression analysis among variables so as to test the correlation. Based on the analysis, the model is built as follows:

$$E_i = f(prop_i, perf_i, fami_i, part_i) \quad (60.1)$$

In this formula,  $E_i$  is the dependent variable, which refers to employee  $i$ 's evaluation of the restructuring or his/her satisfaction to the enterprise reform. The  $prop_i$ ,  $perf_i$ ,  $fami_i$  and  $part_i$  are independent variables, of which  $prop_i$  presents the type of ownership after reform that can be divided into state-owned or state-controlled, collective or collective holding, foreign-owned, internal privatization and external privatization;  $perf_i$  indicates the enterprise performance before restructuring;  $fami_i$  refers to the degree of the employee familiarity with the reform; while  $part_i$  shows the employee's involvement in the reform, among which the  $prop_i$  is a dummy variable based on external privatization,  $perf_i$ ,  $fami_i$  and  $part_i$  are continuous variables. The restructuring assessment is divided into 5 levels, that is, the highest satisfaction, higher satisfaction, general satisfaction, lower satisfaction, and the lowest satisfaction, whose assignment is 1, 2, 3, 4, 5 respectively, the highest assignment has the lowest satisfaction degree. Table 60.5 is the result of regression.

### 60.3.2 The Changes of Personal Circumstances of the Employee

In which way the personal job and welfare change after restructuring and whether these changes affect the employee's evaluation on the reform is what will be discussed later. In order to make further discussion about the employee assessment, we select the changes in working intensity, wage, welfare, job promotion, working motivation, working standard constrains and working passion, all together 7 variables to conduct statistical analysis, the results are shown in Table 60.3. It can be seen that the employee's working standard constraints and intensity have increased significantly, on the contrary, more than 35 % participants hold that their

**Table 60.3** The changes of personal circumstances after restructuring (%)

	Increased	Not changed	Reduced
Working intensity	32.3	42.3	25.4
Wage	29.6	34.9	34.9
Welfare	14.8	45.0	40.2
Job promotion	5.3	64.9	29.8
Working motivation	25.4	45.2	29.4
Working standard constrains	37.8	36.5	25.6
Working passion	16.7	75.1	18.2

income and welfare have decreased significantly. The proportion of position drop is near to 30 % while the pro-portion of working passion also drops obviously.

In the regression, 7 variables concerning personal in-formation are set dummy variable. Least square method and rank-based model are used to conduct comprehensive measurement, and the model is as follows:

$$E_i = f(hard_i, wage_i, welf_i, prom_i, moti_i, norm_i, pasi_i) \tag{60.2}$$

In this model,  $hard_i$ ,  $wage_i$ ,  $welf_i$ ,  $prom_i$ ,  $moti_i$ ,  $norm_i$ , and  $pasi_i$  stand for the working intensity, the income of employee, the welfare, the job promotion, the working motivation, the working standard constrains, the working passion respectively. The dummy variables are set as follows: if working intensity is increased = 1, otherwise = 0;

if the wage is reduced = 1, otherwise = 0; if the welfare is reduced = 1, otherwise = 0; if job promotion is reduced = 1, otherwise e = 0; if working motivation is reduced = 1, otherwise = 0; if the working standard constrains is increased = 1, otherwise = 0; if the working passion is reduced = 1, otherwise = 0. Least square method and rank-based model are employed to conduct regression, the empirical results are shown in Table 60.4.

60.4 Result of Empirical Test

The statistical analysis above shows that the satisfaction of employee to the enterprise reform is not high. And about 40 % of the participants believe that the former performance is good or very good. The percentage of the participant familiarity with the reform and the involvement in restructuring is also relatively low. What’s more, after the reform the working intensity and standard constrains have been improved significantly, while the wage and welfare are decreased dramatically. Whether all of these factors can affect the employee assessment of the enterprise reform needs further verification.

**Table 60.4** The influences from the changes of individual circumstances

Dependent variables	OLS	Oprobit	Ologit
Intercept	2.997*** (45.262)	—	—
Working intensity	0.059 (0.686)	0.073 (0.664)	0.091 (0.485)
Wage	0.281** (2.205)	0.336** (2.076)	0.616** (2.234)
Welfare	0.754*** (6.238)	0.905*** (5.843)	1.568*** (5.810)
Job promotion	−0.042 (−0.309)	−0.069 (−0.397)	−0.196 (−0.648)
Working motivation	0.322** (2.363)	0.414** (2.374)	0.757*** (2.572)
Working standards	−0.185** (−2.111)	−0.237** (−2.129)	−0.391** (−2.04)
Working passion	0.244** (2.104)	0.334** (2.180)	0.706*** (2.707)
F	43.825	—	—
Adjust- $R^2$	0.363	—	—
$\chi^2$		230.142	238.523
Log likelihood	−662.843	−624.550	−620.360

\*\*, \*\*\* denotes statistical significance at the 5, 1% level.

#### ***60.4.1 The Impact from Employee Involvement on the Restructuring Evaluation***

In order to test the influence of employee assessment on restructuring performance, factors as the ownership type, former performance, staff familiarity and involvement are set as the independent variables (see Table 60.5). Meantime, relevant assignment and meaning of variables in this model are also taken into account in the analysis, the results show as follows:

1. The state ownership can improve the employee approval of the reform performance in comparison to external privatization. Specifically, the regression coefficients of OLS show that the state-owned or state-controlled enterprises can improve the satisfaction degree to 42.8 % compared to the external privatization. The fact that the Oprobit regression coefficient is negative also proves the same phenomenon. The coefficient of OLS regression also proves that the ownership of collective or group holding enterprises can also raise the employee satisfaction by 31.3 %; the Oprobit regression coefficient also indicates the same effect.
2. The enterprise performance before restructuring and the employee familiarity with the reform can affect the evaluation of the reform effect from the staff. The OLS regression coefficient of the former performance is 0.099, indicating the negative correlation between the former performance and the employee

**Table 60.5** Factors that impact the evaluation of the reform effect

Dependent variables		OLS	Oprobit	Ologit
Intercept		3.991*** (30.522)	—	—
Type of ownership	State-owned or state-controlled	−0.428*** (−3.971)	−0.450*** (−3.917)	−0.787 (−4.005)
	Collective or collective-holding	−0.313*** (−2.631)	−0.322*** (−2.556)	−0.559 (−2.594)
	Foreign-owned	−0.325 (−0.714)	−0.347 (−0.710)	−0.713 (−0.888)
	Internal privatization	−0.028 (−0.220)	−0.025 (−0.185)	−0.015 (−0.062)
Former performance		0.099** (3.015)	0.101*** (2.866)	0.188 (3.102)
Familiarity in the reform		−0.248*** (−4.897)	−0.263*** (−4.837)	−0.476 (−4.915)
Involvement in the reform		−0.044 (−0.809)	−0.042 (−0.725)	−0.053 (−0.516)
F		11.301	—	—
Adjust- $R^2$		0.121	—	—
$\chi^2$		—	72.293	76.645
Log likelihood		−747.833	−703.475	−739.621

\*\*, \*\*\* denotes statistical significance at the 5, 1% level.

assessment. The fact that the Oprobit regression coefficient is 0.101 also proves that the better the former performance, the lower the employee assessment. On the contrary, the results of the employee familiarity, the regression coefficient of OLS and Oprobit are all negative and significant, and it proves a positive correlation between employee familiarity and their approval.

- While the employee involvement in the reform can benefit the evaluation, the regression coefficient is not significant. This may have something to do with the low proportion of employee participation, only 20.1 % participant are involved in the reform process more or less, and 68 % hold that they have no involvement at all. This also proves that the “right to know” is more important than the real participation in the reform.

#### ***60.4.2 The Impact of the Changes in Individual Circumstances on the Restructuring Assessment***

After the completion of restructuring, the impact of the changes of individual circumstances such as wage, welfare, working motivation, working standards on the restructuring satisfaction are tested and the results are shown as follows:

- The improvements on wage and welfare have a positive correlation with the employee evaluation and help gain recognition from the employee. For

example, the OLS regression coefficient of wage is 0.281 and significant. The assignment proves that reducing the wage can increase the dissatisfaction by 28.1 %. The fact that the regression coefficients of Oprobit and OLogit are negative also shows that reducing the wage would drop the probability of employee's recognition of the reform.

2. The enhancements on working motivation and passion have positive influences on the evaluation of restructuring. For example, the OLS regression coefficient is 0.322, and significant, which proves that the drop of work motivation has a negative effect on assessment. The regression of Oprobit and Ologit also show the same result.
3. Higher working standards, higher working requirement and job constrains have positive impacts on the assessment. As for the work standards, the OLS regression coefficient is  $-0.185$  and significant which show that the improvement of work standards after restructuring can reduce the employee dissatisfaction. The regression coefficients of Oprobit and Ologit are negative and also show the same meaning.

In addition, the working intensity and job promotion also have some influences on the assessment, while the coefficients are not significant; suggesting that they are not the main factors that affect the employee's evaluation.

## 60.5 Conclusion

The article discusses problems existing in the process of enterprise restructuring, and it attaches great importance to respecting the employee's "right to know". Based on organization theory, the paper presents the interactions between organization and the environment and conducts a detailed analysis of employee involvement during the restructuring and the changes in individual circumstances after reform. Data from Chinese General Social Survey is used. It can be concluded that the restructuring of some state-owned enterprises is largely a response to the change in their social and cultural environment, with the aim to improve their adaptability or legitimacy rather than a reaction to the pressure from the competition and the demand for performance improvement.

It is then suggested that the employee involvement should be emphasized and the policy of empowerment should be implemented during the process of reform or governance for the SOEs in China. Meanwhile, the labor relationship is of great importance in restructuring, hence the disputes should be handled properly. Moreover, the employee's basic "right to know" as well as beneficial rights need to be respected to obtain their understanding and support. Only in this way will the transition be achieved smoothly. In a word, when it comes to dealing with restructuring, economic effects shouldn't be the only measurement. Management, sociology and psychology are all have to be taken into consideration for the well-being of the whole society.

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# Chapter 61

## The Research on the Relationship Between Servant Leadership and Knowledge Team Performance

Ya-bo Li and Na-na Han

**Abstract** Servant leadership, different from the traditional leadership style, has attracted the extensive attention since its appearance. It unified leadership with service, and better reflected the leadership philosophy. Knowledge team, as the main organization in modern enterprise, was also focused by researches. However, by reviewing the literature, we found that the research on the relationship between the servant leadership and the knowledge team performance was obviously insufficient. On the basis of the questionnaire, we analyzed the inherent relationship between servant leadership and knowledge team performance. The results showed that servant leadership could boost knowledge staff job satisfaction, thus contributing to the improvement of the knowledge team performance; knowledge employee satisfaction played an intermediary role between servant leadership and knowledge team performance.

**Keywords** Knowledge worker job satisfaction • Knowledge team performance • Servant leadership • Structure equation model

### 61.1 Introduction

Leadership is the critical factor to the success of all economic, political and organizational systems (Barrow 1977). Leadership theory attempts to explain the complexity of the leadership and its consequences. Great leaders create a vision for an organization, articulate the vision to the followers, build a shared vision, craft a path to achieve the vision and guide their organizations into new directions (Banutu-Gomez and Banutu-Gomez 2007). Servant leadership has being attracted

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attentions since Greenleaf, who first coined the word (Greenleaf 1991). The core idea of servant leadership is to serve rather than lead others, on the basis of trust and service, and then it can achieve its betterment. Concerning the effectiveness of the leadership, it can be measured by the follows' motivation, action and output.

Knowledge workers, with modern scientific knowledge and skills, can provide dynamic support for enterprise development. It is an important intellectual capital and the company's core competitiveness in the era of knowledge economy. With the rising costs of increased complexity and development of the modern knowledge, it is necessary for knowledge workers to work together. Knowledge team, combined by knowledge workers, has been widely used in various types of organizations and gradually become the main form of enhancing technical innovation and the competitiveness of organizations.

Although, servant leadership and knowledge team attract much attentions, it still remains doubt that if the servant leadership can promote the performance of the knowledge team. Reviewing the literature, it still can't be proved, so we try to analysis the problem by empirical analysis. Hoping the results can provide the theoretical support for the management of organizations.

## 61.2 Methodology

Servant leader, transcending his own interest, is striving to meet the physiological, psychological and emotional needs of followers. Compared with other leadership, the servant leadership is built on the basis of trust and service, paying more attention to the communication between leaders and employees. And this atmosphere just meets the independent needs of knowledge workers. Thus, employees have a strong sense of belonging, resulting in a higher level of personal performance and team performance. The essence of servant leadership is service, all these leadership behaviors are pointed to followers (Liden et al. 2008).

However, different scholars have different views about the construct of servant leadership, this paper agrees with Wang (2010), who proposed six dimensions of servant leadership, that is, complying with ethical requirements, creating value for the community, authorization, conceptual skills, subordinate the first place and emotional comfort (Wang 2010).

### 61.2.1 *Servant Leadership and Knowledge Team Performance*

Complying with professional ethics is a first quality, Greenleaf pointed that servant leader set an example for employees and then won the employees a sense of trust (Greenleaf 1991). If a leader complied with professional ethics, then the team

members who would feel some sense of trust were likely to use their talents more effectively and improve the whole team performance. Create value for the community was not only attach importance to the employees within the organization, but also to encourage internal staff for other community members (Ling 2007). In this respect, the relatively harmonious social environment, team members also would invest more effort into the team, resulting in higher performance. The authorization was to grant employees appropriate autonomy of work (Ling and Wang 2010). Knowledge workers have the professional knowledge and skills, differing from the previous manual workers, so they were more inclined to the pursuit of efficiency and work autonomy. Therefore, the servant leaders needed to give up some control of work, giving full freedom to their followers to complete the task. The entire team can be more flexible to response environmental challenges, this helped improve the knowledge team performance. Conceptual skills, servant leader with certain management expertise, can solve the complex issues more comprehensively and effectively, so as to provide for their own team the right direction, to create the better conditions needed for team development and team performance. To subordinate the first place was to put employees' interests above their own, and to share with others the power and status as a leader. Different from the traditional leadership, servant leadership was an inverted triangle, a leader in the bottom of the pyramid. To complete the task, the team members in this approach would produce self-esteem, good incentives, but also be conducive to the completion of team performance. Whether the followers are to be healthier, more intelligent, more independent, more willing to be leaded is the best way to judge the success of a servant leader. When their employees faced living or working problems, the leader provided its emotional comfort and help employees betterment. In the process of personal growth of team members, the whole team produces better team performance naturally. Therefore, based on the above analysis on servant leadership, we proposed the following assumptions:

**H<sub>1</sub>: Servant leadership has significantly positive effects on performance of the knowledge team.**

### ***61.2.2 Servant Leadership and Knowledge Worker Satisfaction***

Peter (1959) proposed the concept of "knowledge workers" (Peter 1999), it was predicted that knowledge workers are the core competitive element of the knowledge economy era, a key factor of enterprise survival and development. Today, knowledge workers, in fact, has been extended to most of the white-collar workers (Zhang and Peng 2001). Hoppock (1935) after the summary of literature proposed the concept of job satisfaction for the first time formally, he believed that job satisfaction was an emotional reaction that came from feelings of work experience. As an important aspect of human resource management, job

satisfaction has been the focus of research (Duan 2007). A large number of scholars begin to study the effect of leadership on job satisfaction from a variety of different leadership. Wu and Yao (2009), on the basis of 386 questionnaires of eight enterprises, through statistical analysis and hypothesis testing proved that the relationship between servant leadership and emotional commitment of staff, utilitarian commitment, job satisfaction were positive. By stepwise regression, Wang (2010) also confirmed that a servant leadership had a strong leadership effectiveness, had a significant impact on employee satisfaction. Shen (2010) thought the comparative study of the servant leadership and transformational leadership found that transformational leadership made a better prediction than the servant leadership on the organization's commitment, but servant leadership had stronger interpretation of job satisfaction and task performance. Zhang (2010) surveyed 496 employees of 27 enterprises, compared servant leadership and paternalistic leadership. The empirical research showed that the atmosphere in servant leadership than the paternalistic leadership can better stimulate the innovative behavior of employees, improved employee higher job performance. Based on existing research, we proposed,

**H<sub>2</sub>: Servant leadership has significantly positive effects on knowledge employee satisfaction.**

### ***61.2.3 Knowledge Worker Job Satisfaction and Knowledge Team Performance***

Knowledge team performance was the key concern for the leader, and also was the focus of the entire organization. Cctzzo and Shca put forward "input-process-output" model for the team performance, including team communication, team conflict, team leaders and team learning in the process (Wang 1999). From the system theory opinion, knowledge team-work didn't not always produce the " $1 + 1 \geq 2$ " ideal state, because knowledge team performance depended on the combined action of these factors and was subject to some short boards. Therefore, the team leader was so vital factor in knowledge team performance that could not be ignored. If the team leader wasn't suitable for the team, then the team performance wouldn't increase but decrease because of the contradiction. Servant leadership focused on communication, put emphasis on staff and provided services for staff development, acting as a team communicator with the external environment, which would create a good team atmosphere to the team, so that it can continue to communicate and to learn. This will increase knowledge team more satisfactory. Internal communication can make the team operation more effective, thus improved the performance of knowledge team (Ni and Lin 2011). Based on the above study, we put forward the following assumptions:

**H<sub>3</sub>: The job satisfaction of knowledge workers has a significant positive effect on knowledge team performance.**

### ***61.2.4 Knowledge Worker Job Satisfaction Plays an Intermediary Role***

Servant leadership will create a good communicative and collaborative environment for knowledge workers, which will not only increase knowledge worker job satisfaction and make a good communication platform and harmonious atmosphere for the entire team, all these are able to promote the improvement of team performance (Gu and Li 2009). On the basis of three assumptions, we know that knowledge employee satisfaction plays an intermediary role on the impact of servant leadership and knowledge team performance.

**H<sub>4</sub>: knowledge employee satisfaction plays an intermediary role in the impact of servant leadership on knowledge team performance.**

## **61.3 Results**

### ***61.3.1 Data Collection and Samples***

In this study, by reading the relevant literature and requirement on the research, we prepared the questionnaire. Likert five scale was taken in the questionnaire, 1–5 representing “strongly disagree, do not agree, neutral, agree, strongly agree” respectively. The questionnaires consist of two parts, servant leadership and knowledge worker satisfaction questionnaire and the performance questionnaire. And the servant leadership questionnaire, employee satisfaction questionnaire completed by team members; it was the staff that evaluated the leadership, determining if the behaviors represent by servant leaders were servant leadership. Knowledge team performance scale was completed by the leader, who evaluated the overall team performance. Through home interviews and web-based survey questionnaire, we issued the questionnaire to the academic community in universities, corporate R & D team, the leadership team of government agencies, and MBA students, which received a total of servant leadership questionnaire and knowledge worker satisfaction (team members only) 213, 194 valid questionnaires, effective recovery rate was 91.08 %; 62 knowledge team performance questionnaire, 58 valid questionnaires, so the valid responsive rate was 93.55 %.

### ***61.3.2 Measurement for Variables***

Reference to previous scholars, we measured the servant leadership, knowledge worker satisfaction and knowledge team performance measurement. We prepared a questionnaire on servant leadership measurement using Liden et al. (2008), taking into account Wang (2010) research on servant leadership scale. The questionnaire

included a total of 20 questions, each question using a Likert 5-point scale method. Taking the method of Exploratory Factor Analysis (EFA), we got the conclusion that complying with ethical requirements (three issues), to create value for the community (three issues), authorization (three questions), conceptual skills (three questions), the interests of subordinate the first (five questions) and emotional comfort (three issues) all these six measuring dimensions of servant leadership.

The scale of Knowledge worker job satisfaction and knowledge team performance was prepared according to Motowidlo and Scotter (1994), modified from the circumstances of the case according to this study. Including the team task completion (2 items), team member satisfaction (six items), the final questionnaire was made of 28 items.

### ***61.3.3 Reliability and Validity Analysis***

First we use the SPSS17.0 to test the reliability and validity of the scale. Reliability refers to the consistency of results. In this paper, we used the Cronbach's coefficient to test the reliability on servant leadership, knowledge employee job satisfaction and knowledge team performance questionnaire. Validity referred to the scale to accurately measure the extent of the behavior, the main validity were content validity and construct validity, and the construct validity was measured by factor analysis.

The overall reliability on servant leadership was 0.927, and its six dimensions are professional ethics, community interests, empowerment, and conceptual skills, subordinate interests first, emotional comfort. Their  $\alpha$  values are respectively 0.787, 0.730, 0.635, 0.794, 0.874, 0.848. Although the empowerment was less than 0.7, all the other had good reliability. Knowledge worker job satisfaction value of  $\alpha$  was 0.861, knowledge team performance value of  $\alpha$  was 0.820, both were greater than 0.7, indicating that the measurement with high reliability.

Through exploratory factor analysis on servant leadership, servant leadership, a total of 20 items, which KMO value was 0.918, generally the KMO value was the greater the more suitable for EFA. These 20 items was analyses by SPSS17.0 of principal component analysis, orthogonal rotation extracted six factors, which employees priority factor 2 was too small that was deleted. After this, we renewed the principal component analysis and oblique rotation, the other factor loadings were above 0.55, the cumulative explained variance increased to 71.342 %. Through the above analysis, the scale had good reliability and validity for further research.

### ***61.3.4 Analysis and Evaluation for SEM***

This paper established the relationship between servant leadership, knowledge worker satisfactory and knowledge team performance by AMOS 18.0. The

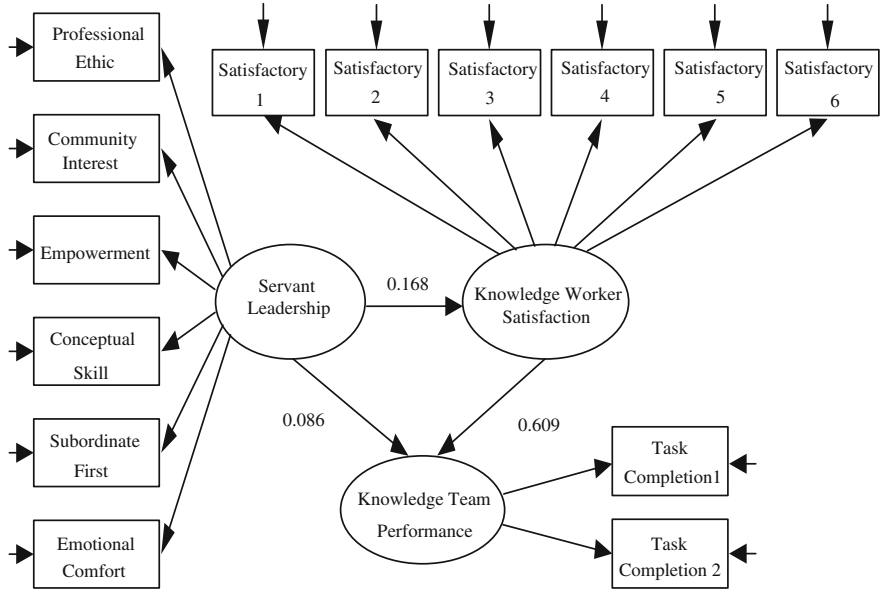


Fig. 61.1 The path results for the hypotheses

structure equation model (SEM) of servant leadership and knowledge team performance was showed as following Fig. 61.1.

After the analysis we concluded the path coefficient was significant, C.R. > 1.96, P < 0.001. These results could support our hypotheses on some certain degree, so we can test our model from the absolutely fitting, simplified fitting and increased value fitting three aspects (Table 61.1).

From the index above, we knew that the model was good and could support the hypotheses put at the beginning of the paper.

Table 61.1 The evaluation for the SEM

Index		Standard	Real value	Result
Absolute fitting	$\chi^2/\text{freedom}$	<3	1.235	YES
	GFI	>0.9	0.942	YES
	RMR	<0.05	0.091	NO
	RMSEA	<0.05	0.035	YES
Simplified fitting	PNFI	>0.5	0.744	YES
	PGFI	>0.5	0.646	YES
	NFI	>0.9	0.94	YES
Increased value fitting	RFI	>0.9	0.924	YES
	CFI	>0.9	0.988	YES

## 61.4 Discussion

The effect of servant leadership on the knowledge team performance was 0.086,  $C.R. = 3.853$ ,  $P < 0.001$ , the coefficient is significant supporting the hypothesis. Therefore, servant leadership plays a role in promoting knowledge team performance. The empirical results show that servant leadership sees the subordinate as the servant objection, pays attention to the development needs of subordinates, so that leaders can make the entire knowledge do their utmost to the work without paying much attention to the other thing out of work. The same time, servant leadership not only provides the requirement for the knowledge team members, but also the necessary conditions for subordinates' further growth. So knowledge team members will have higher satisfaction, and work efficiency and performance.

The path graph shows that the influence coefficient between Servant leadership and knowledge workers job satisfaction is 0.168,  $CR = 6.557$ ,  $P < 0.001$ , it is significant, assuming the establishment of hypothesis two. The empirical conclusions explain that servant leaders not only provide employees the necessary conditions to complete the task, but also provide good conditions for staff further development. Besides, knowledge workers master science and technology, differing from previous employees, such as mobility, higher self-awareness, focusing on the realization of self-worth. Therefore, in the modern enterprise management, the servant leadership do provide their employees with better conditions and management methods, and also better able to promote the development of knowledge employees. The impact coefficient of knowledge employee satisfaction on knowledge team performance is 0.609,  $CR = 7.354$ ,  $P < 0.001$ , achieving significant, proving the hypothesis 3 is established. The empirical conclusion means that if the knowledge workers' job satisfaction is higher then the workers will make more energy into work, and thus expects to produce higher satisfaction and self-worth. And if the whole team member satisfaction is higher, they would produce a higher collective sense of honor and solidarity, the entire team will have a better output naturally. Therefore, the assumption 3 has been verified.

According to Wen et al. (2004), the mediating effect is an indirect effect. Therefore, for the test of hypothesis 4, we took the indirect effects of the test method. According to the results of the structural equation model, the effects of the variable relationship in the Table 61.2 are showed as below:

Drawn from the above table, we know that the intermediary effect of the knowledge worker job satisfaction on servant leadership and knowledge team performance is 0.357, the hypothesis 4 is assumed. And also further validates the previous assumption, the servant leadership, knowledge employee satisfaction and the knowledge team performance are positive relationships. In all, how the servant leadership affects the knowledge team performance, the article took the perspective of the knowledge worker job satisfaction, we conclude that the job satisfaction of knowledge workers have the mediating effect between the servant leadership and knowledge team performance to some degree. Knowledge team is made up of knowledge workers, servant leadership first makes effect on every team member

**Table 61.2** The direct and indirect effect of variables

Relationship between variables	Direct Effect	Indirect Effect	Total
Servant leadership	0.552	–	0.552
↓			
Knowledge Worker Satisfaction			
Knowledge Worker Satisfaction	0.648	–	0.648
↓			
Knowledge Team Performance			
Servant Leadership	0.301	0.357	0.358
↓			
Knowledge Team Performance			

and then affecting the whole team. Therefore, the knowledge employee satisfaction plays the intermediary role between servant leadership and knowledge team performance.

61.5 Conclusion

The paper studied the relationship between servant leadership and knowledge team performance. The servant leadership includes six dimensions, professional ethics, the interests of the community, empowerment, conceptual skills, subordinate interests first as well as emotional comfort. All these dimensions could promote the knowledge team performance. Through the empirical analysis we also confirmed there were positive correlation between servant leadership and knowledge team performance, and importantly job satisfaction of knowledge workers played an intermediary role.

As there is little empirical research on servant leadership and knowledge team performance, this research will further enrich our leadership theory and knowledge team performance. This study provides a theoretical basis and support for servant leadership and knowledge team performance. In the modern enterprise management, knowledge workers as the core of management, leaders can try to switch to servant leadership, paying attention to the interests of the community, to deal with the relationship between corporate stakeholders, considerations of long-term development. Leaders should recognize the autonomy of knowledge workers and other characteristics, according to the fact, the leader will provide the need for self-perfection and work. All these acts can improve employee satisfaction and based on these, the leader can stimulate the learning ability and creative spirit of knowledge workers, resulting to dedicate himself to the team to improve team performance. After understanding the needs of staff development, servant leader provided everything he can do to ensure the development of knowledge team performance continuously. Ultimately the leader in the organization cannot be replaced.

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# Chapter 62

## Small and Medium-Sized Textile Enterprise Employee Turnover Motivation Research

Xiao-dong Li and Xi-yuan Li

**Abstract** Due to the special industry nature, small and medium-sized textile enterprise capital strength limits their lack of attraction on competitive salary of medium and small-sized enterprises compared to large enterprises and institutions, and staff turnover frequently. The massive employee turnover for small and medium-sized textile enterprise brought harm is self-evident. This paper studies small and medium-sized textile enterprise employee turnover drivers, in order to find out influence factors, analysis reasons, and give Suggestions and counter-measures, reducing employee turnover rate and improve the competitiveness of small and medium-sized textile enterprises.

**Keywords** Small and medium-sized textile enterprise · Employee turnover · Salary

### 62.1 The Problem Put Forward

Enterprise staff's proper flow is reasonable, and is helpful to enterprise's development. But too often or a lot of employee turnover will seriously affect the enterprise development and competitiveness of small and medium-sized enterprises increased, especially for textile industry. As traditional industries, small and medium-sized textile enterprises are mostly by family manual mill developed, low compensation levels, the human resources management behind, promotion difficulties are contributed to small and medium-sized textile enterprise employee turnover rate significantly higher than other areas. The data shows, small and medium-sized textile enterprise employees job-hopping phenomena are very

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serious, some small and medium-sized textile enterprise staff turnover amounted to 25 %, many enterprises has been in “recruiting a loss of recruiting” again and again in a vicious cycle. On the one hand, it increased the human capital loss and made human costs rise; On the other hand it made the enterprise the normal production and business order difficult to maintain, impacted the enterprise strategic target realization, damaged the enterprise image, even directly weakened the strength of corporate, took the company’s core technology and market competition strategy, disrupted enterprise marketing system, broke the orderly market competition rules and strength. The lack of talent has seriously restricted the healthy development of small and medium-sized textile enterprise (Wang 2007).

Studies show that private enterprises to keep turnover in 10 % is reasonable, but small and medium-sized textile enterprises of Jiangsu of employee turnover greatly exceed the safety excessive liquidity, so the high turnover rat will inevitably bring harm to the enterprises. Therefore, the current discussion of small and medium-sized textile enterprise employee turnover motivation and erosion process, the strengthened enterprise internal human resource development and management, to improve the competitiveness of small and medium-sized textile enterprise has very important practical significance.

## **62.2 Small and Medium-Sized Textile Enterprise Employee Turnover Influence Factor Analysis**

### ***62.2.1 Research Object Selection***

For learning Jiangsu small and medium-sized textile enterprise employees flow, we had a special sampling survey. First we adopted experts’ investigation, gave questionnaires to five experts, and listened to the expert’s opinion. Then modified questionnaire survey, repeatedly several times to form the final questionnaire, separately from the job itself properties, enterprise development and management of human resources and staff own reason to summarize five factors affecting employee turnover: working long hours, bad working conditions, low salary level, the unfair distribution, employees’ lack of career development opportunities (Ziqiang 2005). Then issuing large-scale questionnaire, through the questionnaire survey to collect data, and the object is small and medium-sized textile enterprise employees in Jiangsu. The issuance of questionnaires were 429 copies, questionnaires 406, recovery were 94.63, eliminated problematic questionnaire 9 portions, effective questionnaire totaling 397 copies. Respondents men made up 21 %, women made up 79 %. According to the results of the survey, 37 % of employees have changed a unit, 59 % of employees have changed more than two units, including 30 % of respondents have changed three or more units. Respondents, 77 % under 30 (excluding 30 years old), 30 years old of above made up 23 %. Because they have the advantage of ages as well as most good education (college

or above major in the background make up 65 %), they have enough time and space to seek more conducive to personal career development of industries and more profitable post. Relatively, older employees relative cherish their present jobs more, so the turnover is smaller. Therefore, in the flow army with a relatively young age structure, working time also to the majority of less than 5 years. Research uses multiple choice, and it can be cross selected. In data processing results of SPSS, “choose” represents chosen that influence factor, “not choose” represents not chosen that influencing factors.

62.2.2 Analysing Research Result

62.2.2.1 Salary Level Lowly

Textile enterprise labor intensity, working conditions and wages of the imbalance are the main reasons for employee erosion. Employee erosion is mainly caused by the lower salary level, almost all of the textile enterprise employees believe. In this research, as many as 89.7 % textile workers chose low levels as their main reasons for leaving, ranked first factors of employee turnover (as shown in Table 62.1). This is the reason why small and medium-sized textile enterprises are hard to hire high-level personnel, and it is also the reason why enterprise internal highly educated staffs lose. Productive employees compared with the knowledge staff with degrees, the wage levels appears more low, and many enterprises workers salaries at the production line are less than the local minimum wage standard (Hu 2004). So the loss of manufacturing employees is more seriously. At present, the competitive salary is still an important condition attracting applicants. Compared with other industries, underdog wages have being the main obstacles of restricted the whole cotton enterprise to attract and retain talents.

62.2.2.2 Working Time Long

Backward production equipment made medium and small-sized textile enterprise only can by extending the working time of the employees to obtain profits,

**Table 62.1** Small and medium-sized textile enterprise employee turnover influencing factors

	Salary level lowly	Working time long	Unfair distribution	Lack of career development opportunities	Poor working conditions
<i>Choose</i>					
Frequency	356	324	287	218	195
Valid percent	89.7	81.6	72.3	54.9	49.1
<i>Not choose</i>					
Frequency	41	73	110	179	202
Valid percent	10.3	18.4	27.7	45.1	50.0

working time is not sure, working overtime is frequently (Li and Gong 2001). Now the younger generation of employees compared to the older employees have two generations' stress. They emphasize their quality of life, and they are more willing to spend their time in enriching themselves or entertainment etc.

#### **62.2.2.3 Unfair Distribution**

If employee's input can not get fair return the staff will lower job satisfaction and organizational commitment to satisfy the coordination on subjective perception of fairness. Because of current our country cotton enterprise take salary allocation plan by different ranks, so the scheme often only works within the same level, and cannot beyond rank achieve real distribution according to work purposes. People's health awareness enhancement, the cost of grass-roots staff's inputs organization (hard, healthy body, experience, etc.) evaluation higher and higher, but they face the distribution of difference and expectations prosthesis. Therefore the asymmetry of input and output causing them to drop the job satisfaction and it will produce a departure tendency. Moreover, in many small and medium-sized textile enterprise human resources management has a lack of performance assessment, even if it also become a surface form, no real implement, thus leading to the unfair distribution.

#### **62.2.2.4 Lack of Career Development Opportunities**

In today's competitive social environment, the reason of the flow of the talents is from high pay to higher levels, paying more attention to the enterprise working environment, the construction of culture atmosphere, and paying more attention to such personal career development and their own value realization. At present the situation of our country textile enterprise employees' lack of career development opportunity in general can be classified into three categories: (1) Textile industry outlook is bleak, and enterprise's future is bad; (2) Textile enterprise does not provide training and opportunity to study; (3) No opportunity for advancement.

Most employees think in the 1980s textile industry experienced the glorious period and now turned into the sunset industry development stages, compared with other industries, the profession staff social status is relatively inferior, lacking professional development prospects, and personal value difficult to achieve. So there is a lot of employees outflow the industry, even they don't want to involve into this industry. Currently most textile enterprise leaders advocate compression training costs and the enterprise is not willing to invest in the practice of staff have made the people who have growth intend and the potential talents are gradually lost.

From the current situation, because of our country textile serious enterprise personnel fluidity, lack of long-term talent reserve consciousness, enterprise lacking internal selection confidence (Wei-Zhi 2008). Once having free position,

they would be more to consider the external recruitment, or family personnel, which reduce the internal promotion for left-behind enterprise employees' future income expectations, causing loss motives.

## **62.3 Countermeasures and Suggestions**

### ***62.3.1 Establish and Perfect the Reasonable Effective Compensation System***

Salary is always the important factors affecting employees flow. To solve the problem of unfair distribution within the organization should firstly eliminate distribution system completely according to rank set paid. In recent years the salary system reform of broadband salary can provide a new thinking for solving this problem to Jin-Hai (2007). The performance of broadband salary is ability instead of comparing organizational levels, improving the internal team compared the relative fairness. Broadband salary reward for system applies to "flattening" organization. The small mom-and-pop mode of textile enterprises destined to its organizational structure of relative "flattening", less rank, making the same rank salary increased and floating range with higher level and overlap again. It makes performance outstanding ordinary employees have a chance to get at the next higher level than his salary, so as to achieve more in the true sense of distribution according to work. Solved the problem of unfair distribution, in a certain extent, is relatively raised some outstanding staff salary level.

### ***62.3.2 Improve Production Efficiency***

In small and medium-sized textile enterprises, we can through some methods, such as improving production equipment, establishing and perfect the performance appraisal system, use the advanced management to improving production efficiency and shorten the employee time. Cutting employee's work time, in strict accordance with the provisions of the state work time. Through improving production equipment, introducing new production lines and improving the efficiency of management, so as to improve the production efficiency, and finally reach the purpose of improving enterprise operating performance, not simply by extend working hours of employees time to improve production efficiency. Through improving the overall performance of the small and medium-sized textile enterprises, improve the management of the enterprise performance, so can give employee more their own time and improve staff job satisfaction, can directly reducing employee turnover rate.

### ***62.3.3 To Improve the Working Environment and Conditions***

Production workshop environment is poor, this is almost all textile enterprise inevitable a problem. The main reasons causing this phenomenon is production equipment shortage of funds, but also behind with management excessive blame it on industry characteristics, and neglect care about the problem of employee health. To update the device in enterprise gradually, at the same time, managers also should do more comprehensive consideration on labor security system for employees on the safety and health of the body. Enterprise does labor safety and hygiene education to employee, to prevent the accidents at the working process and reducing occupational hazards. Do regular work hygiene inspection, and occupational disease prevention and treatment. Provide employees conforming to the provisions of the state labor safety and hygiene conditions, and the necessary labor protection supplies (Ford and Tetrick 2008). Opening air conditioning in the restrooms. In each shift prepare heat-prevention drugs. Provide free cultivated soup, etc. Enterprise of these efforts will make staff practically feel enterprise “people-oriented” management concept, and increase the belonging of enterprise employees. As long as it can let employees feel enterprise have been making indefatigable effort into improve the working environment and conditions, then it can to a certain extent reduce employee turnover motives.

### ***62.3.4 Encourage Employees Enterprise Internal Flow***

Enterprise employee turnover is inevitable, but flow can be divided into internal flow and the external flow achieve internal flow, encouraging employees through internal flow to the needs of the enterprise development as well as employee development. It can reduce the losses from turnover that instead of internal and external flow. Small and medium-sized textile enterprise will step by step from manual mill form, growing up (Li et al. 2010). Along with the development of enterprises, it can lead to enterprise’s goals and business process changes, the corresponding working or content change, old and new work is replaced. Enterprise should base on enterprise development request, and unifies staff own development demand. First to encourage the staff in the enterprise internal flow, difficult to match again in flows between inside and outside (Yang 2012). Thus, it can reduce the loss of liquidity, and employees can better realize the common development of the enterprise and staff.

### ***62.3.5 Development Promotion Channel, Increase Training***

Small and medium-sized textile enterprise familial management make it within the “nepotism” relationship of organization is serious. It makes other staff

promotion difficulty. Staff personal career development cannot be fulfilled, this is another reason why some outstanding employees turnover. So small and medium-sized textile enterprise should change their management concept, develop enterprise promotion channel, and keep promotion channel always unobstructed and fair (Zha et al. 2010). Maximum play of employee's own potential ability. To ensure that employees have enough opportunities for advancement, so that provides job security for the experienced staff. High promotion opportunity encourage individuals within the organization career development, and ensure security of the work and other long-term future earnings (for example: income, power and status). Enterprise increases employee training opportunities. It is to make the employees improve business level and constantly improves the working ability, and take this to gain employee's the maximum psychological satisfaction.

## 62.4 Conclusion

Excessive liquidity problems exposed employee for small and medium-sized textile enterprises existence many disadvantage mainly in human resources management. Small and medium-sized textile enterprises should establish modern management idea, and strengthened enterprise standardization construction. Small and medium-sized textile company realize the real cause of the employee turnover according to employee turnover influence factors, making corresponding measures. To attract talents and keep talents, incentive talents, making staff maximum exert its potential and working for enterprise, enhancing the enterprise overall competitiveness.

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## Chapter 63

# Study on the Characteristics of Fund Managers and the Impacts on Fund Performance in China

Tiao-yan Hui and Yun Chang

**Abstract** This paper makes an empirical study on fund manager's personal characteristics and its impact on fund performance, using the data of open stock and hybrid funds in china from 2005 to 2010. Through descriptive statistics and regression analysis by SPSS13.0, the results show that: fund manager's Securities business time and with MBA degree have significant positive impacts on fund performance; the manager numbers of a fund and fund manager's gender have no significant impacts on risk-adjusted performance; While, differing from our perception, fund manager's overseas experience is significantly negatively related to fund performance. In addition, securities market has significant impact on fund risk-adjusted performance, which is significantly better especially in bull market.

**Keywords** Fund manager · Personal characteristics · Fund performance · Risk-adjusted performance

### 63.1 Introduction

With the development of the economic and the capital market, securities investment fund has not only become the most influential institutional investors in the stock market, but also the main channel for people to invest for its professional management with higher return and lower risk.

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Fund manager's personal characteristics largely determine the style, even the performance of a fund, so it's believed that people choose a fund to a certain extent, is to choose a fund manager (Hu 2009). To date, prior literatures have examined the impacts of fund manager's incentive and fund performance. Some scholars hold that there should be some evidence that some fund managers are better than others. However, the issue of fund manager's personal characteristics has received limited attention in the literature. In this paper we focus on the fund managers' personal characteristics and its impact on fund performance, hoping to shed light on selecting fund manager for fund management companies and investors.

## 63.2 Literature Review

Chvalier, Judith A. and Glenn Ellison (1999) choose fund excess profits, fund risk, fund management fees, fund rate, fund changing hands rate as the dependent variables, while the fund manager age, educational background, tenure as the dependent variables to explore the relationship between fund manager's personal characteristics and fund performance by 3sls regression in United States. The result shows that the younger, with an MBA, longer term of a manager, the better the performance is. The most significant predictor of performance is his or her tenure (Chevalier 1999). Israelsen (1998) found that the term of fund manager more than 6 years with better performance and lower turnover rate. Chen and Lin thought that fund performance is the key to attract and retain investors. Kon (2000) indicated that experienced fund managers in the short term achieve better performance. Bliss and Potter (2002) showed that female fund managers had higher risk appetite and better performance than male (Kempf and Ruenzi 2006). Yang found that the female, older, operated less fund and well educated fund manager performed better.

Based on 54 closed-end funds of 2004 year in China, Xu and Li (2005) studied the fund managers' personal characteristics, such as age, education, gender, experience, tenure and investment style, and found that the fund manager with MBA degree don't have better performance, and their age is negative related to performance. Xu thought the managers with longer working experience do not perform as good as new fund managers in China due to their ideological conservative in order to control risk results. Hu (2011) found that stock selection ability of the fund managers from institution was significantly better than others (Hu 2010).

63.3 Empirical Research

63.3.1 Data

The data is based on the equity open-end Fund and the mixed open-end fund from 2005 to 2010 year in China, excluding bond funds, currency funds and QDII fund. All the data is from the Genius database, wind database.

63.3.2 Descriptive Statistics of the Fund Manager Characteristics

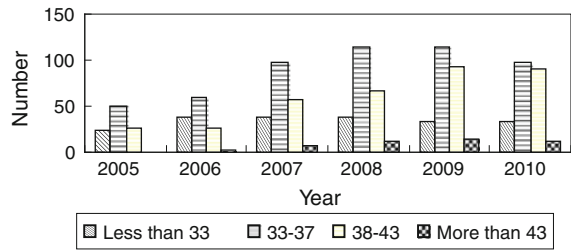
In this paper, fund manager’s characteristics mainly include the following indicators (Table 63.1):

1. Personal factors—Age/Gender
- From the research samples in 2005–2010 year, fund managers’ average age is between 35–37 years old, the minimum is 27, and the maximum is 49, mainly concentrated in the age of 33–43 (Fig. 63.1).  
Richard found that the fund risk level of female managers is higher than the male managers (Atkinson et al. 2003). However, Atkinson et al. (2003) thought gender was not an important indicator for the fund manager, and male managers and female managers had no significant differences in performance. But due to gender prejudice, female fund managers are rare in China. There is no evidence that female ability is inferior to men, but demanding more for female fund managers in the selection practice. The ability of female fund managers won a lot of praise, but from the date of fund managers in china, the ratio of male to female is still higher than 10:1 (Fig. 63.2).
2. Fund manager educational background Degree/Subject/MBA
- Tan (2009) found that the higher the degree of fund managers, the worse is fund performance according to data of the closed-end funds from 2002 to 2008 in China (Tan et al. 2010). It seems to be not consistent with ordinary judgment. Possible explanation is that the highly educated fund managers in venture capital are risk averse or neutral, so they can’t achieve excessive profits. From valid data of 2005–2010, it can be seen that 80 % of the fund managers have

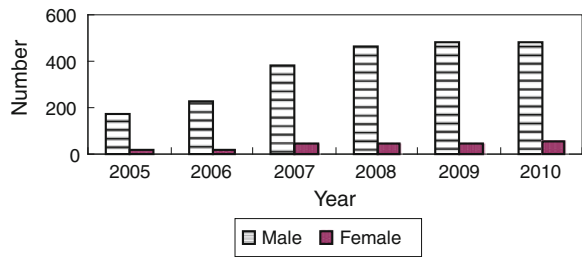
Table 63.1 Main indicators of fund manager characteristics

Personal Factors	Age( $x_1$ )/Gender( $x_2$ )
Educational Background	Degree( $x_3$ )/Subject( $x_4$ )/MBA( $x_5$ )
Occupational	Securities business time ( $x_6$ )/Personal background ( $x_7$ )/Numbers of fund management team ( $x_8$ )/Numbers of managed fund ( $x_9$ )/tenure ( $x_{10}$ )
Postgraduate	Certificate ( $x_{11}$ )/Overseas background ( $x_{12}$ )

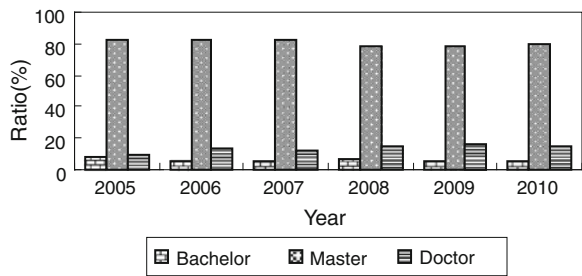
**Fig. 63.1** The fund manager’s age



**Fig. 63.2** The fund manager’s gender



**Fig. 63.3** The fund manager’s degree

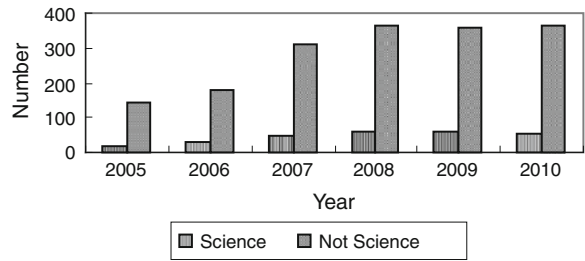


master degree. The proportion of fund managers with doctor degree rose from 17 % in 2005 to 77 % in 2010, and its proportion is going upward year after year (Fig. 63.3).

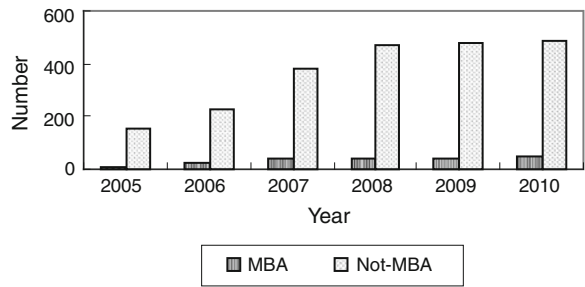
In China, there is more than 80 % fund manager with degrees majoring in finance and economics. The reason probably is that fund operation requires certain amount of knowledge of economic, financial and management. Major in science is good to data analysis and risk control, but not sensitive to the economic phenomenon. Master of Business Administration (MBA) is a master’s degree specializing in training senior professional managers (Figs. 63.4, 63.5, 63.6).

3. Occupational characteristics—Securities business times/Personal background/Numbers of fund management team/Numbers of managed fund/Tenure  
Fund managers’ average experience of Securities jobs is about 8–9 years, and it has an increasing tendency. The shortest is only 0.5 years of experience of Securities to become a fund manager, while the longest has 20 years experience of Securities.

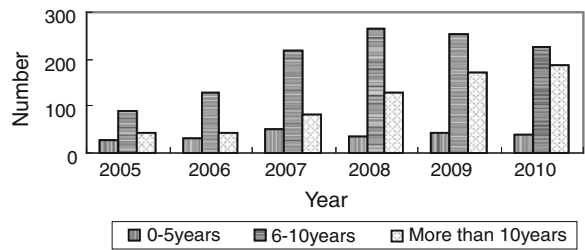
**Fig. 63.4** The fund manager’s major



**Fig. 63.5** The fund manager’s degree of MBA

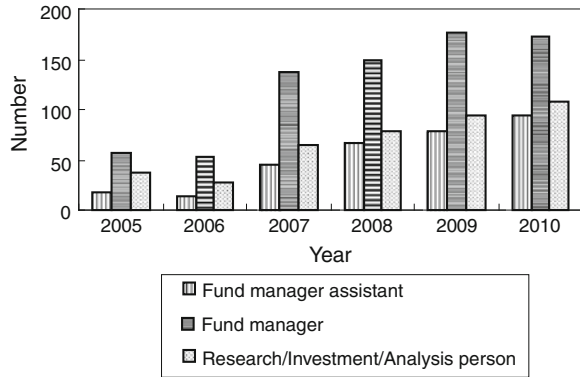


**Fig. 63.6** The fund manager’s securities business time

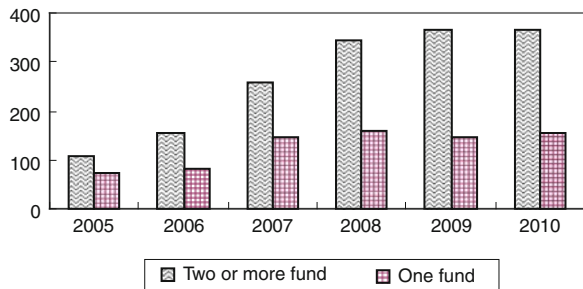


Today, fund managers are mainly come from other fund managers, fund manager assistants, or research/investment/analysis person, which respectively accounted for 50, 25, 25 % (Figs. 63.7, 63.8, 63.9). Zeng (2011) found that managing more funds can made the fund managers invest more energy, it is helpful to improve the fund performance (Zen 2011). Berkowitz and Qiu (2003) thought that Multi-manager can brainstorm, diversify investment style, and group decision-making (Berkowitz and Qiu 2003). While, too much managers for a fund, decision-making need more time and difficult to reach consensus. Today, many funds have 2 fund managers in China. Generally, it’s believed that fund manager’s tenure (the length of time a manager has managed his fund) and fund performance is positively correlated, it means that the longer tenure of fund manager, the more experienced and the better his performance is. The fund manager’s performance is ranked and known by the public, which means only competent managers can stay in business for long time. So his tenure can well reflect his ability and

**Fig. 63.7** The fund manager's personal background



**Fig. 63.8** Numbers of managed fund by a manager



performance (Cha 2006). The fund manager's average tenure is from 8 to 24 months in the period of 2005 to 2010 year in China (Table 63.2).

#### 4. The fund manager postgraduate-Certificate/Returnees

Gottesman and Morey (2006) examined the fund managers' education and their performance and found that there is a significant positive correlation between GMAT scores and fund performance, whether they have such as CFA certificates or doctorate degree has no influence on their performance (Gottesman 2006). But in the financial industry, the CFA, FRM, CPA and other relevant international professional qualifications are considered to be representative of the personal expertise. As shown in the illustration, the number of the certificate holder has an increasing trend, rising from 9.94 % in 2005 to 19.3 % in 2010 (Figs. 63.10, 63.11).

Zhao and Wang (2010) researched fund performance in China from 2004 to 2006, the relationship between overseas background and earning capacity or risk control is not significant. The performance of the overseas fund managers have fallen short of expectations (Zhao and Wang 2010). A considerable portion of China's fund managers had studied or worked abroad, it is useful to master advanced risk management and fund operating methods. The data show that the portion of China's fund managers with overseas background is maintained at about 13 %.

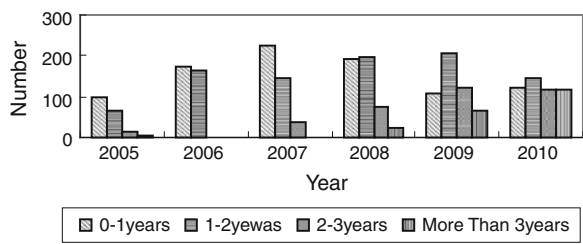


Fig. 63.9 Number of managers to a fund

Table 63.2 The fund manager’s average tenure

Years	2005	2006	2007	2008	2009	2010
Time (month)	12	8	11	16	21	24

Table 63.3 Variables introductions

Fund return	An annual average rate of return of the fund more than the fund industry
Fund risk	The standard deviation of the return of fund
Fund Risk-adjusted performance	Adjusted sharp index, it is the ratio of fund return to fund risk

Fig. 63.10 The fund manager’s certification with CFA/FRM/CPA

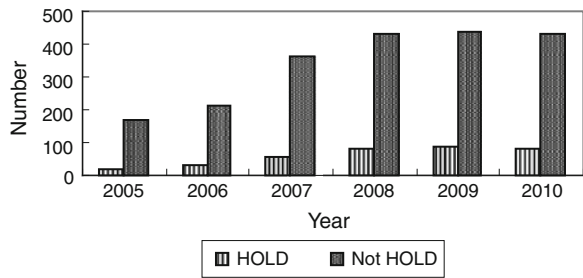
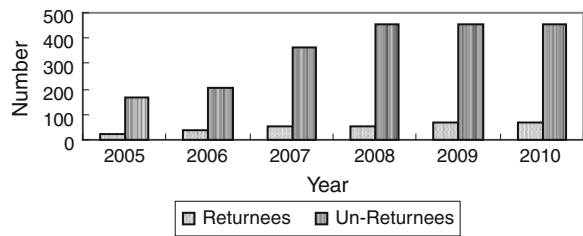


Fig. 63.11 The fund manager’s oversea experience



### 63.3.3 Analysis of the Fund Manager Characteristics' Impact on Fund Performance

This paper makes an empirical study on the fund manager characteristics and fund performance using regression analysis by SPSS. In order to ensure the stability of results, the explained variables include Fund return, Fund risk and Fund risk-adjusted performance (Tables 63.3, 63.4).

The empirical results show that: the fund manager with MBA degree and his experience of Securities has significant positive impact on fund return and Fund risk-adjusted performance at the 0.05 level, which is consistent to the research results of Chvalier. At present, there are a lot of fund managers with MBA, who worked long and came from famous universities such as Tsinghua University, Peking University. So, the working practice and theory studying make manager more competent (Dai 2009).

The fund manager's experience of Securities has significant positive impact on fund return and Fund risk-adjusted performance at the 0.1 level, which is consistent to the research results of Xizhe Li. In 2010 year, the average experience of Securities of fund manager is 8.2 years. The longer experience of Securities means

**Table 63.4** The results of regression analysis

	Fund return			Fund risk			Fund risk-adjusted performance		
	SC	t	Sig	SC	t	Sig	SC	t	Sig
C		-0.037	0.971		9.906	0.000		-0.053	0.958
X <sub>1</sub>	-0.027	-0.957	0.339	0.014	0.698	0.486	-0.026	-0.942	0.346
X <sub>2</sub>	0.020	0.774	0.439	-0.034	-1.822	0.069	0.021	0.790	0.430
X <sub>3,1</sub>	0.017	0.384	0.701	-0.011	-0.343	0.732	0.016	0.366	0.714
X <sub>3,2</sub>	0.004	0.085	0.932	0.026	0.823	0.411	0.003	0.068	0.946
X <sub>4</sub>	0.006	0.236	0.814	-0.023	-1.239	0.216	0.007	0.285	0.775
X <sub>5</sub>	0.077	2.592	0.010	-0.007	-0.304	0.761	0.076	2.537	0.011
X <sub>6</sub>	0.053	1.863	0.063	0.027	1.339	0.181	0.051	1.811	0.070
X <sub>7,1</sub>	0.020	0.720	0.472	0.031	1.533	0.125	0.019	0.701	0.483
X <sub>7,2</sub>	0.019	0.697	0.486	-0.023	-1.175	0.240	0.020	0.755	0.450
X <sub>8</sub>	-0.009	-0.347	0.728	-0.110	-5.723	0.000	-0.008	-0.306	0.759
X <sub>9</sub>	0.035	1.299	0.194	-0.039	-2.000	0.046	0.037	1.369	0.171
X <sub>10</sub>	0.007	0.265	0.791	-0.044	-2.348	0.019	0.009	0.337	0.736
X <sub>11</sub>	0.021	0.786	0.432	0.027	1.382	0.167	0.022	0.840	0.401
X <sub>12</sub>	-0.065	-2.185	0.029	-0.009	-0.437	0.662	-0.064	-2.165	0.031
BULL	0.082	2.831	0.005	0.457	21.785	0.000	0.076	2.624	0.009
BEAR	-0.008	-0.271	0.786	0.723	34.059	0.000	-0.014	-0.461	0.645
SCALE	0.046	1.732	0.083	0.151	7.912	0.000	0.046	1.745	0.081
SF	F = 1.712			F = 85.901			F = 1.658		
	Sig. = 0.035			Sig. = 0.000			Sig. = 0.044		

SC Standard coefficient, SF simulation fitting degree

X<sub>3,1</sub> MASTER, X<sub>3,2</sub> DOCTOR

X<sub>7,1</sub> FROM MANAGER' ASSISTANT

X<sub>7,2</sub> FROM RESEARCH/INVESTMENT/ANALYSIS. PERSON

the more knowledge about financial market, same as the wilder channel for messages, above all positive impact on fund operation (Xv and Tang 2010).

The fund manager's overseas experience has significant negative impact on fund return and Fund risk-adjusted performance at the 0.05 level. In the recent years, the fund manager with overseas background often been questioned, it is not only due to the different national circumstances, but also the fund manager is easy to inherit foreign fund investment style which not fit china. At present, the stock market changed quickly in China, although the fund manager with overseas background has excellent ability to control risk, but weaker profitability.

Male fund manager, Numbers of fund manager, Numbers of managed fund and his tenure have significant negative impacts on fund risk, but not significant impact on Fund risk-adjusted performance. Now, there are more and more female fund managers, who are generally considered to be cautious, exquisite and their investment style is conservative. But the empirical results do not support this view, regardless of fund return or risk control, the male is better than the female, who may be more exuberant and more acute insight.

The more funds managed, the fund manager has more recognition and stronger ability, but it's easy to diversify his work effort. The empirical results shows that the numbers of managed fund has significant positive impact on the risk control and positive impact on Fund risk-adjusted performance, but not significantly. A lot of members of a fund management team is easy to shirk responsibility, leading to both fund return and risk low, but it has significant positive impact on risk control (Zu et al. 2010). The longer of fund manager's tenure, the more fund return but not significantly. It because that they would rather give up the risk-profit in order to not make mistakes, so it made the operational risk in low level, but not significant impact on Fund risk-adjusted performance.

## 63.4 Suggestions

The personality characteristics of fund managers have important effects on fund performance. Firstly, to the choosing of fund managers, fund company should give priority to the factors that experience of Securities and MBA degree, not blindly worship his oversea experience. Secondly, it's important to strengthen professional training for fund managers through well-known college or expert training courses lectures as MBA, update their knowledge to improve the ability of fund operation. Thirdly, it's necessary to carry out investors education to make investors have a clear positioning and chose fund manager properly, such as the risk averse investors to choose the fund manager who is male, his tenure is long, the numbers of fund manager and numbers of managed fund are more, and so on.

Finally, fund manager's frequent turnover is serious in china, which largely obstruct to form a steadily investment style and achieve good fund performance. It's time to take some measures to let fund managers to hold their self-managed

funds, so as to his interests are well consistent with the interests of investors and encourage him work hard to improve fund performance effectively.

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# Chapter 64

## Study on Internship Employee Performance Evaluation Based on the Gray Correlation Analysis and Analytic Hierarchy Process

Ze-hong Li and Meng-zhu Chen

**Abstract** Currently, more and more company find out and reserve talents through intern's enrollment. In order to help the company evaluate the potential and performance of the intern effectively and scientifically, this paper introduce an evaluation method based on the gray correlation analysis and Analytic Hierarchy Process (AHP) and take a case to further explain this method.

**Keywords** AHP · Evaluation · Gray correlation analysis · Interns

### 64.1 Introduction

At present, most companies have realized the advantage of interns, they can found and cultivate the backup talents through the intern trial and it is good for the enterprise personnel echelon construction. Generally, large enterprises, especially foreign-funded enterprises, have a complete set of intern recruitment, assessment and application systems (McClelland 1973). However, companies often have problems in the performance evaluation of the intern. At present, it is difficult to find a method that is effective and feasible and can truly reflect the performance of the intern. This makes difficult for enterprises to judge whether the intern into the enterprise truly bring benefits for the enterprises. The paper use the AHP method,

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which combines the qualitative and quantitative characteristics, to determine the weights of various performance indicators, again according to the uncertainty of the performance evaluation and gray characteristics, use the gray connection analytic method to extract the gain target and the business goal target interrelatedness, to determine the level of the internship employees, and ultimately help the enterprise to make decisions.

## **64.2 Particularity of Intern Performance Evaluation and the Limitations of Traditional Methods**

Firstly, the working time of the intern is very short. General practice time ranging from 2 to 6 months, in such a short period of time an employee's work performance is not adequate. The enterprise is difficult to find clear and quantifiable indicators to judge the employees. Therefore, usually applied scale assessment method, comparing the assessment method and 360° performance appraisal method does not apply (Min 2005). Secondly, the internship period is actually a learning period. During this period they usually do some simple task, contact people are ordinary people in the inner circle around, application of critical incident technique and the opinion poll method are inappropriate. Therefore, from the traditional evaluation method is difficult to find a method suitable for companies to judge the performance of the intern (Wang 2005). However, it is suitable for the AHP to determine the weight of each index to find out the correlation between the target index and the getting index.

## **64.3 The Principle of Performance Evaluation Based on the AHP and Gray Correlation Analysis**

The AHP method is proposed by the United States Operations Research expert T. L. Saaty in the 1970s, it is refers to break down the elements about decisions into goals, standards, programs and other levels (Zhang and Zhang 2006). On this basis, carries on qualitative and the quantitative analysis. An important part is to determine the judgment matrix. In making this judgment, Saaty use 1–9 and its reciprocal as signs. 1 indicates that the two elements have the same importance, 9 expressed that the former is extremely more important than the latter, reciprocal indicates the importance comparison when exchange the order of the corresponding two factors (Wang and Li 2006).

### 64.3.1 Establish Stratification Structure

Establish stratification structure, break the problem into several levels. The first layer is the overall goal; the middle layer according to the nature of the problem can be divided into the target layer, departmental layer and constrained layer; the lowest level is program layer or measures layer. After full discussion and analysis, and finally draw the hierarchy chart.

### 64.3.2 Using AHP to Determine the Weight of Each Indicator

Seek the right value from the top layer to the bottom layer. Set the current level factors as  $C_1, C_2, \dots, C_i$ , Related upper layer is B (Can be more than one). Then aim at factor B, carries on pairwise comparisons to all factors. According to the scale of judgment matrix, get the value as  $a_{ij}$  ( $i, j = 1, 2, \dots, n$ ):

$$C_B = (a_{ij})_{m \times n} = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{pmatrix} \quad (64.1)$$

$C_B$  is the judgment matrix of the factors  $C_1, C_2, \dots, C_i$ 's relative upper level B.  $C_B$ 's maximum characteristic root is  $\lambda_{\max}$ . Standardized eigenvectors of  $\lambda_{\max}$  is  $\omega = (\omega_1 \ \omega_2 \ \cdots \ \omega_n)^T$ , then  $\omega$  gives a sort based on the relative importance of the factors  $C_1, C_2, \dots, C_i$  to B. Standardized  $\overline{\omega}_i$ :

$$\omega_i = \frac{\overline{\omega}_i}{\sum_{k=1}^n \overline{\omega}_k} \quad (i = 1, 2, \dots, n) \quad (64.2)$$

This is the  $i$ th component of the eigenvectors  $\omega$ , the maximum characteristic root is:

$$\lambda_{\max} = \sum_{k=1}^n \frac{(A\overline{\omega})_i}{n\omega_i} = \sum_{k=1}^n \frac{\sum_{k=1}^n a_{ki}\overline{\omega}_k}{n\omega_i} \quad (64.3)$$

Calculate the combination scaling coefficient on the same level.

Set the current level factors for the  $C_1, C_2, \dots, C_n$ , related upper layer factors for the  $B_1, B_2, \dots, B_n$ , every  $B_i$  has a weight vector

$$\omega_i = (\omega_1^i \ \omega_2^i \ \cdots \ \omega_n^i)^T \quad (i = 1, 2, \dots, n) \quad (64.4)$$

The weight of the factors in the upper layer is  $b = (b_1 \ b_2 \ \cdots \ b_n)^T$  currently, each factor's combination scaling coefficient is (Qu 2005; Deng 2002)

$$\sum_{i=1}^m b_i \omega_1^i, \sum_{i=1}^m b_i \omega_2^i, \dots, \sum_{i=1}^m b_i \omega_n^i \quad (64.5)$$

Go on, until all the combination scaling coefficient of the bottom layer is worked out. Finally, find out the weight of every index according to the coefficient of the bottom layer. So, the combination of the weight coefficient vector of the K-th layer is

$$W_K = Y_K Y_{K-1} \cdots Y_1 (Y_1 = 1)$$

Test the Consistency. Generally speaking, if  $CI \leq 0.1$ , we think CB is good.  $CI = \frac{\lambda_{\max} - n}{n-1}$ , set  $CR = \frac{CI}{RI}$ , is a random consistency ratio, if  $CR < 0.1$ , the judgment matrix has satisfied consistency. Otherwise need to adjust the judgment matrix, to reach a satisfied consistency (The and Chen 2004).

### 64.3.3 Gray Correlation Analysis

Determine the reference sequence and comparative sequence. Set a reference sequence  $x_0 = (x_{01}, x_{02}, \dots, x_{0n})$  and some comparative sequence  $x_1, x_2, \dots, x_m$

$$x_i = (x_{i1}, x_{i2}, \dots, x_{in}) (i = 1, 2, \dots, m) \quad (64.6)$$

The elements in  $x_0$  is selected from the best intern or the goal index in the company. In the comparative sequence,  $x_{i1}, x_{i2}, \dots, x_{in}$  is the value for the evaluation unit.

Standardize the sequence. Usually use the following formula to standardize (Fang et al. 2006)

$$y_{ij} = \frac{x_{ij}}{x_{0j}} (i = 1, 2, \dots, m; j = 1, 2, \dots, n) \quad (64.7)$$

( $x_{ij}$  is the original sequence;  $x_{0j}$  is the reference sequence)

Calculate the correlation coefficient. Use the following formula to calculate the correlation coefficient between  $x_i$  and  $x_0$  based on the element j. ( $j = 1, 2, \dots, n$ )

$$\xi = \frac{\min_r \min_j |x_{0j} - x_{ij}| + \rho \max_r \max_j |x_{0j} - x_{ij}|}{|x_{0j} - x_{ij}| + \rho \max_r \max_j |x_{0j} - x_{ij}|} \quad (64.8)$$

$\rho$  is the distinguishing coefficient, generally select between 0 and 1, usually take 0.5 (Duan and Zhou 2006; Zhang and Wang 2005).

Calculate the gray relational grade,

$$R_i = \frac{1}{n} \sum_{j=1}^n \xi_{ij} \quad (64.9)$$

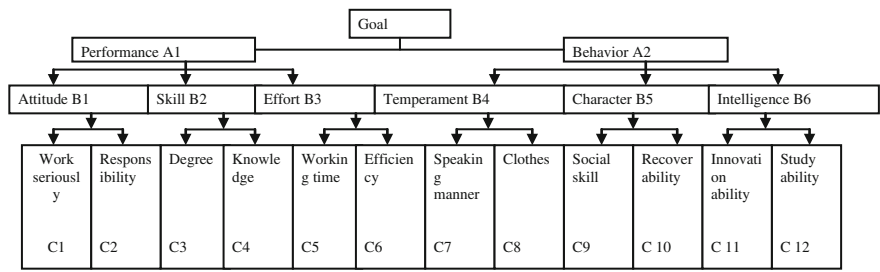


Fig. 64.1 Intern performance evaluation index

In the gray relational analysis, the index set is the time series, each time interval should be the average weight, but it is not suitable for the assessment of the internship positions, therefore, in accordance with the second step in the AHP method to calculate the weight of the index in this layer relative to the upper layer (Liu et al. 2004; Deng 1990).  $\omega = (\omega_1 \ \omega_2 \ \cdots \ \omega_n)$

$$R_i = r(x_0, x_i) = \sum_{j=1}^n \omega_k \xi_{ij} \text{ (k is the k-th layer)}$$

(64.10)

Use Eq. (64.10) to calculate the correlation of every layer from the bottom layer. Finally draw the correlation of the target layer. In order to judge the performance level of each tested internship positions.

## 64.4 The Example Analysis

Set one company has four internship positions and four interns P1, P2, P3, P4. Use AHP and gray relational analysis to assess their performance.

### 64.4.1 Determine the Index System

According to the characteristics of the interns and corporate focus to develop the four-layer index system (enterprise can adjust this standard according to its own characteristics and requirements) (Yuan 1991), as shown in Fig. 64.1.

### 64.4.2 Construct Judgment Matrix

According to Fig. 64.1, we can elect 1 contrast matrix in the second layer, 2 in the third layer and 6 in the fourth layer.  $A_Z$ 's judgment matrix is  $A_Z = \begin{pmatrix} 1 & 3 \\ 1/3 & 1 \end{pmatrix}$ ,  $A_Z$  is the judgment matrix is

$$B_{A1} = \begin{pmatrix} 1 & 1/4 & 1/3 \\ 4 & 1 & 3/2 \\ 3 & 2/3 & 1 \end{pmatrix}, B_{A2} = \begin{pmatrix} 1 & 1/5 & 2 \\ 5 & 1 & 4 \\ 1/2 & 1/4 & 1 \end{pmatrix}$$

$B_{A1}$  is the comparison of  $B = (B_1 \ B_2 \ B_3)$  and  $A_1$ ,  $B_{A2}$  is the comparison of  $B = (B_4 \ B_5 \ B_6)$  and  $A_2$ .  $C_{iBj}$ 's judgment matrix is

$$\begin{aligned} C_{12B1} &= \begin{pmatrix} 1 & 2 \\ 1/2 & 1 \end{pmatrix}, & C_{34B2} &= \begin{pmatrix} 1 & 4 \\ 1/4 & 1 \end{pmatrix}, \\ C_{56B3} &= \begin{pmatrix} 1 & 8 \\ 1/8 & 1 \end{pmatrix}, & C_{78B4} &= \begin{pmatrix} 1 & 5 \\ 1/5 & 1 \end{pmatrix}, \\ C_{910B5} &= \begin{pmatrix} 1 & 4 \\ 1/4 & 1 \end{pmatrix}, & C_{1112B6} &= \begin{pmatrix} 1 & 1/6 \\ 6 & 1 \end{pmatrix} \end{aligned}$$

$C_{12B1}$  is the comparison of  $C = (C_1 \ C_2)$  and  $B_1$ ,  $C_{34B2}$  is the comparison of  $C = (C_3 \ C_4)$  and  $B_2$ ,  $C_{56B3}$  is the comparison of  $C = (C_5 \ C_6)$  and  $B_3$ ,  $C_{78B4}$  is the comparison of  $C = (C_7 \ C_8)$  and  $B_4$ ,  $C_{910B5}$  is the comparison of  $C = (C_9 \ C_{10})$  and  $B_5$ ,  $C_{1112B6}$  is the comparison of  $C = (C_{11} \ C_{12})$  and  $B_6$ .

#### 64.4.3 The Relative Weight Calculations and the Consistency Test

Calculate the relative weight of the comparative element to the reference element and test the consistency.

$$\begin{aligned} B_{A1} &= \begin{pmatrix} 1 & 1/5 & 2 \\ 5 & 1 & 4 \\ 1/2 & 1/4 & 1 \end{pmatrix} \xrightarrow{\text{Standardization}} \\ &\begin{pmatrix} 0.153 & 0.151 & 0.182 \\ 0.770 & 0.755 & 0.727 \\ 0.077 & 0.094 & 0.091 \end{pmatrix} \xrightarrow{\text{Sum the line}} \\ &\begin{pmatrix} 0.486 \\ 2.252 \\ 0.262 \end{pmatrix} \xrightarrow{\text{Decide the number of the columns}} \\ &\begin{pmatrix} 0.162 \\ 0.751 \\ 0.087 \end{pmatrix} = \overline{\omega_2^{(3)}} \end{aligned}$$

$$B_{A2}\overrightarrow{\omega_2^{(3)}} = \begin{pmatrix} 1 & 1/5 & 2 \\ 5 & 1 & 4 \\ 1/2 & 1/4 & 1 \end{pmatrix} \begin{pmatrix} 0.162 \\ 0.751 \\ 0.087 \end{pmatrix} = \begin{pmatrix} 0.486 \\ 2.252 \\ 0.262 \end{pmatrix},$$

The largest eigenvalue is  $\lambda_{\max} = \frac{1}{3} = (\frac{0.486}{0.162} + \frac{2.257}{0.751} + \frac{0.262}{0.087}) = 3.006$ . Consistency index  $CI = \frac{\lambda_{\max}-3}{3-1} = 0.003$ . Look-up the table, the random consistency index  $RI = 0.58$ , so  $CR = \frac{CI}{RI} = \frac{0.003}{0.58} = 0.005 < 0.1$ ,  $B_{A2}$ 's inconsistency can accept. So the weight of  $B = (B_4 \ B_5 \ B_6)$  to  $A_2$  is  $\overrightarrow{\omega_2^{(3)}} = (0.125 \ 0.517 \ 0.087)^T$ , go on,

$$\begin{aligned} \overrightarrow{\omega^{(2)}} &= (0.5 \ 0.5)^T, \\ \overrightarrow{\omega_1^{(3)}} &= (0.125 \ 0.517 \ 0.358)^T \\ \overrightarrow{\omega_1^{(4)}} &= (0.67 \ 0.33)^T \quad \overrightarrow{\omega_2^{(4)}} = (0.2 \ 0.8)^T \\ \overrightarrow{\omega_3^{(4)}} &= (0.89 \ 0.11)^T \quad \overrightarrow{\omega_4^{(4)}} = (0.89 \ 0.11)^T \\ \overrightarrow{\omega_5^{(4)}} &= (0.2 \ 0.8)^T \quad \overrightarrow{\omega_6^{(4)}} = (0.89 \ 0.11)^T \end{aligned}$$

64.4.4 Experts to Evaluate the Interns

The expert group organized by the Human Resources Department, as well as department heads and colleagues around, who is very familiar with their corresponding work (Wang and Ren 2010). The result is shown in Table 64.1.

Table 64.1 Index score

Index	P1	P2	P3	P4	Reference score
C1	7	8	5	7	10
C2	4	5	7	5	8
C3	4	5	6	6	10
C4	5	7	9	4	10
C5	2	4	5	5	6
C6	7	5	6	8	10
C7	5	4	5	5	7
C8	2	5	8	4	8
C9	5	5	5	4	6
C10	7	4	9	3	10
C11	2	7	5	8	10
C12	5	4	2	6	7

#### 64.4.5 Determine the Comparative Sequence and Reference Sequence

Reference sequence:

$$\omega_0 = (10, 8, 10, 10, 6, 10, 7, 8, 6, 10, 10, 7)$$

comparative sequence:

$$\omega_1 = (7, 4, 4, 5, 2, 7, 5, 2, 5, 7, 2, 5)$$

$$\omega_2 = (8, 5, 5, 7, 4, 5, 4, 5, 5, 4, 7, 4)$$

$$\omega_3 = (5, 7, 6, 9, 5, 6, 5, 8, 5, 9, 5, 2)$$

$$\omega_4 = (7, 5, 6, 4, 5, 8, 5, 4, 4, 3, 8, 6)$$

#### 64.4.6 Dimensionless

According to the Eq. (64.7), dimensionless  $\omega_0, \omega_1, \omega_2, \omega_3, \omega_4$ , we can get  $x_0, x_1, x_2, x_3, x_4$

$$x_0 = (1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1)$$

$$x_1 = (0.7, 0.5, 0.4, 0.5, 0.33, 0.7, 0.714, 0.25, 0.83, 0.7, 0.2, 0.714)$$

$$x_2 = (0.8, 0.625, 0.5, 0.7, 0.67, 0.5, 0.57, 0.625, 0.83, 0.4, 0.7, 0.57)$$

$$x_3 = (0.5, 0.875, 0.6, 0.9, 0.83, 0.6, 0.714, 1, 0.83, 0.9, 0.5, 0.286)$$

$$x_4 = (0.7, 0.625, 0.6, 0.4, 0.83, 0.8, 0.714, 0.5, 0.67, 0.3, 0.8, 0.85)$$

#### 64.4.7 Calculate the Correlation Coefficient

According to the Eq. (64.10), calculate  $\Delta_{0j} = |x_{0j} - x_{ij}|$

$$\Delta_{01} = (0.3, 0.5, 0.6, 0.67, 0.3, 0.286, 0.75, 0.17, 0.3, 0.8, 0.286)$$

$$\Delta_{02} = (0.2, 0.375, 0.5, 0.3, 0.33, 0.5, 0.43, 0.375, 0.17, 0.6, 0.3, 0.43)$$

$$\Delta_{03} = (0.5, 0.125, 0.4, 0.1, 0.17, 0.4, 0.286, 0, 0.17, 0.1, 0.5, 0.714)$$

$$\Delta_{04} = (0.3, 0.375, 0.4, 0.6, 0.17, 0.2, 0.286, 0.5, 0.33, 0.7, 0.2, 0.143)$$

So,  $\min_i \min_j |x_{0j} - x_{ij}| = 0$ ,  $\min_i \max_j |x_{0j} - x_{ij}| = 0.8$ , set  $\rho = 0.5$ , take the equations above into Eq. (64.8), we can get a correlation coefficient table, as follows (Table 64.2):

Calculate the correlation of the third layer (B), according to the Eq. (64.10)

**Table 64.2** Correlation coefficient table

Correlation coefficient	P1	P2	P3	P4
C1	0.570	0.670	0.440	0.570
C2	0.440	0.516	0.762	0.516
C3	0.400	0.440	0.500	0.500
C4	0.440	0.570	0.800	0.400
C5	0.374	0.548	0.702	0.702
C6	0.570	0.440	0.500	0.670
C7	0.583	0.482	0.583	0.583
C8	0.348	0.516	0.000	0.440
C9	0.702	0.702	0.702	0.548
C10	0.570	0.400	0.800	0.364
C11	0.330	0.570	0.440	0.670
C12	0.583	0.482	0.351	0.730

$$R_{B1} = \zeta_{B1C12} = \overrightarrow{\omega_1^{(4)}} = (0.5271 \quad 0.6192 \quad 0.5463 \quad 0.5222)^T$$

$$R_{B2} = \zeta_{B2C34} = \overrightarrow{\omega_2^{(4)}} = (0.432 \quad 0.6588 \quad 0.74 \quad 0.42)^T$$

$$R_{B3} = \zeta_{B3C56} = \overrightarrow{\omega_3^{(4)}} = (0.3956 \quad 0.5361 \quad 0.6798 \quad 0.6985)^T$$

$$R_{B4} = \zeta_{B4C78} = \overrightarrow{\omega_4^{(4)}} = (0.5572 \quad 0.4857 \quad 0.5189 \quad 0.5494)^T$$

$$R_{B5} = \zeta_{B5C910} = \overrightarrow{\omega_5^{(4)}} = (0.5964 \quad 0.4604 \quad 0.7804 \quad 0.4008)^T$$

$$R_{B6} = \zeta_{B6C1112} = \overrightarrow{\omega_6^{(4)}} = (0.5471 \quad 0.4945 \quad 0.3636 \quad 0.7275)^T$$

Calculate the correlation of the second layer (A)

$$\begin{aligned} R_{A1} = (r_1, r_2, r_3) &= (R_{B1}, R_{B2}, R_{B3}) \overrightarrow{\omega_1^{(3)}} \\ &= (0.4307 \quad 0.6094 \quad 0.6011 \quad 0.5364)^T \end{aligned}$$

$$\begin{aligned} R_{A2} = (r_4, r_5, r_6) &= (R_{B4}, R_{B5}, R_{B6}) \overrightarrow{\omega_2^{(3)}} \\ &= (0.5824 \quad 0.4697 \quad 0.6756 \quad 0.4721)^T \end{aligned}$$

Calculate the correlation of the goal layer

$$\begin{aligned} R_0 = (R_{A1}, R_{A2}) \overrightarrow{\omega^{(4)}} &= \begin{pmatrix} 0.4307 & 0.5824 \\ 0.6094 & 0.4697 \\ 0.6011 & 0.6756 \\ 0.5364 & 0.4721 \end{pmatrix} \begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix} \\ &= (0.5066 \quad 0.5396 \quad 0.6384 \quad 0.5043)^T \end{aligned}$$

## 64.5 Results

According to  $R_0$ , we can draw the conclusion that  $P_3 > P_2 > P_1 > P_4$ , that is to say,  $P_3$  is the best while  $P_4$  is the worst. Companies can make hiring decisions according to this.

## 64.6 Conclusion

At present, companies recruit more and more interns. It becomes a hot topic that how to evaluate these people. This paper integrates the advantages of the AHP method and gray relational analysis. Use these two methods gives an effective method to evaluate the performance of the interns. Play a supporting role in the enterprise management.

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# Chapter 65

## Customer Engagement Behavior: A New Perspective in CRM

Chun-yu Gao and Ming-liang Chen

**Abstract** Customer engagement behavior (CEB) is a new research domain of customer relationship management, which receives increasing attention from academics and business practitioners. Based on existing researches, we give an overview look of CEB by introducing several dimensions of CEB including definition, form and classification. A conceptual model of CEB which consists of antecedents, consequences and moderators is proposed in the paper. Finally, we suggest a virtuous circle in the conceptual model of CEB for firms.

**Keywords** Co-creation · Customer engagement behavior · Customer relationship management · Word-of-mouth

### 65.1 Introduction

Traditionally, product quality and value are driving force for organizational performance. With a conceptual shift from product-centric to customer-centric, customer-based metrics has become a new measurement for organizational performance (Doorn et al. 2010), which makes customer endogenous to firms (Bijmolt et al. 2010). Since long-term and sustainable competitive advantage relies on the ability of maintain, retain and cultivate customer base, many firms have view customer relationship management (CRM) as a top priority, making heavy investments in CRM implementation.

Studies on CRM are widely focused on the transactional behaviors of customers, such as customer life value (CLV) and customer cross-buy behavior (Gupta et al. 2004; Anderson and Sullivan 1993). However, with a rise of social

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network and new media channels including Facebook, twitter and YouTube, customers are able to exchange information at anywhere and anytime. They can also easily interact with firms and other customers and take active part in marketing activities (Verhoef et al. 2010; Hennig-Thurau et al. 2010). These non-transactional behaviors are increasingly popular among customers, becoming more and more important to firms.

## 65.2 Concept of CEB

Customer engagement behavior (CEB) is an important concept of customer non-transactional behavior. The term “consumer engagement (CE)” has emerged in the academic marketing and service literature for only 5 years, which differs from involvement, participation and commitment (Brodie et al. 2011; Mittal 1995). Many researchers develop their definition of CE from cognitive, emotional and behavioral dimensions (Brodie et al. 2011; Patterson et al. 2006; Vivek et al. 2012). In general, CE involves customer experience and interaction with other customers or firms (see Table 65.1). A widely accepted definition of CEB is given by van Doorn, who posits that *CEBs go beyond transactions, and may be specifically defined as a customer’s behavioral manifestations that have a brand or firm focus, beyond purchase, resulting from motivational drivers* (Doorn et al. 2010). Different from van Doorn, Kumar thinks that customer engagement should include transactions (Kumar et al. 2010).

CEBs include many forms of behavioral manifestations such as word-of-mouth (WOM), customer recommendation, customer complaints, blogging, writing reviews, participating in brand community, as well as all behaviors which affect firm and brand such as co-creation, helping and guiding suppliers (Doorn et al. 2010; Verhoef et al. 2010). As one of the most important forms of non-transactional behaviors, WOM has already attracted plenty of attention at current literature (Luo 2009; Villanueva et al. 2009). To broad the scope of WOM, Libai et al. (2010) focus on the customer-to-customer interactions in new online environment, giving significant research directions in this new domain. Co-creation plays an important role in CEBs, which is still in its infancy of research (Hoyer et al. 2010). Co-creation is defined as *collaborative new product developments (NPD) activity in which consumers actively contribute and select various elements of a new product offering* (O’Hern and Rindfleisch 2009). Hoyer et al. build a conceptual model of co-creation in new product development and explore the impact and outcome of co-creation at each stage of NPD. Blogs and brand communities are fast emerging as new organizational tools for marketing (Ahuja and Medury 2010). By setting up a variety of brand communities spontaneously, customer can engage in CEBs such as sharing experiences and giving recommendations (Lee et al. 2011).

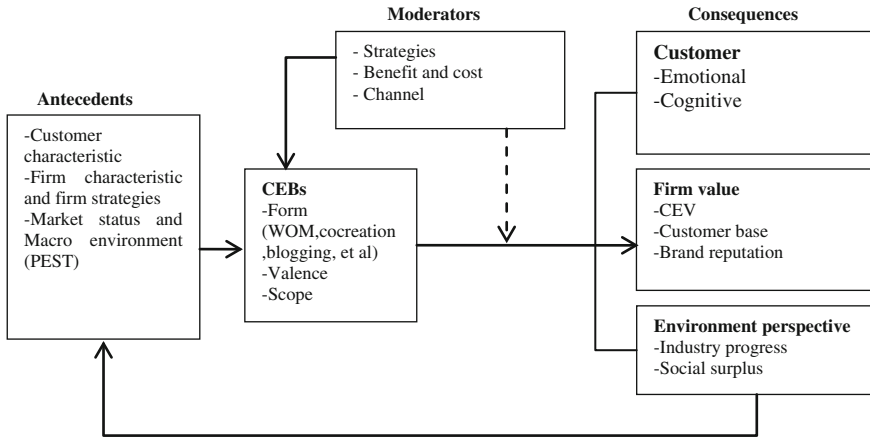
**Table 65.1** The definition of CEB

Author	Concept	Definition
Van Doorn et al. (2010)	Customer engagement behavior (CEB)	Customer engagement behaviors go beyond transactions, and may be specifically defined as a customer’s behavioral manifestations that have a brand or firm focus, beyond purchase, resulting from motivational drivers (Doorn et al. 2010)
Brodie et al. (2011)	Customer engagement (CE)	Customer engagement (CE) is a psychological state that occurs by virtue of interactive, co-creative customer experiences with a focal agent/object (e.g., a brand) in focal service relationships (Brodie et al. 2011).
Patterson et al. (2006)	Customer engagement (CE)	The level of a customer’s physical, cognitive, and emotional presence in their relationship with a service organization (Patterson et al. 2006)
Vivek et al. (2012)	Customer engagement (CE)	The intensity of an individual’s participation and connection with the organization’s offerings and activities initiated by either the customer or the organization (Vivek et al. 2012)
Kumar et al. (2010)	Customer engagement value (CEV)	Four core dimensions: Customer purchasing behavior, Customer referral behavior, Customer influencer behavior, Customer knowledge behavior (Kumar et al. 2010)

Different forms of CEBs may be classified in many ways. Based on the Hirschman’s classic model (Hirschman 1970), CEBs can be divided into pure voice (i.e., complaints, recommendations and WOM) and pure exit (i.e., reducing consumption and nonrenewal of contracts). Particularly, behaviors such as taking part in brand communities, blogging and giving design suggestions comprise both voice and exit. From valence perspective, customer engagement can be classified as positive and negative (Brady et al. 2006). Positive customer engagement behaviors, such as posting positive brand information on the blog and spreading positive WOM, can bring financial and nonfinancial benefits to firms, while organizing boycott, giving negative online reviews, and customer complaints are negative customer engagement behaviors.

65.3 Conceptual Model

A lot of studies have been done on some forms of CEBs such as WOM (Villanueva et al. 2009; de Matos and Rossi 2008), co-creation (Hoyer et al. 2010), and customer recommendation (Jin and Su 2009). These behaviors share similar structural features but lack a unified and systematic conceptual model. By integrating the present researches, we discuss a conceptual model of antecedents and consequence of CEB, as well as the moderators (see Fig. 65.1).



**Fig. 65.1** A conceptual model of CEB

### 65.3.1 Antecedents

Customer-based factors include demographics (Ndubisi 2006), customer goals (Doorn et al. 2010), affective states (Liljander and Mattsson 2002), customer satisfaction (Anderson and Sullivan 1993) and so on. Both high and low level of these factors will bring about customer engagement. For example, customers with high design of self-enhancement or social identity are more willing to engage in WOM behavior (Hennig-Thurau et al. 2004). Goals for social identification will positively influence customers' online brand community engagement intentions (Lee et al. 2011).

Firm-based factors including firm characteristics and strategies can also affect CEB. Researches show that positive CEBs are more likely to be found in firms with high reputation or high brand equity (de Matos and Rossi 2008). Providing convenient platforms (i.e., company-initiated chat forum and brand community) and using new media for customer interaction can be effective strategies for firms to affect CEBs positively (Stauss 2000). Incentives and rewards can also be provided to spur customer input in co-creation (Hoyer et al. 2010).

Other factors such as marketing status (i.e., competition and industry structures) and macro environment will also affect customer engagement behavior (Doorn et al. 2010). For example, due to the development of computer network and IT technology, the cost of information dissemination is reduced to almost zero, creating great chance for online product reviews (Avery et al. 1999).

### **65.3.2 Consequences**

CEBs have emotional consequences on customers. Sundaram et al. (1998) find that WOM spread can help relieve customer emotions of anger, anxiety and regret. Further, CEBs can affect customer cognition, attitude and behavior as well. Research shows that a customer satisfaction survey can positively affect service purchases, responsiveness to promotions, cross-buy time, and spending, thus enhancing their customer equity (Borle et al. 2007). Besides, CEBs can strengthen the social identity of customers. Sometime customers purchase for a sake of a symbol of social status or uniqueness, while identities will be reinforced by related CEBs such as being a member of brand community or fan club (Berger and Heath 2007).

In firm terms, CEBs can enhance customer value for firms. Although transaction behavior can generate immediate cash flows for firms, customer engagement behavior is of same importance, which can result in both transactional value and non-transactional value. For example, both quality and quantity of online reviews can have positive effect on customer purchase intention and customer recommendation (Park and Kim 2008). In study of transaction behaviors, customer lifetime value (CLV) is an important measurement method of marketing. Apart from CLV, Kumar et al. (2010) propose three non-transactional components-customer referral behavior (CRV), customer influencer behavior (CIV), and customer knowledge behavior (CKV)-for the measurement of customer engagement value (CEV).

In addition, customers who are highly involved are crucial source of knowledge, helping firms in design and development of new products, modifying existing brands, and testing beta products (Doorn et al. 2010). Customer co-creation in new product development can help firm gain rapid response to market (Fang 2008), reduce risk of product failure and reduce inventory holding costs, thus saving cost and improving performance (Hoyer et al. 2010). CEBs will also effect reputation. In the long run, CEBs such as taking part in brand community and giving feedback can improve brand awareness and brand recognition (Charles and Shanley 1990).

Apart from the consequence to customer and firm, CEBs have broad impacts on the environment including the entire industry and society (Ahuja and Medury 2010).

### **65.3.3 Moderators**

First, different antecedents can moderate the effect of each other on CEBs. Factors related to the firm as well as the context can moderate the effect of customer factors on CEBs (Doorn et al. 2010). For example, strategies used by firms such as

providing certain incentives to customers to be involved in CEBs may weaken the effects of customer characteristics.

Second, the benefits and costs of CEBs can serve as moderators of CEBs. Stimulators are firm-level moderators of the relationship between consumer motivators and the degree of CEBs (Doorn et al. 2010; Hoyer et al. 2010). Consumers who are predisposed to active participation in co-creation activities may not intend to engage if the benefits involved are too low or the costs involved are too high (Hoyer et al. 2010). The perceived cost of engaging in certain activities can also negatively moderate the impact of customer satisfaction on CEBs.

Third, the channels of CEBs can serve as moderators of CEBs. The traditional ways of CEBs can be carried out through face-to-face communication, phone, and e-mail. With progress of information technology, the new media channels such as blog, Facebook and mobile termination, are becoming more and more important in social contact and information communication (Libai et al. 2010; Ahuja and Medury 2010), which will affect the interaction between customers and firms (Hennig-Thurau et al. 2004).

### 65.3.4 *A Virtuous Circle*

As discussed above, CEBs have antecedents and consequences in three levels—customer, firm and context. What is notable is that the consequences can affect the antecedents of CEBs as well, thus forming a circle of the conceptual model.

For example, suggestions made by customers can make firms run more efficiently, resulting in lower prices and higher customer satisfaction. Higher customer satisfaction may in turn induce positive CEBs such as WOM and customer recommendation. Moreover, CEBs like customer feedback and taking part in brand community can improve brand awareness and thus attract more positive CEBs in turn (de Matos and Rossi 2008; Charles and Shanley 1990).

Therefore, if well managed, the antecedents and consequences of CEBs can become a virtuous circle. In practical management, firms can encourage positive CEBs through related strategies such as implementing incentive mechanisms and smoothing communication channels. With enormous financial and nonfinancial benefits brought by CEBs, firms will have the capability to allocate more resources in CRM including CEBs, thus forming a virtuous circle.

## 65.4 Conclusion and Future Research

As one of the newest research domains of customer relationship management, CEB owns significant research value. CEBs are behavioral manifestations of non-transactional customer behavior, including WOM, customer recommendation, blogging, co-creation and so on. Based on the current researches on CEB, we give

a broad view of CEB by introducing several dimensions including definition, form and classification. A conceptual model of CEB which consist of antecedents, consequences and moderators is proposed in the paper and a virtuous circle of CEB is discussed for firms' practical management.

For future study of CEB, the conceptual model can be refined further. For example, researches can be done on the interaction of customer-based, firm-based and context-based factors of antecedents. CEB models can be constructed on the background of different industries like service, manufacture and retail. Expand the range of influence of CEBs by taking suppliers and competitors into account. Besides, introduce multiple methods like empirical study, behavioral study, and neuroscience into researches and analysis of CEB.

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# Chapter 66

## Development and Revelation of Leadership Trait Theory

Yu-fang Chao and Xue-fei Chang

**Abstract** This article summarizes recent developments of leadership trait theory, explaining, in detail, the content and characteristics of charismatic leadership theory, implicit leadership theory, effective leadership theory, leadership competency theory and other modern leadership theory. On this basis, this article points out that shifting of research paradigm and comprehension of research level, system of research methods are the key to development and its social importance. At the same time, development of leadership trait theory shows that leadership trait theory still has a large value of theory and application, personality traits can promote or impede the efforts of leaders' influence on others, and leadership traits can be formed and developed and acquiesced in practice. This is good for our comprehensive, in-depth understanding of leadership trait theory, promoting study on leadership trait theory.

**Keywords** Leadership trait theory • Charismatic leadership theory • Implicit leadership theory • Effectiveness of leadership • Development

### 66.1 Introduction

Leadership is with humans, but it was not until early in the 1930 of the 20th century, scientific research of leadership really began. Leadership trait theory is the earliest branch of the theoretical leadership study. In the 1930 of the 20th century, researchers applied psychological research methods on the characteristics

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study of the leaders, thus forming the leadership trait theory. Study on the trait theory of leadership during this period focused on mental, character, knowledge, abilities, and other characteristics of leaders, whether there is a difference in essence exists between leaders and followers, whether a particular personality traits, physical property, intellectual or personal values will distinguish followers and leaders.

In 1948, Stodgily conducted a study of relevant literature, came to the two main conclusions that, first, there is no essential difference between leaders and followers in quality; second, some characteristics are very important which have a link with successful leadership. These features are ability, achievement, responsibility, participation, etc. (Stodgill 1948, 1974) Mann and Stodgily reviewed hundreds of documents, large amounts of evidence to consolidate the above two conclusions.

Although Stodgily and Mann have presented sufficient evidence to show that leaders who have the right traits are more likely to succeed, but many researchers neglect this, just concerned about this conclusion “there are no essential differences between leaders and followers”. Thus, they wrongly concluded that “personal attributes cannot be used to predict the future leadership success” (Hughes et al. 1996). So the research perspective from the leadership trait theory was shifted to others, leadership trait theory was into a low ebb. Until the Lord, DeVader, Aligner (1986), Hogan, and Curphy (1994) published seminar articles, leadership personality traits were only broadly concerned by researchers. Leadership trait theory after years of development, through a change of research perspective, created a charm leadership theory, McClelland's theory of achievement motivation and leading motivation.

Leadership trait theory after the recent development of more than 30 years, have gain more and more attention, system research of development of leadership trait theory is of great significance for more in-depth understanding and research and application of this theory.

## 66.2 Methodology

Since the leadership science as an independent discipline, the trait theory of leadership research has been ongoing, forming rich literature. This study has laid a good foundation. We can analyze the choroid about the trait theory of leadership development from a large number of literatures of the leadership trait theory, and can obtain its development law.

So, this article took literature research as the main research methods, through analysis of the development of leadership trait theory in the last 30 years, summarized research conclusions of leadership each trait theory, then made a comprehensive analysis, exploring development and success of modern trait theory of leadership.

66.3 Development Leadership Trait Theory

66.3.1 Effective Leadership Theory

Lord (1986) and some others, by a more complex method called meta-analysis, assessed Mann’s earlier discovery again, finding that intelligence, courage and personal perception are significantly related with each others, that personality traits can be cross-context for leaders and non-leaders (Lord and Maher 1990). Meanwhile, researches of Similarly. A. Kirkpatrick and Edwin. A. Locke show that a series of personal qualities endow individuals with “correct qualification”, which make them to be a competent leader, effective leaders are clearly distinct from other types of people in several key areas (Kirkpatrick and Locke 1996). These qualities are “prerequisite” for a people becoming leaders. In their view, key qualities which make differences between leader and ordinary people are driving force, honesty, integrity, self-confidence, coordination skills and business knowledge. At the same time, according to their view, these characteristics can be a person born, or it can be learned, or both. Richard L. Hughes, Robert C. Ginnett, Gordon J. Curphy, stated that: the strength of the relationship between personality traits and leadership effectiveness is often negatively associated with the relative strength of context. Changes in most organizations are accelerating today; leaders may face more unfamiliar and ambiguous situations. For this reason, personality traits of a leader will be playing an increasingly important role.

For the effective leadership traits, Yukl (1994), Hoy and Miskel (1996) presented a model of effective leadership traits consisting of personality traits, motive traits and skill traits, its content is shown Table 66.1 (Yuke 1998). William Jack Baumol produced ten conditions, enterprise leaders should have according to practical situation of United States corporate; the United States Management Association found that successful managers usually have 20 kinds of qualities and abilities: Japanese business community also made that effective leaders should have ten virtues and ten talents.

In china, “World Executive Digest” organized the customer of “the World Executive”, Chinese business leaders and management experts to select leadership trait of Chinese business leaders in 2002. The ten major leadership traits are: the information decision; the allocation of resources; the effective communication; and

Table 66.1 Effective leadership traits

Personality traits	Motivation traits	Skill traits
1. Confident	1. Working and interpersonal needs	1. Technical capability
2. Under pressure	2. Power and achievement motivation	2. Interpersonal skills
3. Emotional maturity	3. Highly anticipated on the success	3. Thinking ability
4. Integrity		4. Administrative ability

Sources Internet

inspire others; the personnel training; the responsibility; and being honest and trustworthy; of career orientation with fast learning.<sup>1</sup>

### ***66.3.2 Charismatic Leadership Theory***

Charismatic Leadership Theory is a kind of leadership theory under which a leader makes use of his own charm to encourage followers made a major organizational change. House (1976) indicated that charismatic leaders have three personal characteristics; that is, the high degree of confidence, power and belief in their own firm. Bennis found four characteristics; that is, vision, clearly clarifying the goals and ideals for subordinate and identity by subordinate; consistent and persistent pursuit of the ideal, knowing their own strength and making good use of that power (Bennis 1989). J. Congere and others (1988) studies suggest that charismatic leaders have an ideal objectives; focus and dedication; unconventional and very assertive belief; being major agents of change rather than the traditional apologist of the status quo. They think that there are seven key characteristics which distinguish charismatic leadership and non-charismatic leadership.

### ***66.3.3 Implicit Leadership Theory***

Eden introduced the concept of implicit leadership in 1975, thought that the inner factors of leaders has a tremendous impact on assessment of leader's behavior, that is the trait or behavior expectations and beliefs owned by individual leaders are "labels" which distinguish the individual leaders and non-leaders. Offermen and others (1986) studied the content and structure implicit leadership model of United States, and in 1994 produced eight factors as sensitivity, dedication, authoritarianism, charismatic, intellectual, attractive, masculine, and temperament. Leading prototype research by Pavitt and Sackaroff (1990) summarized 8 typical behaviors and 8 typical characteristic and found out that the typical characteristics and typical behaviors can better distinguish good leaders and bad leaders. After Offermen, Epitropaki and Martin (2004) adopted Offermen's 41-quality table to further explore the content and structure of the implicit leadership of United States, the results suggest that both have good fitting, eventually forming the 6 dimension, which contains 21 characteristics of implicit leadership-quality table (Murphy 2011). Test results after one year showed that, the model has sustainability and stability across age, position and cross-service life.

For influencing factors of implicit leadership, Stark pointed out that the characteristics of parents play a key role on children at implicit leadership; parents give

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<sup>1</sup> <http://www.icxo.com/>

their children first social experiences including expectations of future, which may affect their children on the formation of the concept of authority. Individual personality traits have important implications implicit leadership theory, Offermann's (1994) type of implicit leadership theory and the "big five" personality traits have significant common.

#### ***66.3.4 Achievement Motivation and Leadership-Motivation Theory***

David C. McClelland and Professor of psychology, at Harvard University in 1949 produced the concept of three social motives, that is, achievement motivation (Achievement), affiliation motivation (Affiliation) and power motivation (Power) (McClelland and Boyatzis 1982). After a long period of research, McClelland discovered excellent leader ideal types of social motivation, high power motivation, appropriate achievement motivation, of the relatively low level of affinity motivation. High achievement motivation of leaders may harm the development of the organization. At the same time, McClelland stated that although motives are relatively stable personal characteristics, but in some cases can also be changed. McClelland in 1965 published "Toward a theory of motive acquisition", how to enhance motivation is summarized in four steps.

Motivation leadership was stated by Chan K. Y in 1999, and he defined leading motivation as: the inherent the level of effort and perseverance that individual leaders would pay to be a prominent individual and the will that the would-be leaders decide whether to attend relevant training, take on roles and responsibilities (Chan et al. 2000). The theory is that: the leadership motivation level and leadership behaviors are closely related, under the combined action of individual cognitive factors and non-cognitive factors, individuals with high leading motivation are more likely to be a good leader. Chan considers non-cognitive skills such as personality, values, and sense of self-efficacy on the basis will influence leaders' behaviors through leadership motivation, and leaders' behaviors, in turn, will affect the leadership role for the individuals involved in leadership activities. Zaccaro and others (2004) in the 1990–2003, in empirical summary of the leadership characteristics, said that results from Chan and Drasgow make you feel that there is hope and it deserved further study.

#### ***66.3.5 Leadership Competency Theory***

In the 1970 of the 20th century, competency theory was proposed and practical application of the theory of competency theory is growing, many scholars also carried out research on leadership competency. As for the connotation of the

leadership competencies, it is generally considered as the potential characteristics of leaders, including motivation, characteristics, sense of self, values, knowledge, and so 5 levels (Zaccaro et al. 2004).

The most prominent parts of leadership competency theory are its application in practice. At present, many companies, which had greater influence on business in the world, had developed leadership competency models, and use it for leadership development and training of personnel. Motorola, United States Bank, GE, IBM, Lufthansa Airlines, PepsiCo, Pfizer, Royal Dutch Shell and Canada Royal Bank Financial Group had developed a leadership competency model. Many well-known enterprises in China also attaches great importance to development and application of leadership competency model, Huawei, Lenovo, Haier, China Resources group, also started to develop leadership competence model and applied it to the leadership development in the Organization.

In addition, the global famous management consultancy Hay company (2008) after 2 years of time, established the first “Excellence quality model for business leaders of China”, and on the basis had launched the plan of “future stars of excellence cultivating business leaders in China”. At the same time, with the application of competency theory, there was born a number of research institutions in China, such as NorthForest consulting ([www.beisen.com](http://www.beisen.com)), BDZH, HeBang ([www.hebangchina.com](http://www.hebangchina.com)), driver management consulting ([www.DriveTop.com](http://www.DriveTop.com). CN), they all promote development of leadership competency.

World renowned consulting firm Gallup put great emphasis on the important role of the leader in the development of modern enterprises and its core concept is “competence + skill”, that the core of advantage is competence, competences are persistent patterns of thinking, feeling and behavior demonstrated spontaneously by the personal that would make benefit. The competence and leadership, which Gallup stressed, are same theory of leadership traits. Gallup believes that talents have 4 dimensions, 34 themes.

## **66.4 Inspiration from the Development of Leadership Trait Theory**

Throughout the history of the development of leadership traits, the reasons why leadership trait theory had been in low ebb, one important reason was that we were just concerned about this conclusion “there are no essential differences between leaders and followers”, while neglecting this conclusion that “there is a link between certain traits and leadership success” (Bass 1990). We found that in practice leadership training alone does not bring about effective leadership, leadership traits plays an important role in the development of leadership (Fiedler 1996). The wide application of leadership trait theory verifies its rationality, science and value. Therefore, that, the studies of leadership trait theory in the 1980 of

the 20th century get people's attention, is taken for granted again; it is a rational regression of leadership theory.

Second, the development of leadership trait theory shows that points of view, "personal traits cannot be used to predict the future leadership success", "trait theory is not an effective method of training development" is one-sided. Now the more consistent view is that personality traits can promote or impede the efforts of leaders' influence others, various scenarios and characteristic of the followers will also have an impact on the leader's personality (Hamid and Krauss 2005). Practices of leadership trait theory show that the leadership trait can predict leadership effectiveness. Practices of Microsoft, Motorola, Gallup, Huawei, Hay and many other companies show that this theory did play a role in the development of leadership qualities and the prediction of performance of it. Application of leadership traits in a large number of organizations actually broke the conclusions that the leadership traits cannot predict performance, of course, this prediction of performance takes place in a particular organization, with the scene (Organization) variables, and leadership trait has the ability to predict performance. At the same time, if the leadership was regarded as a dynamic process, to be analyzed from a developing perspective, then, it is not impossible for successful leadership trait to be learned, but it can be formed and developed in practice of leadership.

Again, the development of leadership trait theory is inseparable with the awareness of leaders. In the first study of relevant leadership, leadership was viewed as leaders. Over the past twenty or thirty years of development, concept leadership undertook greater progress, from the leader to interactive process of leaders, context and followers (Howell 1988). The development of leader concept laid a foundation for the paradigm shift of leadership trait theory. Leadership trait theory paradigm has evolved from simple studies of leader traits, into system study of leaders, context and followers. Leadership trait theory development also demonstrated the development law of leadership theory research from the simple to the complex, from the fragment to the system. On this basis, leadership trait theory broke through the leader's personal research and was developed into a comprehensive research on multiple levels. Shift of research paradigm made people once again recognize the value of leadership trait theory, leadership trait theory had gained a new vitality, there came charismatic leadership theory, implicit leadership theory, effective leadership theory, leadership competency theory.

Finally, although the leadership trait theory has gained greater progress in nearly 30 years, but it must be noted that leadership trait theory also needs further integration. Leadership study has hundreds of years of history; leadership theory research already has a lot of accumulation. However, the subject is far from being mature and perfect. Researchers and practitioners don't have consistent view on important issues such as the essence of leadership and effective leadership; on the other hand there were many fields to which we have not answered. As for leadership trait theory, in order to get further development, it must effectively integrated the existing theoretical research results, forming a more theoretical framework of norms, to lay the foundations for the next study.

## 66.5 Conclusion

Scientific research of leadership has a short history in China, has a history of more than 30 years only. As the leading resources is increasingly becoming a critical resource and an irreplaceable resource for social development, scientific research has grown quickly, also achieved more success.

How to correctly and systematically treat the development of leading scientific theory is not only a very concerned academic issue, but a problem that had plagued Western for a long time. This article do hope that by recalling the trait theory of leadership development and making comprehensive introduction, we can have a comprehensive understanding of it and generate a certain amount of inspiration and lessons for effective application and innovation of leadership theory in China.

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# Chapter 67

## Study on Theory Framework of Enterprise Strategic Motivation

Tong-ai Du

**Abstract** Due to the inherent characteristics of human resources, motivation becomes key factor for carrying out human resource potential. Employee motivation decision must be carried out on enterprise strategy, which is implementation of the strategic motivation management. This article combined the strategic motivation background, characteristics of strategic motivation, consolidating existing research, expounding in depth strategic motivation, proposing a more normative framework of enterprise motivation strategic theories. Based on this theoretical framework, we can clearly understand the strategic motivation content, objectives and implementation steps, which is conducive to promoting the implementation of strategic motivation.

**Keywords** Knowledge economy · Business strategy · Strategic orientation · Motivation · People-oriented management

### 67.1 Introduction

After entering the 21st century, knowledge economy is getting faster and faster development, human capital is increasingly playing a prominent role in the development of organizations, becoming an irreplaceable resource (Noe et al. 2000). Moreover, with the development of economic globalization, enterprises face increasing uncertainty; change and innovation became the key to the survival and development of enterprises. At the same time, with the development of social productive forces, rich material resources, people have access to more comprehensive development, their needs are increasingly diversified. In this context,

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human resources become the key to competitive advantage of enterprise activity (Wang 2006).

Human resources are different from material resources (Wei 2004). In general, it is dependent on the employee body, has the potential and activity. Therefore, the incentive is critical for human resources management. As for how to motivate employees, scholars in the West conducted a lot of research from the perspective of psychology, sociology and economics, had produced rich results. But it must be noted that traditional methods of employee motivation is for short-term goals, for a specific task or job, this incentive can blur overall objectives, weaken the of comprehensive and sustainable organization development, strengthen individual goals, weaken the overall incentive effect (Li 2003). Researchers referred this traditional incentive as task-incentive, and proposed to establish a strategic incentive to ensure the enterprises to be adapted to changes in external environment, and gain a competitive advantage.

For now, simple task motivation can no longer adapt to socio-economic development, a consensus for the need to strategically motivate employees has been reached. Strategic motivation as a new model, having shorter development time, has not yet formed a more normal theoretical framework, lack of systematical analysis, impeding the effects of the application of strategic motivation. Based on this, this article, on the basis of existing research, combined with the development background of strategic motivation and analysis of drawbacks of simple task motivation, thereby combined characteristics of human resources, constructed strategic motivation theory framework, with a hope to advance the strategic depth of research.

## 67.2 Methodology Background of Strategic Motivation

Any new points of view can not be made without of socio-economic development, strategic motivation is as well. Taken together, it was put forward under such background.

First of all, knowledge and ability is playing an increasingly important role in the socio-economic development. Distinguished from such production growth relied on materials and capital, modern economic growth is increasingly dependent on the growth of knowledge content. Value created by knowledge in modern society is much higher than such traditional factors as capital and material; knowledge became the most basic elements of creating value. Knowledge and abilities are there in the human body, being inseparable with people (Aseff and Santos 2005). Therefore, as dynamic changes of resource with the social productive forces, knowledge as first essential elements for economic growth in the knowledge economy era, human resources will inevitably gain emphasis.

Secondly, economic globalization is increasingly high; businesses are facing growing incentive competition. Economic globalization and internationalization significantly alter the structure of markets, business competition is increasingly

fierce. Intensifying of corporate competition put forward higher requirements for corporate change and innovation. And innovation is inseparable from support of human resources (Staikouras et al. 2007). Therefore, human resources as a strategic resource of modern enterprises, naturally become the object of the competition, competition for human resources has reached unprecedented levels.

Once again, human resources increasingly become the core resource. 1990 Hamel and Prahalad published article of the competitive capacity of the company in Harvard Business Review, sparking a wave on study of core competence, and soon it was accepted and used by the business community in Europe and America (Heneman et al. 2001). On the base of the concept of enterprise core competence, attitude of competitive advantage based on competence is achieving a dominant position. With the advent of the knowledge economy, the concept of competitive advantage based on knowledge came. This view takes that competitive advantage comes from knowledge hidden behind the ability of enterprise, and being closely related with cognition and learning, especially knowledge has played a key role (Balkin and Gomez-Mejia 1987). Either the knowledge economics or the learning organization, all put full importance on the role of human resources, have stressed that the core position of human resources (Main et al. 1993). Human resources increasingly become the core resources for development (Levinson et al. 1962). From then on, all the competitive advantages can not be obtained without the knowledge, even without the carrier of knowledge—human capital, because of characteristics of property rights of human capital requires companies to motivate it to achieve strategic objectives. Therefore, research course on theory of competitive advantage naturally became the base for research of motivation theory based on strategic theory.

Finally, the traditional task motivation increasingly can not adapt to the changes in the socio-economic development. Traditional task motivation stimulates some very specific short-term targets, being unable to meet the needs of enterprise's long-term, comprehensive development, task motivation may not be achieved in the long term development strategies and objectives (Schein 1980). Not only that, task motivation may also deviate from the strategy, destroying strategic foundations of the organization. How to effectively motivate staff, provides staff enthusiasm, initiative, and meet the requirements of enterprise development, and realize enterprise development goals is hot areas for nearly 20 years (Herriot et al. 1997). In this regard, management patterns such as the strategic human resource management, strategic salary management, strategic performance management with strategic guidance had emerged, which provide a fresh perspective for people to inspect motivation.

### 67.3 Results Concept and Features of Strategic Motivation

As for concept of strategic motivation, most of the researchers defined it from the organizational strategy and some researchers defined it by means of a comparison of task motivation with the strategic motivation, the following definition of strategic motivation is more typical among scholar at home.

Yin-hao Wang: strategic motivation is based on the Organization's long-term development strategies, using comprehensive incentive programmer designed to achieve harmonization of responsibilities and rights, more motivation of the team or group (Argyris 1960).

Ming-hai Wei: a strategic motivation is aimed at the long-term development strategy and the implementation of comprehensive incentive. Motivation is not just a strategic incentive scheme; it is a business or organization culture, covering a series of important content of the formation of common values, system design and construction, job promotion, a combination responsibilities and rights (Jensen and Murphy 1990).

Bao-yuan Li: strategic employee motivation should not be confined to resolve the immediate problem; it should be based on the long-term development of enterprises, focusing on organizations, teams and individuals of long-term and long-term incentive (Barro and Barro 1990).

From the existing research on concepts of strategic motivation, strategic motivation exhibits the following characteristics:

1. Strategic motivation is the starting point of the enterprise strategy, with an emphasis on enterprise strategic support. Based on human resources and the important role of motivation, strategic motivation is as a whole from the enterprise, and around the enterprise strategy to develop appropriate incentive measures, to solve the problem which is the long-term development of the enterprise.
2. Strategic motivation is a comprehensive motivation. Existing research of strategic motivation has made that a strategic motivation is a comprehensive motivation. Judging from existing research, most of the so-called comprehensive motivation refers to a comprehensive incentive measures, such as property right motivation, emotions, encouragement, incentive pay, such as combining a systematic set of motivation.
3. Strategic motivation is a long-term motivation. On the base of increasing uncertainty and fierce competition, existing study of strategic motivation stated that it be a long-term incentive. Enterprises must make sound use of long-term motivation the mechanism stimulating staff continue to win in the competition to maintain the Organization's sustainable development.
4. Strategic motivation is team-oriented. It is different task strategic motivation focused on personal motivation, which focuses on team motivation. It is inseparable for putting more emphasis on team collaboration in today's enterprises.

In General, at present, strategic motivation should proceed from a strategic point of view, dealing with organizational strategy, playing a supporting role, and a consensus has formed. At the same time, for comprehensive strategic motivation, there are also such strategic motivation management methods and approaches as property right motivation, encouragement, material incentives. But there are some system issues such as what the goals of the strategic motivation are, how it guides the comprehensive and sustainable development of organizations to form core

competitiveness, how it put up a bridge between corporate strategy and staff, currently, most of the recent research is not involved. In other words, most of the existing strategic motivation study is stay in the “point”, has not yet formed a complete theoretical framework. Deficiency of strategic motivation will definitely affect the standardization of theoretical framework practical application.

## **67.4 Discussion Strategic Motivategic Theory Framework**

### ***67.4.1 Human Resource Features and Motivation***

Fundamental features of Human resources, which make it different from the other non-human resources, are that it exists in the body of the staff, and it cannot be separated from the staff, when other people or organizations want to use human resources, which can only be achieved by the cooperation of individuals through its natural owner. Therefore, whether human resources management is “people-oriented”, whether it can effectively arouse the enthusiasm of the staff, whether it can maximize staff’s subjective initiative and creativity, will determine the organization’s performance and became key factors of success of human resources management. Therefore, compared to other aspects of management, human resource management is through “motivation” to be achieved.

Motivation as a psychology term refers to stimulating mental process of human behavior. The concept of motivation for management refers to stimulate staff motivation, meaning that various effective means should be used to mobilize the enthusiasm and creativity of employees, make the employees try to complete the tasks of the organization, achieving the organization’s goals. Therefore, the fundamental purpose of motivation mechanism of enterprises is to properly induce motivation of employees, enabling them to achieve organizational goals while achieving their needs, increase their satisfaction, initiative and creativity so as to enable them to continue to maintain and develop it. So we can say that application of motivation mechanism in a certain extent is an important factor which determines the rise and fall of business. How to use motivation mechanism has become a very important issue facing businesses.

### ***67.4.2 Principles of Strategic Motivation Theory Framework***

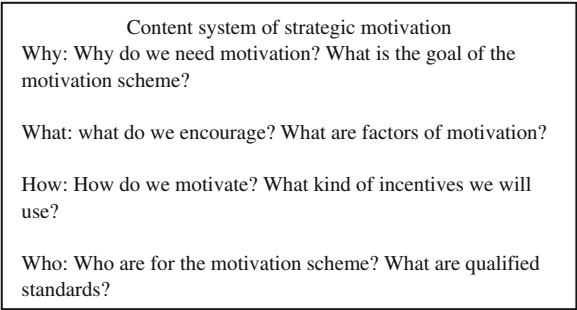
Based on the above analysis, strategic motivation is about making decision of staff motivation at the height of strategy, and the specific incentives and methods must be developed from the staff needs, its ultimate goal is to enhance the competitive advantage of enterprises, realize strategic goals. Based on analysis, strategic motivation theory framework should follow the following principles:

1. Strategic guiding principle. The mutual agreement of strategic motivation and corporate strategy is to improve business performance, improve the enterprise advantage within organization, and help companies achieve their strategic objectives. Therefore, the strategic motivation theory framework of enterprise should be designed in the light of development strategy and should fully reflect the requirements of your enterprise strategy. Therefore, the framework of the strategic motivation theory should further refine the strategy to form expected strategic capability or behavior, and thus form a strategic incentive objectives. Through strategic behavior and ability, we can join the corporate strategy and the strategic measures to realize coherence of employee behavior and capacity and strategic choice and combination.
2. People-oriented principle. Human resource is different from the general material resources, particularly for its special features. At the same time, modern contract theory proves that any business is essentially a “special contracts” made up of human and non-human capital. Human capital property in enterprise system arrangements has a special decisive status and role, power and interest of non-human capital property can only play a role by direct participation of human capital; enterprise system arrangements changes with contract conditions realizing revolution in interactive game enterprise members, its basic trend is: human capital and ownership in enterprise contract has increasingly large of competition advantage, And a variety of enterprise system arrangement and corporate governance evolve in cooperation and competition of the non-human capital. Therefore, the strategic motivation theory framework need to adhere to the people-oriented principle giving full consideration to employees’ needs and expectations inside.
3. Systematic principle. Strategic motivation is not against only one person or one issue, but a comprehensive incentive for enterprise development strategy. Therefore, the strategic motivation itself is an organic system; it is made up of strategic motivation, strategic objectives, strategic motivation means and other factors. And corresponding strategic motivation target was a network of strategic target, management goals and other objectives; strategic motivation measures are determined by a comprehensive incentives system made of property right motivation and remuneration motivation, emotions motivation and culture motivation. Thus, strategic motivation theory framework must follow the systematic principle, taking into account the incentive problems and making integrated design.

### ***67.4.3 Content and Theory Framework of Strategic Motivation***

Strategic motivation is the connection point of organizational development and employee needs, being tools and methods for the achievement of “win-win” of enterprises and employees. It is based on the organizational strategy, fully paying attention to the demands and expectations of the stakeholders, mobilizing the

**Fig. 67.1** Strategic motivation content system

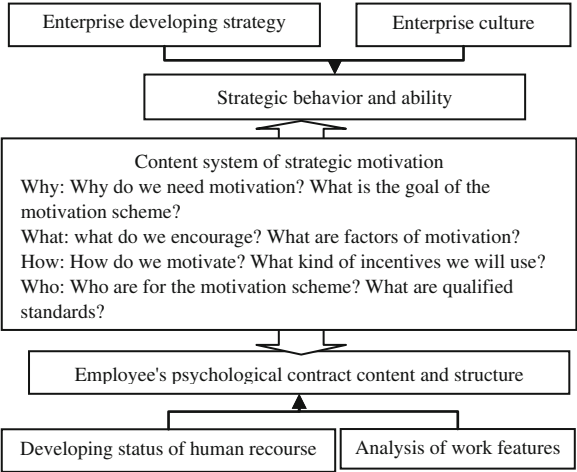


enthusiasm of the staff, improving organizational performance, achieving the organization’s strategic goals. The bridge between corporate strategy and strategic motivation is staff strategic behaviors and abilities. Strategic behavior and capacity have value of the long-term development expected by enterprises, including two kinds of behavior, one is the company’s general required behavior, and two is those which have special value being the key link in the value chain. Of course, behavior of employees will not naturally evolve into strategic behaviors and abilities; it must be inspired and shaped to strengthen strategic behaviors and abilities of the staff. In addition, the strategic motivation must fully take into account the organization’s development strategy and corporate culture, must also fully understand staff’s characteristics and needs, it can only be effective by combining the two factors t. Psychological contract theory provide a good ways and means for comprehensive and in-depth understanding of employee needs.

Based on the above analysis, we propose content and framework of strategic motivation theory respectively, as shown in Figs. 67.1, 67.2.

The theoretical framework proceeds from the strategy, centering on corporate strategy and corporate culture, refining requirements of strategy and culture into

**Fig. 67.2** Framework of strategic motivation



behaviors and capacities expected by the organization. Strategic motivation goals are, through comprehensive incentive measures, to encourage their employees to achieve expectations of enterprise strategic behavior and ability, so as to realize the enterprise's development strategy. At the time of design of strategic motivation objectives and methods, we must fully take into account the employee's inner expectations, appropriate incentives and objectives can only be truly effective we it meet requirements of employees and business requirements.

## 67.5 Conclusion

Strategic employee motivation, even in Western countries, is a relatively new field, for Chinese enterprises in a transition period, regardless of the theory study or the actual applications there are a number of issues. This article try to make comprehensive research on existing strategic motivation outcomes through the analysis of strategic motivation background, propose principles of framework design strategic motivation theory, from the perspective of corporate strategy and employee's psychological contract, strategic motivation theory framework should be designed, contribute to strategic motivation of research and application.

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# Chapter 68

## The Research of the Knowledge Worker Incentive Strategy Based on Human Capital Characteristics

Nai-wen Li and Meng-hong Xu

**Abstract** The labor and industry structure are becoming increasingly “knowledge intensive” as the proportion of the “knowledge labor” and the “knowledge workers” is becoming bigger and bigger in modern production. They possess more residual rights of controls. In this case, the knowledge workers cannot be fully motivated merely by mandatory supervision or material award. As the new management philosophy is being accepted by an increasing number of people, the revolution and enhancement of the philosophy of human resources management are making fundamental changes on its status and functions. From the perspective of human capital, this paper analyses the characteristics of human capital, and put forward several human resource development strategies with the new philosophy of human resource management and the idea of human-oriented management about employees’ participation in management, stock option incentive mechanism, and career development which provides a good reference to the modern enterprises.

**Keywords** Knowledge worker • Human capital • Incentive strategy • Innovative labor

### 68.1 Introduction

At the age of the steam engine, the ratio of intellectual labor and physical labor was 10:90. At the age of internal combustion engine, this ratio became 50:50 (50.2:49.8 for America in 1956). However, at the age of knowledge economy represented by the development of computer, the ratio of intellectual labor and

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physical labor is 90:10 (95:5 for America in 1999). In the era of knowledge economy which is dominated by innovations, the system of intellectual property right including the patent right is being built up powerfully and becoming increasingly developed. It has become the dominant factor and core competence of the economic development. In this new historical period, the character of labor has some changes. More attentions are drawn to the intellectual labors. Thus, the value of innovative labors and responsible labors has become the key element in the development of knowledge economy. Knowledge workers are now the core talents of enterprises. Thomas Davenport says knowledge workers are the horse which pulls the plow of the economic progress (Davenport 2005). They are a special group of workers with good personal qualities and good educations. They have independent thoughts, judgments, and values, and have strong desires on self-development and self-actualization. Those workers are mainly engaged in intellectual works and innovative works. Their working process is not easy to monitor, and their achievements are sometimes hard to assess.

Knowledge workers with intellectual capitals are the key factors of the modern enterprises' success. The most valuable resource exists in the intellectual works of the employees which is the core force of every enterprise. If all the employees are loyal to the enterprise, and are willing to work creatively, and dedicate all their intellectuality to the enterprise, this invisible source of competitiveness can be significantly improved. However, in many enterprises, there still exist some problems of incomplete ownership of the intellectual human capital, inappropriate access to the intellectual human capital, imperfect disposal of the intellectual human capital, and defective gains right of the intellectual human capital (Lin 2011). Therefore, how to effectively protect the rights of the owners of intellectual capital and adequately motivate them is a crucial problem in the field of human resource managements.

This paper takes knowledge workers as a research object, and puts forward a strategy on the motivation and development of knowledge workers on the basis of human capital characteristics and human resource management and development philosophies. It provides enterprises with some valuable references.

## 68.2 Human Capital and its Characteristics

The human capital is the ability, knowledge and skills that enables a person to take part in activities with economic values. It is a kind of initiative asset which cannot be separated from its carrier, and is controlled by the carrier to activate, develop, and utilize the capital (Becker 1962). According to the Marx's Capital theory, capital can bring value that exceeds itself, which is the surplus value. Human capital has this characteristic too (Marx 1975). In addition, human capital also has some other characteristics. It is invisible, alive, private, initiative in utilization, reproducible, and capable of increment. The development of enterprises' human

capital should comply with those characteristics. It is important for enterprises to develop appropriate knowledge worker incentive strategies.

In modern enterprises, both surplus income and economic growth depend on human capital. Thus, the status of human capital is being improved gradually. The components of human capital, like the knowledge, skill, and attitude, have the general characteristics of capital. The ownership of health, physical strength, experience, knowledge, skills and other spirits' stock can only inseparably belongs to the carrier, the carrier must be not only people, but must be himself (Zhou 1996). The owner of human capital has property right. The property right of human capital, including ownership, right of dominion, right of disposal, right of utilization, and right of income, is a kind of incomplete and restricted right. It is a set of rights that belongs to the investor under certain conditions. The basic characteristics of property is private, limited, can be traded and decomposable (Huang 1995). Although the property right of human capital is transferable and exchangeable, the owner of human capital always has the gains right. This gains right does not only include gains of salaries and bonus from the individual transfer or exchange, but also include the added value brought by the operation accumulation, knowledge increase, skill improvement and attitude amelioration.

Human is the owner of the human capital who has the right to independently judge and analyze the control power of the utilization, exchange, and disposal of the human capital. When an enterprise fails to satisfy the physical and psychological needs of the owner of the human capital to some extent, the initiative of human capital will start to bring some effects. To be more specific, in the process of combining human capital with nonhuman capital, if the carriers of human capital get income that can only maintain their reproduction of labor force without any surplus value created by them, they would become lazy and "pick up free rides" or even shut their human capital (Zhou 2000). Thus, the specialty of the human capital's private ownership requires the managers think highly of the human capital investment, pay more attentions to the management of human capital utilization, and respect the human capital property rights, so as to provide the individual human capital with a better development and maximize the output of the human capital investment.

### **68.3 The Development of New Philosophy of Human Capital Management**

Enterprise as a human and non-human capital special contracts, starting from view of the parties of the contract all have equal property rights, they are eligible and may have business ownership (Yang and Zhou 1997). According to Marx's Labor Theory of Value, the surplus of an enterprise comes from the live labor of the workers. The private ownership of the human capital determines that the carrier of human capital should be motivated by the right of residual claim. The essence of residual claim is

residual control rights (Zhang 1996; Fang 1997). Therefore, in order to enhance the influence to the innovative workers and responsible workers, enterprises should provide incentives of respecting and sharing the right of surplus division in exchange for the control of surplus labors. However, the private ownership of the human capital determines that the distribution of the residual rights of control is uncertain, and there hardly be a unified regulation. Efforts of operators and producers have not oversight, just varying degrees of it (Li and Zheng 2005). The effectiveness of the incentives cannot be guaranteed solely by supervision, but by incentives like the employees training programs, career development management, compensation management, enterprise culture, and by providing the employees with proper guidance to serve the organization. Chinese Enterprises Federation and Chinese Entrepreneurs Association released a report including questionnaires of thousands of managers in state-owned enterprises at the end of August in 1999. The report shows that 82.64 % of state-owned enterprise managers believe that major factors affecting the construction of contingent of enterprise managers in China is “lack of incentive and constraint mechanism” (Wang 2010). Above all, in the era of knowledge economy, the role of human resource management, which serves as restriction, motivation, and guidance, is becoming increasingly significant.

Human resource management is a management activity to satisfy individual needs and realize organizational goals by which human is effectively developed, reasonably utilized, and scientifically supervised. From the perspective of development, human resource management includes not only the intellectual development, training development, and career development, but also the improvement of ideological and educational levels and moral consciousness. It helps to fully display existing capabilities and effectively release potentials. From the perspective of utilization, human resource management should involve the discovery, identification, selection, distribution, appropriate utilization, and maintenance of human resource. It should adequately inspire potentials and subjective initiatives so as to match talent with proper positions and improve productivity. From the perspective of supervision, all the supervision measures are expected to fulfill employees' needs, inspire their initiatives, and make them contribute their intellectual capitals to the organization. How to attract and retain competent staff and stimulate their dedication spirit, become the mission of human resources management (Lu 2006).

## 68.4 Knowledge Worker Incentive Strategy

Being fully motivated, human capital can be strongly adaptable and creative in the process of its utilizing and consuming. Modern human resource management is essentially a platform for transactions between enterprises and employees. By satisfying the employees' working and living needs, this platform allows the employees to realize their values to the greatest extent and to make contributions to achieve the organizational goals, and brings in the mutual development of enterprise and employees.

### ***68.4.1 Incentives Based on Job Redesign***

When the condition of performance and profit is not bad, most companies would rarely consider whether the existing organizational structure and job design conform to the changes in the external environment, nor do they consider whether the employees have devoted great passion to their works, and give full play to the initiative to promote their performance. Job redesign is a process of redefining job duties, contents and working methods on the basis of the original design to improve the employees' working and living qualities.

Job redesign can solve the problem of inappropriate human capital utilization. It creates positions and job contents that inspire individual potentials, comfortable working environment, and convenient working procedures to stimulate the invisible human capital and avoid the excessive use of the human capital.

Every work can be described with five core dimensions, which are the skill variety, task identity, task significance, work initiative, and feedback. Knowledge workers have stronger independent abilities and values. In order to realize their values, they prefer the works with challenges and creativity. Thus, when designing works for knowledge workers, the focus should be on the characteristics of the work content, so as to improve the employees' satisfaction and loyalty.

1. Apply job designs of job rotation, job enlargement, and job enrichment to change and enrich work contents, and eliminate the lassitude towards a long-term single job. In the process of job rotation and enrichment, employees are motivated by new skills they have learned and by strengthened autonomy and responsibilities. At the same time, the cooperation and communication among employees are also significantly promoted.
2. Carry out alternative works. In addition to redesigning the characteristics of the job itself, changes in work arrangements can also make the working environment more stimulating. Flexible working hours, job sharing and telecommuting works are three major forms of alternative works. Since it is difficult to monitor the working process of knowledge workers and is hard to assess their performance, providing a more relaxed psychological environment and working environment ignoring the rigid working rules can inspire greater enthusiasm for their works. Employees are able to choose specific working time, working place and combinations of works by themselves, provided that they can ensure the completion of the established tasks within limited time. In recent years, this flexible job design is being accepted by an increasing number of enterprises both at home and abroad.

### ***68.4.2 Incentives Based on Employee Training***

Warren Bennis, a master of American leadership theory, developed Bennis theorem, said that training is strategic investments with the least risk and the largest return (Ma and Yang 2010). Training meets with the characteristics of human

capital's reproducibility and capability of increment. It helps to add value to the human capital, and prolongs the "life time" of the human capital. Becker's study points out: Education and experience are the key features of the concept of human capital. Education increased the stock of individual's information, knowledge and skills; experience includes work experience, on-the-job practical learning and training. Thus having more and higher-quality human capital will help enterprises get more ideal profit (Gu and Wang 2009). Knowledge workers have strong thirst for frontier knowledge and skills. Enterprise should provide knowledge workers with more educations and training opportunities to arm their heads with advanced concepts and ideas, and improve the employees' learning and innovation abilities. Therefore, the employees' needs for self-development are fulfilled, and their "lifelong employability" is enhanced. When the employees apply those knowledge and skills to practical works and their dependence and loyalty to the organization are enhanced, the enterprise competitiveness will be greatly improved.

### ***68.4.3 Incentives Based on Employee Career Management***

Knowledge workers have the characteristic of strong mobility. If they are not satisfied with the treatment or the development opportunities in an enterprise, they often have a strong intention to resign. Enterprises should adequately understand the personal interests, talents, abilities, and personal development goals of the knowledge workers and then design, plan, implement, evaluate, and feedback about their careers. It is important for enterprises to help the workers achieve their personal development aspirations according to systematic plans, and to provide them with opportunities for their career development. Enterprises must make it sure that the individual career is aligned with organizational strategic objectives. For the employees, they hope to receive the organization's recognitions and equal opportunities of promotions or switching to better positions. Thus, effective career management will boost the employees' morale and strengthen the organization's appeal to employees.

### ***68.4.4 Incentives Based on Compensation Management***

Compensation management is an important embodiment of human-oriented management in the enterprises. The philosophy of the so called "human-oriented" management is to respect the needs of human capital and to satisfy both their physical and mental needs. In view of the special psychological features of the knowledge workers, the enterprises can not only use material incentives, but also establish a long-term incentive mechanism which allows employees to share the values created by their works. The enterprises should also pay attention to the intrinsic forms of compensation which are the job autonomy, opportunities of self-

developments, and the sense of self actualization. To some extent, the intrinsic forms of compensation incentives are even more effective. The enterprises should place equal emphasizes on both spiritual incentives and material incentives, and enhance the incentive mechanism as a whole. The problem of defective gains right of human capital can be solved by proper compensation management. However, there must be a scientific performance assessment standard to evaluate the values that the knowledge workers contribute, so as to avoid the decrease of morale brought by the misunderstandings in benefit distributions.

1. Lay stress on long-term incentives such as stock options. According to the theory of property rights, in order to effectively retain the core knowledge-workers, enterprises must give them some “residual control rights” or “residual claims”. As to the practice, that is to take the “stock option” as incentives to bundle the benefit of the employees and the development of the enterprise together, so as to share the profit and motivate the employees in a long-term.
2. Pay attention to intrinsic compensation. The psychological benefits brought by fair internal promotion opportunities, self developments, the work content or the working environment are also necessary supplementary incentive measures.

#### ***68.4.5 Incentives Based on Enterprise Culture***

Culture is invisible, but it can be the most durable incentive to the people. Establishing a kind of human-oriented enterprise value can make the employees feel that they are no longer tools employed by the enterprise, but a new type of strategic partner of the enterprise. Under the nurture of a human-oriented atmosphere which is filled with mutual respect, trust, and fair competitions, employees' sense of ownership will also be enhanced. They will actively contribute their power to the development of the organization. The conduct of motivation, organizational learning, employee participation in management, feedbacks, and guidance will build up a bridge between the enterprises and employees. Participating in management or being authorized increases the employees' sense of achievement. As a result, they would work more actively with the flexible techniques and the right teams. Thus, the philosophy and core value of the enterprise will be kept deep in the minds of the knowledge workers.

### **68.5 Conclusion**

The core competition between modern enterprises is the competition for talents. Human capital is a kind of intangible asset that exists in the individual carriers. How to develop and utilize the human capital is a crucial problem to all the enterprises. This paper is based on the characteristics of human capital, and introduces the philosophy of human resource management. The paper has proved

that by human resource management on the basis of respecting the private ownership of human capital, the enterprise can fully activate the invisible capital's initiative, improve its capability of increment, and prolong its working life. The core competitiveness of an enterprise can be enhanced by both complying with the characteristics of human capital and realizing individual values of the knowledge workers. The result of this is a win-win situation.

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# Chapter 69

## Study on CDIO Talents Training Mode of Industrial Engineering

Xiu-ju Lan, Yan Zhan, Ying-de Li and Jian-sha Lu

**Abstract** Manufacturing is the leading industry of Zhejiang Province. Under the guidance of the CDIO engineering education concept, industrial engineering of Zhejiang University of Technology proposed the CDIO personnel cultivation mode. The mode takes the market demand on manufacturing talents as the direction, constructs basic curricula system according to the requirements of ability training, enhances the ability of engineering education for teachers and sets up sustainable improvement system on education quality project.

**Keywords** Industrial engineering · CDIO · Talents training mode

### 69.1 Introduction

CDIO training syllabus foster engineering graduates from four aspects: basic engineering knowledge, personal skills, interpersonal team skills and engineering systems, while students take the initiative, practical and organic learning among the courses (Crawley and Gu 2009). In 2005, college of engineering Shantou University carried on CDIO engineering education mode, focusing on training the students' systems engineering technology ability, especially project conceiving, designing, developing and implementing abilities, and strong self-study ability, organizational communication and coordination abilities. The mode aimed at absorbing world advanced developments of engineering education concept and establishing curricular system to reach consensus on international engineering education, to acquire agreement on Washington certification in 2011 and let its graduates standing on the same starting line with those from international famous

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universities (Gu and Shen 2008). Zhejiang University of Technology was among those 39 CDIO pilot universities, which were identified by the Ministry of Education from the Department of Higher Education from 2008 to 2010. In recent years, the number of colleges and universities setting up industrial engineering specialty has increased rapid (Qiu 2007). Industrial engineering (IE) is a kind of professional skill combining technology and management (Zhou 2008), thus engineering education background should be a trend of industrial engineering education and talents training mode.

According to statistics, labor productivity from manufacturing sector in Zhejiang did not reach one-tenth of the level which the United States, Japan and Germany had in the middle of 1990s, relying on low-cost labor and low prices to maintain competitive advantage (Wang and Sheng 2011). Industrial upgrading and change of economic growth mode require a lot of industrial engineering professionals with high-tech skill (Zhou 2009; Yang and Shi 2006). Manufacturing is the leading industry of Zhejiang Province, which needs lots of professionals with engineering education background to enhance enterprises competitive (Liu 2007). It is an urgent problem to establish “employment-oriented” talents training mode to meet the talents needs from enterprises.

## 69.2 Present Situations of IE Talents Training

There is a great number of manufacturing enterprises in Zhejiang Province and the demand for industrial engineering professionals maintains sustainable growth trend (Li et al. 2011). The purpose of IE talents training is to serve the manufacturing industry in Zhejiang Province. The statistics data on graduates' employment from industrial engineering of Zhejiang University of technology in the last 3 years show the average proportion of graduates serving the manufacturing was 60 %. With the help of mechanical engineering courses platform, industrial engineering has the advantage of engineering skills training mode under CDIO professionals.

IE is a professional skill consisting of technology and management (Yang et al. 2007), of which the purpose is to train talented manager with engineering background in manufacturing enterprises. The practical curriculum of engineering includes two aspects that consist of mechanical practice corresponded with mechanical curriculum and comprehensive practice of IE. The purpose of strengthening the engineering background is indicated in the curriculum on the whole. The exploration has been developed for many years for the talents training project to improve the background of students. However, CDIO is not used as direction. In another word, the four aspects in the CDIO outline consisting of basic knowledge of engineering, person competence, team interpersonal competence and systemic competence of engineering are not applied in neither planning nor operation of talents training project.

### **69.3 CDIO Talents Training Mode of i.e. Professionals**

#### ***69.3.1 The Purpose of Talents Training of IE Professionals***

Explore the talents training mode of IE professionals based on CDIO engineering education concept and IE major cultivation program in existence, in order to determine the joint of colleges, enterprises and students as soon as possible, enhance thinking skill, quality, engineering background and ability of practice widely and optimize comprehensive competence of students.

#### ***69.3.2 Basic Idea of Talents Training of IE Professionals***

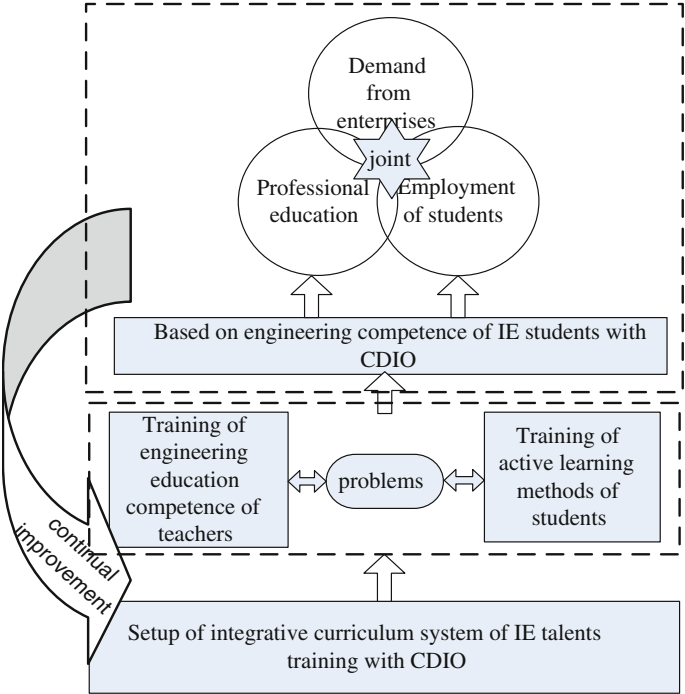
Build up the talents training mode of IE major directed by CDIO, based on which system of curriculum should be developed according to the demand of competence level. Teachers should receive training on skill of engineering education, so as to possess high level competence of engineering education to get technical support for developing project and heuristic education and correlative practice. It is necessary to establish continual improvement security system on education quality project, make an improvement step by step in planning of training as well as in ideal and method of education, reform engineering education, and actualize the combination of education, employment and demand. Figure 69.1 indicates the basic idea that help build up talents training mode of IE major with CDIO.

#### ***69.3.3 Implementation of Talents Training of IE Professionals***

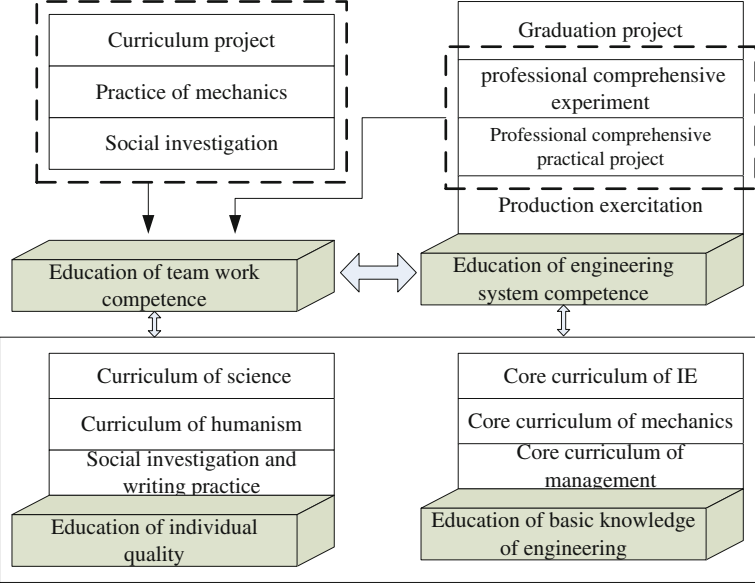
1. Optimize the talents training project of IE in existence, and determine the integrative curriculum system with CDIO.

Setup of curriculum, with four aspects of CDIO consisting of basic knowledge of engineering, person competence, team interpersonal competence, and systemic competence of engineering, is the foundation of realizing training of students. It is meaningful to analyze the relationship between professional curriculum and CDIO competence, and perform a good beginning of engineering education. The planning of curriculum is indicated in Fig. 69.2.

Education of basic engineering knowledge is led by professional curriculum. Every type of curriculum should be developed by the reformation of teaching way. The main curriculum are adjusted, of which 20 % of teaching hours will be used to comprehensive practical training.



**Fig. 69.1** Basic idea of reformation of talents training mode of CDIO professionals majored in IE



**Fig. 69.2** Planning of curriculum of IE major with CDIO

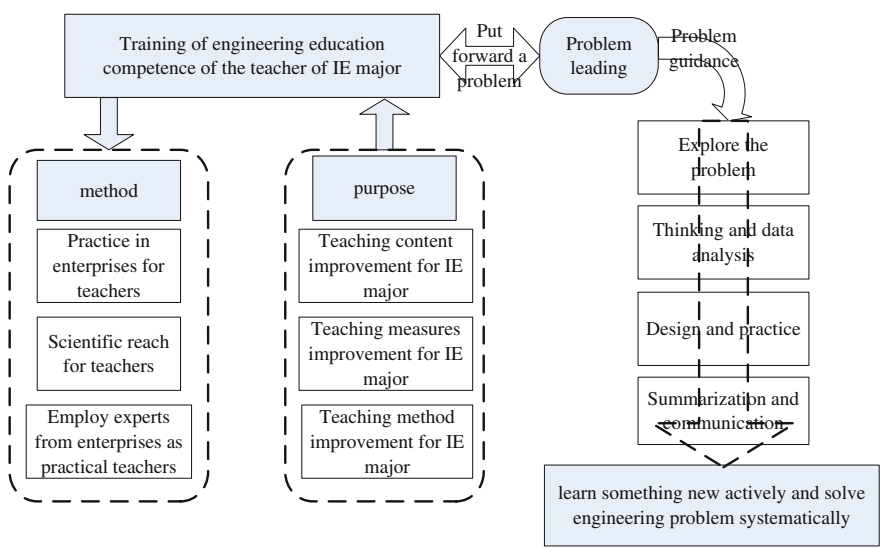
Education of systemic competence on engineering is led by practice. Based on the practical training (including experiments) in class, a new training plan of IE major is drawn to add more teaching hours, develop more comprehensive practice. Curriculum project, exercitation of different grade, professional practice by the integrative skill, professional comprehensive experiment, and the graduation project are suited to satisfy CDIO. Students’ engineering skill will be represented during the practice.

Team work competence is developed by a teaching method that provides some project accomplished by more than one student. The core curriculum is determined and provides more chance for students on team work, which will be helpful for students to form team spirit and method.

The quality-oriented education is developed by the elective course provided for students from different majors and the comprehensive quality compulsive course established by university. In addition, instruction of the major is provided, and managers from enterprises, experts and scholars are invented to share in professional quality. It is also useful for team work.

2. Realize engineering education, lead and impart student’s active learning competence.

Engineering education competence of teachers includes two aspects, the training of engineering for teachers and teaching method of engineering, which is indicated by the update of teaching content, teaching method and teaching measures. Importing a problem in the way of project, teachers lead students to explore, think, practice, summarize and evaluate. It is useful for students to learn something new actively and solve engineering problem systematically. See Fig. 69.3.



**Fig. 69.3** The training process combining engineering competence for teachers and active learning competence for students based on CDIO

3. Focus on comprehensive ability, satisfy enterprises' demand and make a combination between professional education and employment of students.

The final purpose of engineering education is transforming knowledge learned by students into productivities. In another word, the joint of three factors should be the final purpose of exploration for IE talents. Based on the exercitation bases in existence, more new exercitation bases should be built up continually. More tutors from exercitation bases will be employed. The combination between heaviest of scientific research and teaching content should be encouraged, so that students can get instruction directly by professional teachers and technician from enterprises both in laboratories and enterprises.

4. Education quality engineering, as well as enterprise quality engineering, should follow the principle of PDCA that means cyclic process of continual quality improvement. Correlative management mechanism will be build up to ensure continual improvement.

As support and safeguard of the whole project, teaching management system, teaching operation system and teaching quality control system of the IE major is a necessity. Dynamic improvement system is to be built, to follow the industrial upgrade of manufacturing in Zhejiang Province and satisfy the social requirement. Demand conditions for talents are investigated to obtain the information of the knowledge structure and skills requirement of IE talents from manufacturing. What's more, the system evaluates the IE talents training mode with CDIO.

## 69.4 Conclusions

The purpose of IE talent training is to build a system with direction of CDIO and mutual support curriculum system. Let students obtain experience of active learning. Good continual operation security management system will help students of IE major to be modern IE engineers with deep foundational knowledge of mechanical engineering, ability of developing and operating new system, management for new product and other comprehensive application competence. Through the exploration for talents training mode for many years, the IE students from Zhejiang University of Technology are always highly appreciated in manufacturing in Zhejiang Province.

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# Chapter 70

## Study on Limited Partnership Based on an Analysis of Incentive Mechanism Model of Venture Capitalist

Tian-jia Wang and Ya-na Chen

**Abstract** In the system of venture investment, there exists a kind of principal-agent relationship between the venture investor and venture capitalist, which will bring about a series of problems such as moral hazard. The organizational form of limited partnership is inclined to establish an incentive mechanism which can maximize the utility of both the venture investor and the venture capitalist with the coexistence of incentive and constraint. The paper establishes an incentive mechanism model in the organizational form of limited partnership and systematically discusses the effectiveness of the incentive pattern of limited partnership.

**Keywords** Principal-agent relationship · Venture investor · Venture capitalist · Incentive mechanism model · Limited partnership

### 70.1 Introduction

In the system of venture investment, there is a kind of principal-agent relationship between the venture investor and venture capitalist. The principal's adverse selection of the agent and the problem of moral hazard caused by information asymmetry often exist.

A limited partnership is a form of partnership in which investor and manager of venture capital form a limited partnership enterprise, and the investor provides capital and assumes the limited liability for the loss and debt of the enterprise to

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the extent of its capital contribution, while the manager takes charge of the management and operation of the investment and assumes the unlimited liability for the loss and debt of the enterprise (Cheng 1999). In the limited partnership, the venture investor invests equity capital which accounts for 1 % of the gross assets. But the equity capital is rarely in the form of cash, out of the consideration of management commitment and tax benefits. The venture capitalist can use 2.5 % of the gross assets as their management fee. They can generally get the 20 % of total investment revenue in the distribution of the investment income, but the premise is that the lowest rate of return on investment has been reached (at least principal guarantying). Applying the limited partnership into the venture investment, the organizational form of limited partnership has an significant incentive-and-constraint effect on the venture capitalist. On one hand, besides the fixed management fee as reward, the venture capitalist can receive investment revenue according to a relatively high proportion, which can generate a long-term incentive. On the other hand, as the general partner, the venture capitalist is obligated to assume unlimited liability for the loss and debt of the venture investment, which, in turn, urges him to work hard.

From the above, it can be seen that the organizational form of limited partnership is inclined to establish a set of covenant which can achieve the maximum utility for venture investor on the condition that participation constraints and incentive compatibility are satisfied simultaneously. Scholars have undertaken a series of discussions and researches on these problems. Sahlman studies how the venture investor monitors and motivates the venture capitalist to work hard by designing the covenant on the basic of unilateral principal-agent relationship (Sahlman 1990). Jiang Junfeng et al. study the divisible covenant model of the venture investment revenue by comparing the indirect pricing theory with transaction efficiency and combining the principal-agent relationship (Jiang and Wang 2009). Bergmann and Hege find that if a long-term contract is established between the venture investor and venture capitalist, the venture investor actually receives an incentive to not put off the successful accomplishment of a project (Bergemann and Hege 1998). This paper establishes an incentive mechanism model to make a systematic analysis of the effectiveness of the incentive mechanism of a limited partnership.

## 70.2 The Model and Analyses

### 70.2.1 The Basic Analytical Framework of the Model

**Hypothesis 1** The degree of effort of the venture capitalist is  $a$ . To simplify the analysis, assume that the set consisting of all the degrees of effort has only two elements,  $a \in \{\bar{a}, \underline{a}\}$ , and  $\bar{a} - \underline{a} > 0$

**Hypothesis 2** The working cost of the venture capitalist is  $C(a)$ , which is solely related to the degree of effort  $\frac{\partial C}{\partial a} > 0$ ,  $C(\underline{a}) = o$ .

**Hypothesis 3** Within each venture investment cycle, the total reward of the venture capitalist paid by the venture investor is  $I$  which is related to the degree of effort of the venture capitalist. The total revenue  $w$  is measured by the degree of effort  $a$  in each venture investment cycle, and  $\frac{\partial w}{\partial a} > 0$ . The total reward paid by the venture capitalist is  $I(w)$  and the set consist of all the  $I$  has two elements, namely,  $I \in \{\bar{I}, \underline{I}\}$

**Hypothesis 4** Stochastic variable  $w \in \{\bar{w}, \underline{w}\}$ , and  $\bar{w} - \underline{w} > 0$ .  $w$  is influenced by the degree of effort of the venture capitalist  $a$ , which can be shown as  $P(\bar{w}|\bar{a}) = p_1 P(\underline{w}|\underline{a}) = p_0$ , in conditional probability.

**Hypothesis 5** The total utility function of the venture capitalist is  $U_c = U(I) - U(a)$  and  $U(I) = I$ ,  $\frac{\partial I}{\partial a} > 0$ ,  $\frac{\partial^2 I}{\partial a^2} = 0$ . The revenue of the venture capitalist  $w$  from the venture investment revenue is  $V(w)$  and  $\frac{\partial V}{\partial w} > 0$ ,  $\frac{\partial^2 V}{\partial w^2} \leq 0$ .

According to the hypotheses above, the expected utility function of the venture capitalist is

$$E(U_c) = p_1 \bar{I} + (1 - p_1) \underline{I} - C(\bar{a}) \quad (70.1)$$

The expected utility function of the venture investor is

$$E(U_R) = p_1 (\bar{V} - \bar{I}) + (1 - p_1) (\underline{V} - \underline{I}) \quad (70.2)$$

The expected utility function of the venture investor increases with the level of project benefits, therefore the venture investor prefers the venture capitalist to take up high degree of effort  $\bar{a}$ . The expected utility function of the venture capitalist increases with, the total reward paid by the venture investor, thus the venture capitalist has to take up high degree of effort  $\bar{a}$  in order to obtain high expected utility.

### 70.2.2 The Optimal Incentive Model for the Venture Capitalist Based on Principal-Agent Relationship

In the process of entering into a reward contract, information asymmetry often leads to the fact that the degree of effort and the ability of the venture capitalist cannot be observed (Zhang 1996; Trester 1998). To motivate the venture capitalist to work hard, the venture investor need to design a new incentive mechanism. The new incentive mechanism can reach a equilibrium point where the revenue of both the venture investor and the venture capitalist can be maximized while the venture capitalist is also made to pay high degree of effort.

The new incentive mechanism can be divided into three stages. In the first stage, the venture investor offers a kind of reward mechanism. In the second stage, the venture capitalist decides whether to accept the incentive mechanism provided by the venture investor. If the incentive mechanism is accepted, then they will enter into the third stage. In the third stage, the venture capitalist will choose his action subject to the constraint of the accepted incentive mechanism (Compers 1995). The incentive mechanism provided by the venture investor need to satisfy two categories of constraint conditions. The first category is participation constraint, which means that the expected utility gained by the venture capitalist when they pay high degree of effort is no less than the utility when they accept this incentive mechanism. The second category is incentive compatibility, which means the utility gained by the venture capitalist when they pay high degree of effort is no less than that when they pay low degree of effort. Therefore, the optimization of the incentive model for the venture capitalist can be transformed into the following problem:

$$\text{Max}[E(U_R)]$$

S.t.

$$p_1\bar{I} + (1 - p_1)\underline{I} - C(\bar{a}) \geq 0 \quad (70.3)$$

$$p_1\bar{I} + (1 - p_1)\underline{I} - C(\bar{a}) \geq p_0\bar{I} + (1 - p_0)\underline{I} - C(\underline{a}) \quad (70.4)$$

According to assumption 3:  $I \in \{\bar{I}, \underline{I}\}$ , there are only two modes of payment that the venture investor can choose from. The venture capitalist can choose either mode of payment to simultaneously satisfy both the participation constraint and incentive compatibility. To solve the problem above, we have

$$\bar{I}^* = \frac{1 - p_0}{p_1 - p_0} C(\bar{a}) \quad (70.5)$$

$$\underline{I}^* = -\frac{p_0}{p_1 - p_0} C(\bar{a}) \quad (70.6)$$

When the revenue of venture investment is high, the net utility of the venture capitalist is  $\bar{U}_c^* = \bar{I}^* - C(\bar{a}) = \frac{1-p_1}{p_1-p_0} C(\bar{a}) > 0$ , then the venture capitalist obtains award. When the revenue of venture investment is low, the net utility of the venture capitalist is  $\underline{U}_c^* = \underline{I}^* - C(\bar{a}) = \frac{-p_1}{p_1-p_0} C(\bar{a}) < 0$  and then the venture capitalist suffers loss.

### 70.2.3 Further Discussion on the Basic Analytical Framework

In Sect. 70.2.2, there are only two elements in the set consisting of three variables: the degree of effort, the total reward and the revenue of the venture capitalist. Each

element in the set is studied in two extreme cases. The expression of the total reward of the venture capital is relatively simple. This section is a supplement to the basic analytical framework in order to make the analysis more generalized (Sahlman 1999; Mirrlees 1979; Holmstrom and Milgrom 1987).

**Hypothesis 1** Within a venture investment cycle, the degree of effort of the venture capitalist is  $a$ , and  $a \geq 0$ . The working cost of the venture capitalist is  $C(a)$  and  $C(a) = \frac{ha^2}{2}, \frac{\partial C}{\partial a} > 0$

**Hypothesis 2** Within a venture investment cycle, the total reward of the venture capitalist paid by the venture investor is  $I$ , which includes the fixed reward  $f$ , the variable reward  $n$  and the capital unvested by the venture capitalist  $q$ . The fixed reward  $f$  depends on  $\lambda$ , the rate of management fee on investment funds agreed by both venture investor and venture capitalist in advance. The variable reward depends on the rate of management fee  $\lambda$ , the total revenue  $w$  of venture investment and the profit sharing rate  $z$  agreed by both venture investor and venture capitalist in advance.

**Hypothesis 3** Within a venture investment cycle, the original capital of the venture investment is  $T$ , the capital unvested by the venture capitalist  $S$ , and the corresponding shareholding proportion of the venture capitalist is  $M \cdot M \neq \frac{S}{T}$ , because the venture entrepreneur might get equity in exchange of technology or other elements.

**Hypothesis 4** Within a venture investment cycle, the total revenue of venture investment  $w$  is affected by the degree of effort of the venture capitalist  $a$  and the random factor  $\sigma$ . Assume that  $w = a + \sigma$ . The probability of successfully realizing the revenue of venture investment is  $p$ , shown as  $p(w|a) = p$  in conditional probability, and the probability of failing to realize the revenue of venture investment is  $(1 - p)$ .

**Hypothesis 5** Within a venture investment cycle, the total utility function of the venture capitalist is  $U_c = U(I) - U(a)$  and  $U(I) = I, \frac{\partial U}{\partial a} > 0, \frac{\partial^2 U}{\partial a^2} = 0$ . The revenue of the venture capitalist from the venture investment revenue is  $V(w)$  and  $\frac{\partial V}{\partial w} > 0, \frac{\partial^2 V}{\partial w^2} = 0$ .

According to the hypotheses above, within a venture investment cycle, the fixed reward gained by the venture capitalist is

$$f = \lambda T \quad (70.7)$$

The variable reward gained by the venture capitalist is

$$n = \lambda w + pz w \quad (70.8)$$

The capital unvested by the venture capitalist is

$$q = p(1 - z)Mw - (1 - p)S \quad (70.9)$$

So the total reward gained by the venture capitalist in this investment cycle is

$$I = f + n + q = \lambda T + \lambda w + pz w + p(1 - z)Mw - (1 - p)S \quad (70.10)$$

That is

$$I = \lambda T + \lambda(a + \sigma) + pz(a + \sigma) + p(1 - z)M(a + \sigma) - (1 - p)S \quad (70.11)$$

The total utility function of the venture capitalist is

$$U_c = I - C(a)$$

That is

$$U_c = \lambda T + \lambda(a + \sigma) + pz(a + \sigma) + p(1 - z)M(a + \sigma) - (1 - p)S - \frac{ha^2}{2} \quad (70.12)$$

If we want to maximize the total utility function of the venture capitalist, we can apply the definition of derivative to (70.12) and set it equal to 0.

$$U'_c = \lambda + pz + p(1 - z)M - ha = 0$$

We have

$$a = \frac{\lambda + p[(1 - z)M + z]}{h} \quad (70.13)$$

This is the optimal degree of effort of the venture capitalist. The greater the probability of success in investment project, the greater the corresponding degree of effort.

Take the derivative of (70.13) with respect to  $M$ , we can get  $\frac{\partial a}{\partial z} = 1 - M > 0$ . Thus, improving the profit sharing rate of the venture capitalist as  $z$  proves to be able to improve his degree of effort.

Take the first derivative of  $a$  with respect to  $M$ , we can get  $\frac{\partial a}{\partial M} = 1 - z > 0$ . Thus, improving the shareholding proportion of the venture capitalist as  $M$  proves to be able to improve his degree of effort.

After the venture capitalist invest a certain amount of capital, the low degree of effort will lead to the failure of investment project. The failure of investment project will result in the loss of the revenue of the capital unvested by the venture capitalist. Therefore, this payment model has have incentive-and-constraint dual effect on the venture capitalist, which supports the conclusion of the basic analytical framework.

We use  $E(U_c)$  to represent the expected utility of the venture capitalist:

$$E(U_c) = E[I - C[a]] \quad (70.14)$$

We use  $E(U_r)$  to represent the expected utility of the venture investor:

$$E(U_r) = E(w - I) \quad (70.15)$$

The venture investor designs a kind of covenant which can maximize the utility of both the venture capitalist and the venture investor. The premise of designing this contract is to satisfy two covenant conditions. The first one is participation constraints, which has been presented in previous paper. The second one is incentive compatibility, which means that the maximization of utility of the venture investor has to be achieved by the maximization of utility of the venture capitalist. We can put forward the following questions from the above:

$$\text{Max}[E(U_r)] = \text{Max}[E(w - I)] \quad (70.16)$$

s.t

$$E[I - C(a)] \geq U' \quad (70.17)$$

$$\text{Max}[I - C(a)] \quad (70.18)$$

Put Expression (70.13) into the target function (70.16), we have

$$\text{Max}[w - C(a) - U'] \quad (70.19)$$

Take the derivative of (70.14) with respect to  $z$  and set it equal to 0:

$$\frac{\partial w}{\partial a} \times \frac{\partial a}{\partial z} - \frac{\partial C}{\partial a} \times \frac{\partial a}{\partial z} = 0 \quad (70.20)$$

Put  $w = a + \sigma$ ,  $C(a) = \frac{ha^2}{2}$ ,  $a = \frac{\lambda + p[(1-z)M+z]}{h}$  into Eq. (70.19), we have

$$\lambda + p[(1-z)M + z] = 1 \quad (70.21)$$

When the rate of management fee  $\lambda$ , the shareholding proportion of the venture capitalist  $M$  and the probability of success in investment project  $p$  are given (Hellmann 1998; Sweeting 1991). We can get the optimal profit sharing proportion  $p$  for the venture capitalist  $z^*$

$$z^* = \frac{1 - \lambda - pM}{p(1 - M)} \quad (70.22)$$

Likewise, When the rate of management fee  $\lambda$ , the profit sharing rate of the venture capitalist as  $z$  and the probability of success in investment project are given, take the derivative of (70.19) with respect to  $M$  and set it equals to 0, we can get the optimal shareholding proportion of the venture capitalist:  $M^*$

$$M^* = \frac{1 - \lambda - pz}{p(1 - z)} \quad (70.23)$$

### 70.3 The Venture Capitalist Contract Arrangement and the Optimal Incentive Model in a Limited Partnership

A. Assume that the total revenue of the venture capitalist is  $I$ , the rate of management fee is  $\lambda$ , generally from 1–2 %. The profit sharing rate is  $\delta$ , generally from 10–30 %. The initial amount of venture investment is  $T$ , and the rate of return on venture capital operation is  $r$ .

The total revenue of the venture capitalist is

$$I = \lambda(T + T \times r) + \text{Max}(\delta \times T \times r, 0) \quad (70.24)$$

When the venture capitalist pays high degree of effort, the income of the capitalist is

$$I = \lambda(T + T \times r) + \delta \times T \times r \quad (70.25)$$

$$\frac{\partial I}{\partial r} = \lambda T + \delta T = (\lambda + \delta)T \quad (70.26)$$

The equity capital of 1–2 % which the venture capitalist is required to invest in the initial phase can earn 20 % of profits when the venture investment makes a profit. The venture capitalist has a relatively major residual claim for the venture investment.

If the venture capitalist pays low degree of effort, the total revenue of the venture capitalist is

$$I = \lambda(T + T \times r) \quad (70.27)$$

$$\frac{\partial I}{\partial r} = \lambda T \quad (70.28)$$

When the venture capitalist pays low degree of effort, he can earn no profit. But can only gain the basic fee for the management of original venture capital. In reality, if the venture investment organization goes bankrupt, the venture capitalist is obligated to assume unlimited liability for the loss and debt of the venture investment organization.

B. From another perspective, the venture investor's expected payoff for the venture capitalist is  $p_1 \bar{I}^* + (1 - p_1) \underline{I}^* = C(\bar{a})$ , exactly equal to the cost of the venture capitalist when he pays high degree of effort. Therefore, when  $U(I) = I$ , the venture investor can carry out the optimal incentive covenant through the covenant arrangement of incentive compatibility. The optimal incentive covenant not only avoids the extra cost of the venture investor, but also guarantees the degree of effort paid by the venture capitalist.

## 70.4 Conclusions

According to the theory on mechanism design, the optimal incentive model, which is deduced under the framework of principle-agent theory, features the coexistence of incentive and constraint. The optimal incentive model enables the venture capitalist to gain high level of reward if he pays high degree of effort. And he is held responsible for the loss of venture investment if he pays low degree of effort.

In the limited partnership, contract arrangement for the venture capitalist has the advantages of the above optimal incentive model. The venture investor plays dual role as both the manager and investor of venture funds. As the manager of venture funds, the venture capitalist possesses a relatively major residual claim and he can gain high level of reward if he pays high degree of effort. If he pays low degree of effort, the venture capitalist, as the investor of venture funds, would not only lose the revenue of the original capital he has invested, but also have to assume unlimited reliability for the venture investment organization.

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# Chapter 71

## Analysis of Losing Talents and Incentive Theory in Economics: Shenhua Group in Henan as an Example

Shuo Hao and Wei-min Cai

**Abstract** The purpose of this paper is to discuss the solving methods of losing talents in Shenhua Group and other state-owned enterprises by analyzing the problem of losing talents in Shenhua Group. Incentive theory in economics was applied to establish an effective incentive system for Shenhua Group. What could be seen by analyzing Shenhua Group was that incentive theory in economics was effective for solving the problem of losing talents. However, this theory would be more effective in practical application when combined with incentive theory in management. There is a significant use for reference not only to Shenhua Group but also to those state-owned enterprises which existing the problem of losing talents. Direction of the development of human resource management theory is to absorb the economic theory of motivation.

**Keywords** Losing talents • Incentive theory in economics • Incentive mode • State-owned enterprises

### 71.1 Introduction

The problem of losing talents in Shenhua Group limited company (Shenhua Group as follows) in Hunan province was aimed at. Incentive theory in economics was applied to propose effective incentive modes for Shenhua Group which was extended to other state-owned enterprises which existing losing talents. The

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purpose was to solve the problem of losing talents in Shenhua Group and other state-owned enterprises, to lower the costs of recruiting, choosing hands and retention. At present, talents are not valued enough in state-owned enterprises and are easy to lose. An amount of distinguished talents are going to non-state-owned enterprises resulting that state-owned enterprises lack of talents and need to improve the bad situation (Guo 2012; Xue 2012; Wang 2011). The problem of unsatisfied employees and losing talents in Shenhua Group is severe and needs solving. The research of losing talents is the requirement of development of Shenhua Group. Theoretical support and advice is provided for effective incentive, employees' activeness, finding talents, developing talents, retaining talents and lowering human resource costs. Meanwhile, other state-owned enterprises are beneficial to improve incentive system. Foreign incentive theory in economics illustrates the importance of human resource to enterprises as human resource property, entrust-agency relation and relevant beneficiaries' theory. Staff incentive theory based on management summarizes that human resource management in development forms recruiting, training, performance evaluation, staff incentive, staff salary, etc. Mature theoretical system is established. But new incentive theory in economics is not well absorbed (Hou 2011; Zhu et al. 2008; Shi and Deng 2007). The author thinks that one direction of human resource management development is to absorb incentive theory in economics. Domestic economic incentive theory emphasizes more to incentive problem research of senior manager while less to staff (Wang 2009; Xu 2006). The research in the future should be based on the present theories and be cases of successful enterprises in applying property incentive. The proper incentive ways to all kinds of enterprises should be found. By research of incentive theory and analysis of losing talents in Shenhua Group, the scheme of solving the problem of losing talents in Shenhua Group is offered as theoretical support. The ratio of losing talents is decreased. The development and competitive ability of Shenhua Group is enhanced.

## 71.2 Major Incentive Theories in Economics

Firstly, human resource property incentive theory: human capital is used to provide future income compared with material and non human resource and is the benefit and the increasing abilities gained in economic activities. As far as Schurz is concerned, human resource is attached to human and is the combination of knowledge, skills and strength. Human capital is formed by most effective investments and is the major source of economic growth (Wei 2008). This theory asserts to let intelligence investors owe a part of property. They concern more about long term benefit, which is good for sustainable growth of enterprises. Knowledge becomes the source of value in intellectual economy era. Intellectual staffs who are the carrier of knowledge should have a part of property of enterprises and be offered value distribution (Huang 2011).

Secondly, stakeholders' theory: the objective of enterprises is not just limited by maximizing the profit of shareholders, but to take the profit of other corporate participants into consideration in the meantime. To maximizing the profits of all the stakeholders is the goal which modern corporations are pursuing. In the modern capital market, shareholders become scattered and negative, use feet bit to transfer risks, and undertake fewer obligations. On the contrary, other stakeholders, especially intellectual employees, have closer benefit relation. The loss of core human resource means the bankruptcy of enterprises. With the growing negotiations of human resource factors, all stakeholders will share the system arrangement of corporate ownership together, and manage the corporation equally (Xu and Li 2008).

Thirdly, entrustment-agency theory: those who master less information are called consignors in incentive theory, and the opposite are agents. The main achievement is entrustment-agency theory and model applied analysis mainly deal with unsymmetrical information and incentive problems in corporate structure. "Team production" theory is raised which holds the idea that corporation is a typical team production. Other achievements include raising the concept of agency cost, which means that agency cost is the determined factor of corporate ownership structure. Letting the operator be the owner of total surplus equities can decrease, even remove, agency costs. The importance of surplus claim in solving corporate incentive problems is emphasized.

Fourthly, unsymmetrical information problems: on the one hand, reverse choice of choosing talents and incentive matters means that the chosen ones are not the most excellent or suitable people. On the other hand, ethical risks, which means that the chosen people do work hard. The ways to solve the problems are: (1) to establish good selecting system aiming to select suitable agents by forming competition among agents; (2) to form a good incentive system aiming to make agents continuously work hard to the consignors' goal by meeting two principles: participating constraint principle and incentive compatible constraint principle.

## 71.3 The Shenhua Group Incentive Model

### 71.3.1 Background

The Shenhua Group is large state-owned enterprise groups, which owns coal, power generation, aluminum production and deep processing of products. It is one of the Chinese top 500 enterprises. There is a serious problem currently, mainly for the loss of highly skilled personnel.

1. *The status quo of talents loss in Shenhua Group*: (a) Loss of high skilled talents: among all the technical and skilled laborers in Shenhua Group, technicians and senior technicians only take up 4 % of the total amount, while what the corporation needs is 14 % of that, the difference is 10 %. This has become the

bottleneck to prevent corporation from upgrading. (b) Heavy loss of potential talents: the potentials of most of the newly recruited graduates are not properly found. 40 % of the graduate laborers suggest that what they do is the same as other workers, not only labor some but also not showing their expertise. They cannot learn any professional knowledge. They have lost the passion to apply for Shenhua Group. Instead, they come up with the complaints and the thoughts of job-hopping.

2. *The cause of talents loss in Shenhua Group:* (a) Low payments: compared with either powerful multinational corporations or thriving private enterprises, the incomes in Shenhua Group are far too low. It cannot meet the value anticipation of corporate internal talents to themselves under the condition of market-oriented economy. (b) Irrationality of payment distribution system: the disproportion of talents' labor and gains is prominent. The drawback of payment structure in Shenhua Group is the excessive consideration of laborers' qualifications and less concerns of laborers' capabilities, difference not widening, level not showing, hardly presenting the difference of the good and bad, intense equalitarianism. (c) Lack of development space of talents, lag of talents system: this is caused by leaders' neglect and official rank standard. Leaders do not respect talents, do not care about their work and do not provide talents with good working environment. Talents do not what to do and cannot realize their value in career. When continuing to introduce talent, corporations cannot fully provide effective development space and environment to maximize talents benefits. (d) Lack of scientifically rational performance appraisal system: the performance appraisal in Shenhua Group does not have clear goal and principles. The methods are improper, appraisal and assessment standards are simple, specific appraisal methods cannot be applied to the right things. This appraisal system has seriously reduced the laborers' initiatives and talents cannot play their roles in their work, leading to low productivity, waste of human resources, and the most important is loss of talents. (e) Bad development of human resources: Shenhua Group lack of effective systems of talents development and training. It is short of the concept of talents career life design and affected by the traditional system of personnel management, making the most of workers have little things to do and the most of things be done by nobody. Human resources are dramatically wasted. At present, the phenomenon of severe promotion according to status still exists in the selection and appointment of talents, which restrict the stand out of excellent talents. (f) Hard to form the rational formation of talents: the loss of some business elites and skilled technicians whom the corporation used to train makes the corporate operators be worried about the training and further education of present workers. The consequence is that the whole business level of present coal workers is difficult to be improved and that the rational formation of higher, vantage and primary technicians is difficult to form. (g) Operator's short term behaviors: the operator's appointment in Shenhua Group is still administrative. The promotion of positions rather than the rise of contributors' benefits are valued. The short term behaviors are easy to exist, unwilling to long term

incentive invest in human resources. (h) Deviation in talents concept: talents concept in the eye of people always stays in the old and narrow pattern. Only the leaders, the experts and the high title and high education background people are referred as to talents. They are high valued and more cared. As to the most professional workers who stay in their position and make contributions are excluded from the concept of talents because of lacking of the so-called conditions. They have comparatively bad treatments and high pressures. The narrow concept of talents severely decreased the enthusiasm and the creativity of most of the professional workers. It is these professional workers who are the loss of Shenhua Group.

### ***71.3.2 Effective Incentive to Improve the Status of the Brain Drain***

1. *Building operators incentives*: the ability of the business operators to work, personal qualities, a code of conduct, and work attitude can affect the enthusiasm of entire corporate staff and determine the survival and development of the company, so the operator is the primary incentive object. The state-owned enterprise operator is state-owned assets agent, grasping the whole information and controls the rights. The Shenhua Group is facing the lack of real assets client and strong regulatory agencies. Establishing incentive measures has the important meaning to guard against the group agent risk and to prevent the loss of state-owned assets. The company should construct operator incentive-restricted mechanism from different aspects according to the enterprise operator expectations and its special position. The concrete measures include: (a) Establishing operator target motivation : target incentives for operators in Shenhua Group can determine the responsibilities and tasks of the operators and incentive compensation in the next few years according to the actual situation of the macro-market environment, industry development and corporate calendar year operating conditions, an annual basis or operator of the production cycle to the enterprise's development goals, such as the designation of enterprise production and the growth rate of corporate profits and other key performance indicators. The specified target of target incentives for operators will be the main pressure and momentum for operators. Clear incentive to operators to achieve the goal is a measure of the performance of the business operators and can provide a direct basis for managerial compensation. Implementation of the objectives of the operator's incentive should pay attention to the next. First, goal-setting should be reasonable and necessary to fully consider the characteristics and the present situation of the industry, trying to make the target specific and digital to understand and implement easily. The second is to strengthen the supervision to prevent operators from tampering with the financial data in order to complete the assigned objectives. (b) Improving the salary incentives for operators: the companies could improve the incentive pay

of the operators, according to the principle of combination of fixed income and risk, short-term income and long-term revenue and paid in cash and material subsidies. The company also could establish a variety of methods of distribution of the remuneration system, making the operators pay management market-oriented and international. Operators' incentive, pension plans, jobs and spending plans. The Shenhua Group can choose a different pay mix in proportion to the development of their enterprises characteristics, operators, material incentives. (c) Making full use of market of professional managers to select personnel for Shenhua Group: the manager market operators have the role of incentive and restraint. Manager markets evaluate the performance of operators and individual ability to achieve effective supervision of the operators through the market mechanism, and also use the strong reputation incentives of the manager market, providing a good environment for the cultivation of elite entrepreneurs. The Shenhua group should reform the traditional specify business system to make full use of the market law of value and the talent competition mechanism to select excellent professional managers.

2. *To build the employee-incentive system*: managers of the Shenhua Corporation should make a comprehensive understanding of the employees' demands and expectations before carrying out the motivation program. For different employees, different incentive strategies should be taken to achieve a good incentive effect. Second, managers should correctly handle the relationship between the motivation and performance. The corporation must establish a sound management system of human resources by carrying out systems of clear post responsibilities, reasonable employment and fair appraisal and setting specific objectives to ensure the effective implementation of the incentive system. Also, attention must be paid to team incentive. The speculative lazy behavior of individual employees must be reduced and put organizational synergy into effect. The managers also should actively increase the team reward; introduce performance competitive systems between teams and improve reputation of an excellent team. The following are the specific employee-incentive measures. (a) Material incentive: establish reasonable salary system and improve the effectiveness of material incentives. The salary should not only be the compensation or material reward for work, but also be fair, scientific and motivational. The wage level should be of the same consistent with others of the same occupation, for a too high or a too low level will both affect the staff morale. Managers should improve the performance appraisal system which links salary with performance. Egalitarianism should be opposed. For employees who are outstanding in performance, specific reward regulations should be made for them. They should also concern about the life quality of their staff and enhance welfare incentives modestly. The Shenhua Corporation should show concern employees and increase affection with them through a variety of welfare systems, such as paid holiday, housing subsidies, health care and so on. (b) Spiritual incentive: the spiritual incentive to the staff should mainly reflect the concept of corporation's respect for the staff and the people-oriented spirit. Spiritual incentives mainly include: to establish a

reasonable employment system on the basis of fair competition to create a good space for employees; to design reasonable career plans for the staff and ensure open and democratic opportunities for promotion, and take enough consideration and give support to management technical talents in key positions; to actively provide staff with training and learning opportunities to improve the overall quality of staff and create a learning environment in the corporation, to those who improve work efficiency by learning and actively carrying out technological innovation, reward and promotion are necessary. To establish a good corporate culture, interpersonal relationship of mutual equity and mutual trust between managers and employees should be developed. Besides, to advocate unity and cooperation among employees and proactive attitude will also contribute to a good corporate culture.

## 71.4 Conclusions

In the era of knowledge economy, intellectual capital is becoming the first element of competition; the importance of human resource management is increasingly highlighted. However, the state-owned enterprises are behind the trend in the competition for talent. It is an indisputable fact that especially the brain drain of key positions will be business losses. From the current incentives, measures and offence, the strategic thought still does not fully manifest itself. It is not yet out of the passive situation of “heavy use of light inspire”. Through the research of the theory of incentives and put forward the talent incentive scheme through analysis brain drain problem of Shenhua group, to solve the brain drain problem of the group provide theoretical support, effective to reduce the proportion of brain drain, accelerate the pace of development of Shenhua Group and enhance international competitiveness. It shows the principle of economics incentives for talent loss is very effective, but combine to the principle of management incentives in the actual use would be more effective. Direction of the development of human resource management theory is to absorb the economic theory of motivation.

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# Chapter 72

## Enterprise Compensation Incentive Theory on Principle-Agent Relation

Huo-bao Xie and Chun-yan Chen

**Abstract** This paper makes an analysis of the enterprise compensation incentive theories and documents their own advantages and shortcomings. From the perspective of principle-agent relationship, it put forward the opinion that tournament theory and behavior theory are suitable used in the relation between shareholders and managers, while piece-rate theory and time-rate theory are mainly applied in relation between managers and the front-line workers.

**Keywords** Compensation · Incentive theory · Principle-agent relation

### 72.1 Introduction

Principle-agent relation is a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some services on their behalf which involves delegating some decision-making authority to the agent (Jensen and Meckling 1976). In real life, it is necessary to point out the generality of the principle-agent relation, which exists in all organizations and in all cooperative efforts—at every level of management in firms (Jensen and Meckling 1976). With the ‘separation of ownership and control’ of the corporation, shareholders and managers form pure principle-agent relationship. While managers further decompose the goals and tasks of the organization and deliver them to the front-line workers to accomplish with the organization. Therefore, the managers

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and the front-line workers form the implicit principle-agent relationship. Both parties of the principle-agent relationship as ‘rational economic man’ seek their own utility maximization. The agent will not always act in the best interest of the principal. In the place out of the supervision of the principal, he may shirk or even seek his own benefit maximization by using his private information even in spite of damaging the interest of the principal. The principal can limit the agent’s aberrant activities which damages his own interest by making the necessary monitoring and establishing appropriate incentives for the agent. As the analysis shows, as long as in some cases, employees have more specific information about the environment than managers, the employee’s incentive problem is still in need of being solved (Putterman and Kroszner 2009). At present, the academic research on motivating and inducing the agent serves the principal’s welfare maximization, gradually developed a series of compensation incentive theories—tournament theory, behavior theory, piece-rate theory and time-rate theory.

## 72.2 Compensation Incentive Theory and Literature Review

Lazear and Rosen (1981) put forward tournament theory, which deeply interprets the agent relation between shareholders and managers of companies by using game theory and designing wage spread. Tournament theory states that if monitoring is difficult and the costs of monitor are very expensive, then managers will reduce their input with less than perfect detection. Shirking has become a serious problem. The situation can be improved under condition of that compensation is related with the agent’s outputs which can be measured in an easy way. Therefore, it is optimal to set up compensation incentive mechanism according to an individual’s ordinal rank in an organization rather than his absolute out-put level. For these reasons, the rank-order payment scheme is sometimes a superior way to bring about an efficient incentive structure. Eriksson (1999) tests several of tournament models by collecting a data of 2,600 executives in 210 Danish firm from 1992 to 1995. The result indicates that firm performance has a positive and significant correlation with wage spread, which is in consistent with tournament theory. Junqing et al. (2003), Yixuan (2010), Yongle and Jizhong (2010) have made some empirical analysis from the relation between performance and wage spread. Their findings also support tournament theory.

Behavior theory is a branch about fair distributive of rewards, mainly involving equity theory, relative deprivation theory and distributive justice theory. Equity theory thinks that people in social exchange relationships believe that rewards should be distributed according to the level of individual contribution (Adams 1965; Homans 1974). Individuals always compare the ratio of inputs to outcomes with that of reference groups they have chosen to judge whether they are treated fairly by the organization. If the ratio is dissimilar, then individuals will perceive

unfairness, so that they may alter their actual inputs by decreasing their work effort and even possibly terminate the inequitable relationship by leaving their organizations (Cowherd and Levine 1992). Relative deprivation theory states that individuals will suffer the deprivation when they compare the rewards they receive to that of reference groups and find that they have received less than what they deserve (Martin 1981; Crosby 1984). Relative deprivation theory typically deals with the upward comparisons made by low-status people. Once the low-status people perceive the deprivation, they will have the obvious directed behaviors with destructiveness, including absenteeism, strikes, vandalism, and violence. Distributive justice theory states that a certain level of pay gap is reasonable between the low-status workers and the high-status managers because of the difference of their interclass inputs (Cowherd and Levine 1992). However, the influence of the difference of the interclass inputs on pay equity perceptions is limited for the reason that inputs are typically more ambiguous relative to compensation, and are subject with strong self-enhancing perceptual biases (Cook and Yamagishi 1983). So the perception of the low-status employees of whether they are treated fairly will mainly depend on the fair compensation distribution between the lower and higher organizational strata (Jasso and rossi 1977). Therefore, once the low-status employees suffer the unfairness of rewards, they will reduce the degree of commitment to their organization and lower the level of cooperation among their workmates. Zhengtang and Xin (2007) use the data of 264 Chinese listed companies from 2001 to 2004 make an empirical analysis about this question. The result indicates that firm performance has a negative and significant correlation with the wage spread, which is consistent with behavior theory. Zhengtang (2008) also finds the same conclusion.

Piece rates are defined as that works are paid according to their outputs and given a fair price for each unit completed work. Piece-rate theory provides workers with incentives to work harder and faster to get higher rewards for their higher productivity. However, piece rates have two serious shortcomings. The first is that managers can't make certain workers' productivity because workers have the private information about the difficulty of their jobs. The second is that employers always cut the price paid to workers in practice so that employers have the opportunity to revise the rate over time (Gibbons 1987). Time-rate theory is a compensation payment scheme that workers are paid according to the time they have spent on their work rather than their outputs in a short time. Although, in a long run, the corporations still make decisions of keeping job position or promotions according to the performance of the workers (Borjas 2010). In a situation of complete information, the principals know all activities done by the agents, under which time-rate theory is the best incentive compensation scheme. While, in a situation of incomplete information, the incentive effect of time-rate is not desired. Lazear (2000) makes an analysis of the effect of monetary incentive on outputs by collecting data from Safelite Glass Corporation during 1994 and 1995. The results imply that the shift of the compensation method from hourly wages to piece rates bring about an increase 20 % in productivity, 10 % in income received by workers.

### 72.3 Analysis and Application of Compensation Incentive Theory

For the principle-agent relation between shareholders and managers, tournament theory and behavior theory are mainly used due to shareholders' expensive monitoring cost and managers' marginal outputs which are not easy to be measured. Generally speaking, tournament theory induces managers to work hard by a large amount prize from the perspective of individual competition. Behavior theory encourages the cooperation among managers to improve the organizational performance from the perspective of equity. Tournament theory emphasizes competition, while behavior theory emphasizes cooperation. Hence, it is appropriate to apply tournament theory for managers in charge of production, sales and projects whose outputs are easy to be measured in a relative performance rank order. Instead, it is good for applying behavior theory for managers in charge of administration and logistics management whose outputs are not easy to rank order.

For the principle-agent relation between managers and the front-line workers, piece-rate theory and time-rate theory are mainly applied in practice. Which theory do the corporations choose to induce the front-line workers to work harder depends on industry, department, monitoring cost and incentive effect. From the perspective of industry, piece-rate theory and time rates are always used in manufacture. In the industries of candy, industrial chemicals and assembly structure steel, more than 90 % workers are paid by time rates. While in the production industries of shoes, shirts as well as steel and iron materials, more than 75 % workers get rewards according to piece rates (Borjas 2010). From the angle of departments in corporations, the production and sale department where the front-line workers' outputs are easy to be measured generally applies piece rates. While the human resource management department and logistics department, where the outputs of the front-line workers' outputs are uneasy to be measured, generally applies time rates. From the view of monitoring costs, the front-line workers' wage level should equal to their marginal product value under piece rates, so it is necessary to know worker's real productivity. However, one of the piece-rate's shortcomings is that managers can't make certain workers' productivity because of workers' private information about the difficulty of their jobs. As a result, managers have to monitor their employees' work all the time, which causes expensive monitoring cost. Under time rates, the fixed wages are paid to workers according to the time spent on jobs rather than their outputs. It is not necessary to monitor workers' work from the beginning to the end, which saves the monitoring cost. Therefore, the enterprises with expensive monitoring costs choose time rates, while those with inexpensive monitoring costs choose piece rates. Finally, workers with higher ability can obtain higher utility under piece rates, but they can't obtain higher utility under time rates. Under piece rates, workers with high ability make more products, obtain higher income and naturally achieve greater utility. On the contrary, the utility of high ability and low ability workers who are paid by time rates is the same due to that workers are paid by the time spent on work, As long as workers

spent the same time on work despite of how much effort is put into work, they all get the same wages and utility. Thus, considering the incentive effects, piece rates can attract workers with higher ability and induce them make effort to work while time rates can't achieve the same effect.

## 72.4 Conclusion

In a word, each compensation incentive theory has its own advantages, shortcomings, application range and conditions of application. For the principle-agent relation between shareholders and managers, tournament theory and behavior theory are mainly used. Specifically, managers who are responsible for production, sales and projects are appropriate to use tournament theory. Instead, managers who are in charge of administration, human resource and logistics management are suitable to use behavior theory. For the principle-agent relation between the managers and the front-line workers, piece-rate theory and time rates are mainly applied in practice. To be specific, it is appropriate to apply piece rates for the enterprises with inexpensive monitoring costs, the departments with outputs easy to be measured and the workers with higher ability. On the contrary, it is better to apply time rates for the enterprises with expensive monitoring costs, the departments with outputs uneasy to be measured and the workers with lower ability.

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## Chapter 73

# Different Paths Different Effects: Testing the Relationship Between Team Task Conflict and Team Creativity

Ming-jian Zhou and Hai-bo Pan

**Abstract** Based on the self-justification theory, we argued the causal relationship between team task conflict and team creativity in two different paths—team learning behavior and team relationship conflict as two mediators. Furthermore, we proposed that team collectivism would moderate the two paths concurrently: high team collectivism would slightly weaken the path that team learning behavior as the mediator and significantly weaken the path that team relationship conflict as the mediator. In the end, we discussed the contribution of the model to task conflict theory and research, as well as for management practice, and directions for further research.

**Keywords** Self-justification theory · Task conflict · Team collectivism · Team creativity

## 73.1 Introduction

Recently, team work becomes increasingly the norm and team creativity attracts more and more attention from organizations than ever before since it has been proved that team is elementary to organizational success (Martin and Bal 2006) and creativity is crucial for employee performance (Gong et al. 2009) and organizational competitiveness (Oldham and Cummings 1996). Meanwhile, task conflict- the conflicts about the distribution of resources, procedures and policies,

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and judgments and interpretation of facts (De Dreu and Weingart 2003)—seems to be inevitable in the team process in that team members are often from diverse background with different skills, knowledge, experience and so on (Chen 2006). Consequently, the associated between task conflict and team is desirable to explore profoundly.

According to Shin and Zhou, team creativity was defined as the production of novel and useful ideas concerning products, services, processes, and procedures by a team of employees working together. Many studies have shown the relationship that task conflict has a positive affect on team creativity under certain conditions (De Dreu and Weingart 2003; Chen 2006; Curseu 2010; De Dreu 2006; Farh et al. 2010; Hu Lsheger et al. 2004). For instance, (De Dreu 2006) pointed out that task conflict had a curvilinear effect on innovation and the innovation was optimal at moderate levels of task conflict. Farh et al. (2010) gave a similar conclusion in his study, and found that the team phase also moderated the relationship with the strongest effect at an early phase.

However, few empirical studies were done to interpret clearly and thoroughly about how task conflict influences a team's creative performance. To further understanding of the process, a path model is established on the basis of self-justification theory, in which two variables—relationship conflict, referring to conflict about personal taste, value, interpersonal affairs etc. (De Dreu and Weingart 2003), and team learning behavior—are introduced as mediators.

Moreover, some values should affect task conflict more or less, which means the inconsistent perspectives on the team tasks (Hui et al. 1991). Collectivism, one kind of values, has displayed an impact on work behaviors in groups, influencing social, cognitive and affective processes in teams (Gibson and Saxton 2005). However, little empirical work has examined collectivism as a potential moderator in the relationship between task conflict and team creativity. Thus, to fill the gap in literature, testing the moderate effect becomes the second task in the study.

## 73.2 Theory and Hypotheses

### 73.2.1 Task Conflict and Team Creativity

Prior studies have shown that creativity—the generation of novel and useful ideas (Amabile 1988)—derived from the exhibition of the different ideas, or viewpoints or from integrating the old with new thinking way (Mumford and Gustafson 1988). A team is more likely to generate creative ideas or solutions if its members frequently discuss divergent perspectives (Farh et al. 2010). Task conflict is a vital process to stimulate the member's divergent opinions; consequently, it is beneficial to team creativity. A great of researches have proven that task conflict has a positive influence on creativity (Jehn 1995; Simons and Peterson 2000; Van de Vliert and Carsten 1994; De Dreu and West 2001) or has a curvilinear effect

(Curseu 2010; De Dreu 2006; Farh et al. 2010). Although most of the precious work have demonstrated the relationship between task conflict and team creativity and tested some moderate variables, few of them explored and tested the affecting path.

Since task conflict is the outcome of disagreement viewpoints, it always evoke individuals' cognitive dissonance—a 'state of tension whenever an individual holds two cognitions (ideas, attitudes, beliefs, opinions) that are psychologically inconsistent' (Aronson 1995). Dissonance is an uncomfortable feeling, and obviously individuals are supposed to reduce it by moderating their behaviors, but more often through self-justification (Jonathan 2011). Self-justification is a psychological terms, principally referring to individuals tend to base their attitudes on the experimental task in a positive way in order to justify their precious behavior (Weick 1964; Pallak et al. 1972).

Once task conflict appears, the self-justification motivation will stimulate individuals to try their best to keep their actions in accord with their former arguments. The higher the level of task conflict—I defined as the extent to everyone insists on his opinions—is, the greater the motivation or preference of self-justification is. To justify themselves, participators are supposed to take two strategies, either to elaborate their own points or to attack others' weakness. In any case, they need more information, knowledge or other evidence to support his points or refute others points. This demand definitely encourages the team learning behavior—the process by which team members discuss and solve problems (Hirst et al. 2009). Obviously, team learning behavior—seek information, address differences of opinion (Edmondson 1999)—facilitate team creativity by enhancing the opportunities to acquire domain-relevant skills and creativity-relevant skills, both of which are identified as the building blocks necessary for individual creativity (Amabile 1996). Thus, we propose:

**Hypothesis1** (a) Task conflict will have an indirect positive effect on team creativity and team learning behavior will partially mediate the relationship between them.

On the other hand, individuals are hardly to accept others' views and are inclined to persuade others to embrace their own points on the basis of self-justification. In the process to justify themselves, they may emotionally use harsh language (Pelled 1996), intimidation tactics, or ad homonym arguments (Simons and Peterson 2000). In this case, opponents may feel frustrated, disgrace, and even brutalized, and then tend to attribute these actions to personal attack (Jehn 1997) or hidden agendas (Amason 1996), eventually resulting in relationship conflict. Once relationship conflict emerges, team members' attention will increasingly move to how to return the 'attack' actions or languages from how to solve the initial issues. This change can raise individuals' stress and anxiety level, both of which are supposed to restrain the cognitive ability and thus weaken the creativity (Jehn 1997). Thus, we propose:

**Hypothesis1** (b) Task conflict will have an indirect positive effect on team creativity and team relationship conflict will partially mediate the relationship between them.

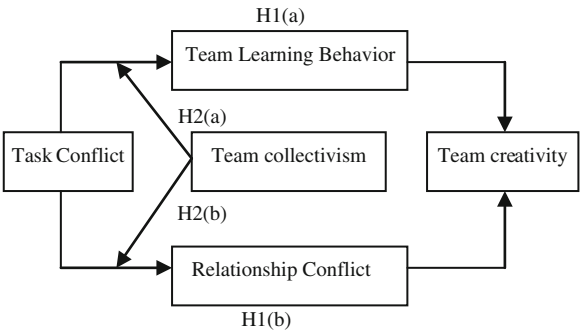
### *73.2.2 The Moderate Effect of Team Collectivism*

Collectivism, one value which mostly emphasizing the interdependence, was originally conceived at the culture level as well as individualism (Hofstede 1980). Then the constructs was studied at lower level, such as team level (Gibson and Saxton 2005; Colquitt et al. 2002; Goncalo and Staw 2006; Kirkman and Shapiro 2001), individual level (Earley and Gibson 1998; Dierdorff et al. 2011). But further study about collectivism at team level or individual level has been largely unexplored (Earley and Gibson 1998; Jackson et al. 2006) for a long time, due to the shortcomings associated with exiting collectivism measures. Recognizing the problems, (Jackson et al. 2006) developed a new measure of psychological collectivism—the individual level of collectivism- on the basis of integrating conceptual review of existing scales.

Without a specific and generally accepted definition about the team collectivism, here we defined the variable as the average level of the team members' psychological collectivism-the individual vision of collectivism that consists of five facets: Reliance, Preference, Concern, Norm Acceptance, and Goal Priority (Jackson et al. 2006). Reliance emphasizes that one person's responsibility is the responsibility of the entire group and that they have a collective sense of responsibility that leads them to feel comfortable relying on and trusting in the role. Preference highlights the relationships with in-group members and the preference to exist within the bounds of a group. Concern stressed on an interest in gaining knowledge about other team members and a desire to develop an understanding of their needs. Norm Acceptance focuses on complying with the norms and rules of the in-group in order to foster harmony with the team. Goal Priority means that team goals take precedence over individual goals even when it causes them to make sacrifice (Dierdorff et al. 2011; Jackson et al. 2006).

On one hand, high Reliance is more likely to weaken the feeling that individuals are personally responsible for the negative results, which will lead to lower self-justification (Cooper 1971). It will reduce individuals' motivation to insist on and persuade others to accept his perspectives, which means the mediate effect of team learning behavior and relationship conflict will be undermined simultaneously. On the other hand, high Goal Priority is supposed to stimulate team members to maintain effort and persist toward team goals, considering that goals increase effort toward the goal-related task (Locke and Latham 2002). When task conflict emerges, the members will try their best to find the best solution. This motivation will promote the learning behavior. Thus, we propose:

Fig. 73.1 Path Model



**Hypothesis2 (a)** team collectivism will slightly weaken the mediate effect of team learning behavior

The common characteristic of Preference, Concern, Norm Acceptance is to emphasize that individuals want to establish a harmony environment. Preference and Norm Acceptance actually decrease the frequencies and intents that they use harsh language during the process they persuade others, which is useful to hold back the increase of the relationship conflict. Concern is available to lessen the misunderstood about others intense, which is useful to reduce the level of relationship conflict or even eliminate it thoroughly. And all of them are considered to significantly undermine the mediate effect of relationship conflict. Thus, we propose:

**Hypothesis2 (b)** team collectivism will significantly weaken the mediate effect of relationship conflict

Based on the deductions above, we establish the path model shown in Fig. 73.1

73.3 Discussion

73.3.1 Contributions of the Study

Firstly, the study will empirically explore the mechanism of how task conflict influences the team creativity for the first time. Prior studies focus on demonstrating the relationship between conflict (task conflict, relationship conflict) and creativity. Little empirical work was done to interpret the process. Thus, our research has filled the gap.

Secondly, the present study creatively employs two paths to elaborate the process from task conflict and team creativity. Precious explanations on the causal relationship between the two variables almost underline only one path. Thus, our research has some theoretical innovation.

Finally, the study will investigate the moderate effect of team collectivism—one kind of values. Few researches tested the role of collectivism, perhaps due to various psychometric shortcomings associated with collectivism measures. Although (Jackson et al. 2006) have developed a new scale, this field still remains unexplored. Thus, our research has filled the gap.

### ***73.3.2 Managerial Implications***

The present study put forward a new idea: task conflict can benefit the team creativity by team learning behavior and deter the creativity by relationship conflict simultaneously; team collectivism is supposed to slightly weaken the positive effect and to significantly weaken the negative effects. This implies that managers can reap more team creativity by encouraging task conflict and cultivating the team value- team collectivism concurrently.

### ***73.3.3 Directions for Future Research***

Further studies can investigate whether there is another influence path, which is valuable in theory innovation. Also, further studies can examine more factors that can simultaneously moderate the two paths in the model - such as task phase, team style etc., which is valuable in management practice.

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# Chapter 74

## Organizational Routines and Organizational Performance Feedback

Dong-hong Hu

**Abstract** This paper aims to explore what the organizational routines are, how organizational routines form and change, as well as their effect to performance feedback. The paper also tells how organization performance feedback affects organizational routines from the individual, job team, and organizational level. It points that organizational routines help to improve enterprise performance, however, the organizational routines need adjust according to change of organizational environment, and the positive effect could be lasting only in this way.

**Keywords** Formation mechanism · Organizational routines · Performance feedback · Routines changed

### 74.1 Introduction

Organizational performance is a hot issue has been studied by many scholars for a long time. The enterprises' resources, innovation capacity and business environment will affect the performance apparently, while the research on organizational routines how to impact on performance, as well as the interaction between them are really rare. The detail definitions of organizational routines are hard to clarify and test. This paper gives a define of organizational routines based on a number of the scholars' definitions and research conclusions and tells how the organizational

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routines change and its interaction with performance. Also, it constructs performance feedback model to reveal their interaction, from which we can see organizational routines have beneficial effect on performance.

The study of organizational routines focus on three areas: the forming of routines, the change of routines and its impact to performance. The contribution of this paper is to supplement routines changing driven not only by internal factors also by environmental factors. In addition, I specify the organizational routines effect business performance through organizational feedback system. If there is no feedback, the persistent organizational routines will be negative to the organization, called organization rigid, which means no vitality and difficult to maintain innovation.

## 74.2 Organizational Routines

### 74.2.1 *The Define of Organizational Routines*

The concepts of routines were presented from the individual level to the organization level. The concept of Routines was first proposed by the Stene in 1940, comparing routines to the personal habits thought that the routines had the same stability as personal habit. March and Simon (1958) illustrated the majority of organizational behaviors were decided by performance programs. They compared routines to the computer program, emphasizing that the routines sequence bridged the individual perception and reactions. Gersick and Hackman (1990) proposed a “habitual routines” concept, pointed out that “habitual routines” would produce if the group behavior patterns contacting with a given stimulus context promoted the habitual action. These researches lead the analysis of organizational routines from individual to the group level.

With further research, the researchers began to analyze routines from the perspective of the organizational level and emphasize routines’ constraint how to affect organizational structure and institutionalized constraints. Nelson and winter (1982) using the gene as analogy thought that the organizational routines just as the organization genes with functions of memory, coordination disputes and others. Organizational routines were vital essential to organization’s growth and development (Nelson and Winter 1982). This perspective had expanded March and Simon’s fixed behavioral response patterns and Gersick and Hackman’s group habits, focused on routines as the significance of organization behavior patterns.

On this basis, Levitt and March (1988) further suggested that the organizational routines should include both organizational construction and various operation forms, rules, procedures, strategies and technologies, should also include belief structure, framework, paradigm, coding, culture and knowledge supporting official routines. Cohen and Bacdayan (1994) thought organizational routines as a series of mutual locked or triggering actions by a number of actors together, and make clear

that routines is different from or at least is not equivalent to standard operating procedure with a clear explanation and specification. Becker and Knudsen (2005) summary the economics and management literature, point that definition of the organizational routines has three categories: recurrent interaction patterns. This definition captures the actors' behaviors in a particular context and how the job tasks were typically completed in the organization; Organization rules and standardized operating procedures, and by the composition of two elements on ostensive and performative (Feldman and Pentland 2003). The actions deployments to express the behavior and ideas combined with the scholars' research conclusion. This paper argues that organizational routines means implicit criterions, interactive consensus and actions shared and complied with by members, which has been changing or evolving with the actors' interaction and the organization members may control, duplicate and imitate actions in this process.

### ***74.2.2 The Form and Change of Organizational Routines***

When the individual finds a satisfactory answer to a problem that frequently arises, there is a tendency to repeat the behavior or thought. Incentives are important in habit formation. Immediate rewards or incentives reinforce the repetition of behavior or thought. Organization members may find solution paths on the basis of sequences of immediate rewards (Pentland 2011). The accumulative of experience and reinforced behavior under rewards may become the organizational routines.

The focus of organizational routines is the behavior stability in an organization and how organizational routines change. The organization can be seen as a series of routines, and then the difference between organizations stems from their different organizational routines (Ke 2006). However, scholars have lot of controversy whether the stable routines are good or bad for performance. There are lots of reasons why organizational routines should be stable. Schulz offered an extensive list of mechanisms that reinforce the tendency of organizational routines to "stay on track". This view is consistent with the metaphor of routines as "ruts in the road." As more traffic passes, the ruts get deeper, and the path of the traffic becomes less variable. More formally, the tendency of repetition to reduce variability can be seen as form of path dependence. The alternative perspective on routines starts from the observation that organizational routines involve patterns of actions distributed in time and space (Wang and Feng 2009). Although these small differences seem irrelevant, their existence is important. Each performance is not only an occasion for repetition, but also an occasion for improvisation or error; thus larger numbers of performances create more opportunity for change. This view aligns well with Tsoukas and Chia (2002) notion of organizational becoming, which is characterized by continuous change.

From organizational routines’ definition, we know routines ready solve frequently arising problems and contain knowledge that are common to a group of people. Different organizations have a series of various routines.

The stability of organizational routines brings high efficient and low cost for the organization, also has a negative impact. Stability may result in rigidity, actors’ unconscious behaviors in the implementation of routines and organizational routines accumulated over time would loss problem-solving efficiency. Therefore, in order to keeping high efficiency on organization routines solving problems, organizational routines need to change as the environment changes. Organizational routines are embedded in an organizational environment change, which means it may constrain its ongoing adaptation (Jennifer 2005).

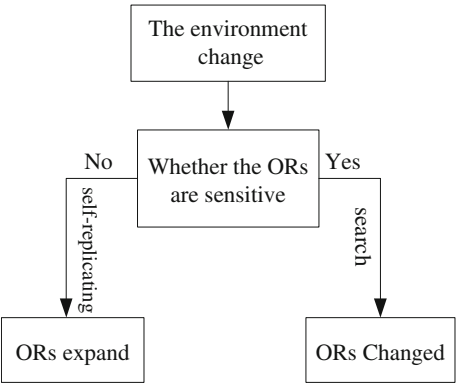
ORs in Fig. 74.1 is the abbreviation of organizational routines. According to the Fig. 74.1, the form of Ors change has two, the one is to be expanded, which means the original routines are replicated. The other is changed as environment changed. Whether the ORs change or not is depended by how sensitive to the environment.

74.3 Performance Feedback

74.3.1 What is Feedback

Feedback means the knowledge about individual performance provided by external structure of an organization (Kulger and DeNisi 1996). It is used to describe whether the result is correct or not and whether current work is consistent with the goal need to be achieved. In the interpersonal domain, feedback includes how do person perceive and evaluate individual behaviors. In other words, feedback can not only be the appropriate diagnostic information for whether individual achieve goals, but also can be evaluative information to know individual behaviors are good or bad.

Fig. 74.1 The form of change on ORs



Feedback have a positive effect for improving the performance and motivation, it has been a very important resource in the organizational context. Feedback could be a tool allocated by external motivations essentially (Kulger and DeNisi 1996). External motivations provide the individual feedback information on operation task and past actions to induce the individual's internal motivation and improve individual performance.

### ***74.3.2 The function of Performance Feedback***

Performance feedback is very important management tool to encourage the advanced, urge backward, stimulate the potential employees in the organization (Wang and Shi 2004). Using feedback to improve organizational performance can be traced back to the 1970s. Then, performance feedback has been applied to improve performance in the organization and management practices.

It has not been concluded the meaning of feedback and behavioral principles on effect of feedback. Integrating scattered views, I believe that feedback is a two-way dynamic process, which consists of three parts: the feedback source, the information transmitted by feedback, feedback recipients. Performance feedback is different from the normal communication process, as the information transmitted should contain the information about the feedback recipients (Li 2005).

In management practice, feedback does raise the changes of people's behavior. But whether feedback always has a positive impact to behaviors' changes has not unanimous conclusion. In the paper, I think the comprehensive performance feedback system help to affect the form of organizational routines.

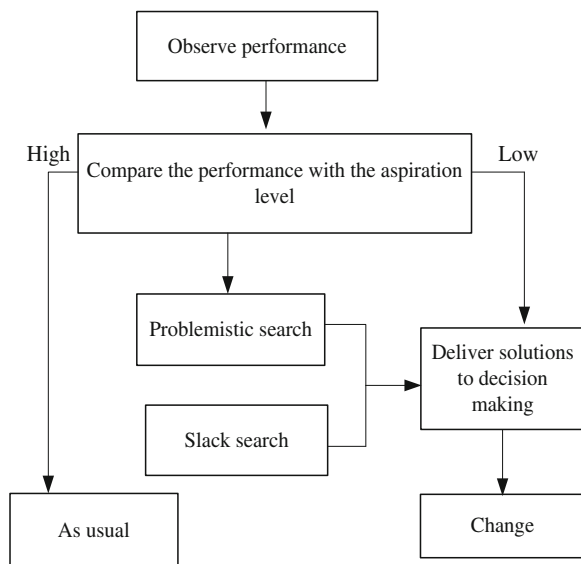
### ***74.3.3 Performance Feedback and Organizational Routines***

Performance feedback operates on the organization and job teams in the organization, and on individuals, though the goals and consequences differ in each case. Individual who given information on their performance and goal will monitor their performance relative to the goal, will change their behavior if the performance is below the goal. This goal seeking behavior can be strengthened by attaching reward to goal fulfillment. At the job team level, performance feedback causes modification when goals are not met. At the individual level, persons may use performance feedback to modify their own habits.

The multilevel nature of performance feedback effects on routines should be clear from the preceding review. Performance feedback operates on the organization, on job teams in the organization, and on individuals, though the goals and consequences differ in each case. Table 74.1 depicts the processes discussed here. At the organizational level, performance feedback causes entire activity sets to be added, modified or replaced. The goals are typically negotiated or imposed on the

**Table 74.1** Cross-level performance feedback

Level	Goal source	Actions
Organization	Environment and dominant coalition	Select and modify macro routines Update own aspiration levels Design goal systems for lower levels Influence lower-level aspiration levels
Job team	Organization and group	Select and modify job team routines Update own aspiration levels
Individual	Organization, group and individual	Select and modify individual routines Update own aspiration levels Modify individual actions used in job team routines

**Fig. 74.2** The form of performance feedback

organization by external actors, and tend to be profitability or stock price goals for private sector firms. At the job team level, performance feedback causes modification of production routines when goals emphasized in the internal goal-setting system are not met. At the individual level, persons who are not constrained by the stabilization of routines at the job team level may use performance feedback to modify their own habits, and the goals will either be set by the organization or created by the individual.

The performance feedback at multiple levels constitutes a system, but the system is not likely to be consistent with early work imagined an organizations as hierarchical, self-regulating systems. Rather, organizations are drawn to pursue goals that happen to be salient.

Figure 74.2 tells the form of performance feedback. From the front text, we know individual will change their behavior if the performance is below the goal. Actually, either individual or group demanded to give performance feedback will compare their performance with the aspire level to see whether they have fulfilled the goals. If they fulfill the goals, they just do as usual and don't change. Otherwise, they will do problemistic search, combined to the slack search to find the solutions, then decide to change or not. Performance feedback is causing the actor to do something. It does not directly investigate how habits and routines are changed. But it's a great driving power to make the organizational routines to change. In other words, this change mechanism is the really competitive advantages for the organizations.

## 74.4 Conclusion

Basing on many scholars' studies of organization routines, I has defined organizational routines, explained what will changes the organizational routines, discussed that organization performance feedback will also affect organizational routines except business environment, and how organization performance feedback affect organizational routines from the individual, job team, and organizational level. This paper clearly tells the beneficial effect of organization routines to organization performance, but this positive role must be combined with organization performance feedback to last. Because organization performance feedback can promote the change of organizational routines timely, or the entire organization may be into a rigid which greatly damage the organization.

**Acknowledgments** I thank my friend Y Jiang who gives me lots of advices and help in the process of writing paper. Also, I appreciate Wuhan University figures provided lots of data resources. This study is still limited, although it gives the concept of organizational practices, identifies organizational routines help to improve organizational performance, organizational performance feedback and business environment can promote change of routines, but it lack of quantitative research, the measurement of organizational routines and empirical research is important and difficult in the future.

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# Chapter 75

## Corporate Entrepreneurship: Constructs and Research Focuses

Qi-lu Fang

**Abstract** Corporate Entrepreneurship has drawn great attention in the research field of strategic management, innovation and entrepreneurship. However, confusion about the extension and intention of Corporate Entrepreneurship still exists and knowledge of which remains quite fragmented and non-cumulative. This article will clarify the definition and scope of the theory of corporate entrepreneurship, study the evolution of the constructs, and identify the research focuses and trends for future studies. The future research possibilities are also discussed.

**Keywords** Corporate Entrepreneurship • Entrepreneurial Orientation • Review

### 75.1 Introduction

For both start-up ventures and existing firms, entrepreneurship carried on in the pursuit of business opportunities spurs business expansion, technological progress, and wealth creation (Lumpkin and Dess 1996). It has drawn great attention in the research field of strategic management, innovation and entrepreneurship.

Since Peterson and Berger discussed entrepreneurship in organizations in *Administrative Science Quarterly* in 1971, scholars had begun to pay increasing attention to entrepreneurial activities within existing organizations. After decades of development, our knowledge of Corporate Entrepreneurship (CE) continues to expand. In 1990, the *Strategic Management Journal* published a special issue on CE, which showed that CE had officially become an emerging branch of strategic management research.

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Clarifying the definition and scope of the theory of corporate entrepreneurship, studying the evolution of the constructs, and identify the research focuses and trends for future studies are the basic premise of researching and developing the corporate entrepreneurship theory. This article represents one effort to explain the evolution of key constructs in the field of corporate entrepreneurship and the research focuses and paradigm within the research domain.

## **75.2 Evolution of Key Constructs**

Scholars have developed numerous typologies to describe alternate perspectives of corporate entrepreneurship. These classification systems typically depict differences in corporate entrepreneurship as the result of various combinations of individual, organizational, or environmental factors. Corporate Entrepreneurship is a multifaceted concept that for some refers to a firm-level disposition to strategic daring, for others to the process of new business creation within established companies, and for others still, to the adoption of entrepreneurial values and behavior by corporate staff. Construct refers to a special concept, and the specificity is reflected in four aspects: (1) construct is constructed by human to meet a certain need of scientific research; (2) it is abstract and cannot be directly observed; (3) it is related to theories and particular models; (4) it is clear and explicit. The different constructs in the research field are complicated with overlaps. Among which, Entrepreneurial Orientation and Corporate Entrepreneurship are two significant constructs.

### ***75.2.1 Entrepreneurial Orientation (EO)***

From Miller first brought out the several dimensions of a firm's renewal process in 1983 to the clear define of the concept and dimensions of entrepreneurial orientation by Lumpkin and Dess in 1996, the evolution of EO has experienced three phases.

#### **75.2.1.1 An organizations' Renewal Process**

Based on the analysis of impact factors of entrepreneurship in different enterprises, Miller (1983) pointed out that the entrepreneurship (which actually referred to entrepreneurial orientation) is a multi-dimensional construct, including the company's innovation (products, market and technology), risk taking and pioneering. Entrepreneurship can be tried to seem as a weighted combination of these three dimensions. It is noteworthy that the three dimensions are related to each other and cannot be separated, which means when we use this criteria to examine a firm's

entrepreneurial activities, we must use the whole. Miller's (1983) discourse on three-dimensional division of EO and the relationship between the three dimensions has been widely recognized. However, he did not explicitly put forward the construct of entrepreneurial orientation.

### **75.2.1.2 Entrepreneurial Posture**

Covin and Slevin (1989) first use mentioned the concept of entrepreneurial posture in a paper discussing about different strategic choice of high performance small businesses in poor and good environments, and further clarified that entrepreneurial posture was a kind of corporate strategic choice (Covin and Slevin 1991). Zahra (1993) argued that Covin and Slevin's entrepreneurial posture did not clarify the nature of corporate entrepreneurial activities from the firm level. Covin and Slevin's (1991) conceptual model of entrepreneurship as firm behavior only illustrated the intensity of this behavior, which was extended by Zahra (1993) to other 3 aspects: the formality of entrepreneurial activities, the types of entrepreneurial activities a firm undertakes to rejuvenate or renew it self and redefine its business concept, and the duration of such efforts. After several arguments between the two teams of scholars, the nature of the concept of entrepreneurial posture was confirmed: it is a strategic choice of corporate, explaining the strength or inclination of enterprises' engagement in entrepreneurial activities (Covin and Slevin 1993).

### **75.2.1.3 Entrepreneurial Orientation**

In 1996, Lumpkin and Dess clarified the construct of entrepreneurial orientation in the paper published on *Academy of Management Review*, which indicate the maturity of the EO construct. In this research, they defined entrepreneurial orientation as the processes, practices, and decision-making activities that lead to new entry. New entry can be accomplished by entering new or established markets with new or existing goods or services. New entry is the act of launching a new venture, either by a start-up firm, through an existing firm, or via internal corporate venturing (Lumpkin and Dess 1996). In their study, new entry is the central idea underlying the concept of entrepreneurship. The key dimensions that characterize an EO include a propensity to act autonomously, a willingness to innovate and take risks, and a tendency to be aggressive toward competitors and proactive relative to marketplace opportunities (Lumpkin and Dess 1996). They disagreed with Covin and Slevin (1989) about the relationship of different dimensions of entrepreneurial orientation. They suggested that autonomy, innovativeness, risk taking, proactiveness, and competitive aggressiveness may vary independently, depending on the environmental and organizational context.

### 75.2.2 *Corporate Entrepreneurship (CE)*

Corporate Entrepreneurship is a complicated concept. It was confused with entrepreneurial posture and entrepreneurial orientation in the early years of research in 1980s. The broad definition of CE includes the domain of EO and other relevant concepts. However, we define corporate entrepreneurship with a more narrow intention from the entrepreneurship perspective as a phenomenon or process, instead of EO from a more strategic perspective.

Burgelman (1983a) thinks that corporate entrepreneurship refers to the process whereby firms engage in diversification through internal development. Such diversification requires new resource combinations to extend the firm's activities in areas unrelated, or marginally related, to its current domain of competence and corresponding opportunity set (Burgelman 1983b).

Covin and Selvin (1991) and Zahra (1993) also revealed the idea of thinking corporate entrepreneurship is a process of organizational renewal that has two distinct but related dimensions: innovation and venturing, and strategic renewal. Guth and Ginsberg (1990) identified that corporate entrepreneurship encompasses two types of phenomena and the processes surrounding them: (1) the birth of new businesses within existing organizations, i.e. internal innovation or venturing; and (2) the transformation of organizations through renewal of the key ideas on which they are built, i.e. strategic renewal. This two-dimension explanation of corporate entrepreneurship was further refined as innovation, strategic renewal and corporate venturing by Zahra himself in 1995 (Zahra 1995).

Sharma and Chrisman (1999) defined corporate entrepreneurship as “the process whereby an individual or a group of individuals, in association with an existing organization, create a new organization or instigate renewal or innovation within that organization” based on study of a large number of former researches. At the same time, they proposed the hierarchy of terminology in corporate entrepreneurship (see Fig. 75.1).

Although there is further subdivision of dimensions of CE by several studies, most scholars stay with the three dimension construct since they all actually developed from it.

### 75.2.3 *Other Constructs*

In the research field of corporate entrepreneurship, besides the two main streams of EO and CE, there are several other relevant constructs such as intrapreneurship and entrepreneurial management.

Intrapreneurship is the development within a large organization of internal markets and relatively small and independent units designed to create, internally test-market, and expand improved and/or innovative staff services, technologies or methods within the organization. This is different from the large organization

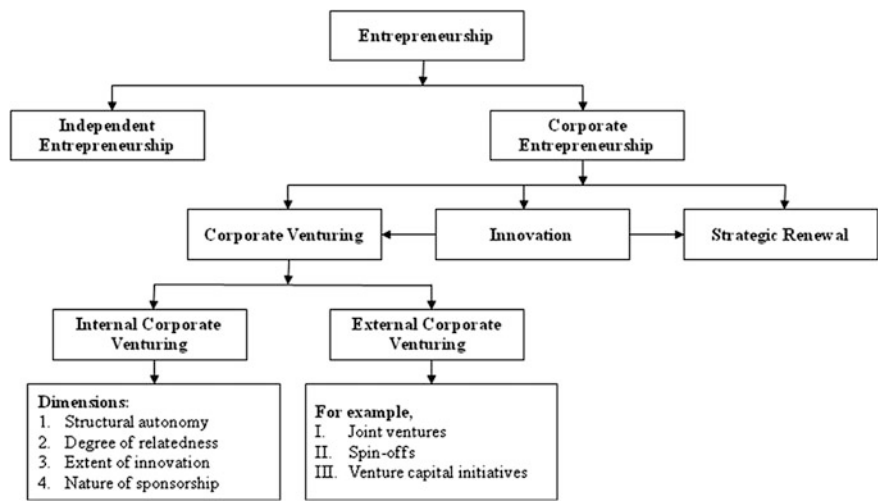


Fig. 75.1 Hierarchy of terminology in corporate entrepreneurship

entrepreneurship/venture units whose purpose is to develop profitable positions in external markets (Nicolson et al. 1985). Intrapreneurs are any of the “dreamers who do.” Those who take hands on responsibility create innovation of any kind within an organization. They may be the creators or inventors but are always the dreamers who figure out how to turn an idea into a profitable reality (Pinchot 1985).

Entrepreneurial management is a distinct management style compared with traditional one, which is the behavior of company’s management group performed to cultivate the company’s entrepreneurial activities.

It is a management philosophy, to promote the company’s strategic agility, flexibility, creativity and continuous innovation (Stevenson and Jarillo 1990). Its main objective is to develop people at all levels to think and act like entrepreneurs within an organization.

75.3 Research Focuses

In the history of corporate entrepreneurship research, there are plenty of propositions and hypotheses. Based on the review of former studies in main stream authoritative journals like AMJ, AMR, SMJ and ETP, we summarize the research focus in the field focused on antecedents, processes and its link to performance.

### ***75.3.1 Antecedents***

Zahra (1986) identified the antecedents of corporate entrepreneurship as environmental considerations, the effect of corporate and SBU (strategic business unit) strategies and organizational factors. Firms' investment decisions, including the willingness to carry out entrepreneurial activities are subjected to the influence of the external competitive environment. The strategic relevant elements can be considered as strategic management practice, corporate governance and ownership structure, and strategic orientation. The organizational factors are a more complicated dimension. Influential factors are organization culture, structure, human resource management practice, resource and capability, executive team characteristics, information technology system and basic characteristics of enterprises (Dai 2009).

### ***75.3.2 Processes***

Gartner (1990) claimed that corporate entrepreneurship includes four elements: individuals, creative process, the organization created and the environment. Burgelman (1980) proposed in his doctoral dissertation and demonstrated in several following studies that corporate entrepreneurship process can be spontaneous (employees spontaneously attempt and sometimes manage to create successful ventures within established organizations or rather, in spite of them) or induced (companies define policies and set up programs, systems, organizations to encourage the adoption of entrepreneurial behavior and the development of entrepreneurial initiatives in their midst), which is widely accepted by the research field.

### ***75.3.3 Link to Performance***

The inherent value in entrepreneurship is that for new entry to result in high performance, firms must have a strong entrepreneurial orientation. This assumption remains largely untested, as suggested by Zahra, who found that there is "a paucity of empirical documentation of the effect of entrepreneurship on company financial performance" (Zahra 1993). To address this question, Lumpkin and Dess provided an integrative framework for exploring the relationship between entrepreneurial orientation and performance (see Fig. 75.2). While other scholar also proposed alternate contingency models of the Entrepreneurial Orientation-Performance relationship. Exploring relationships between entrepreneurial behavior and performance is very timely, given the competitive conditions faced by firms of all sizes in today's economy.

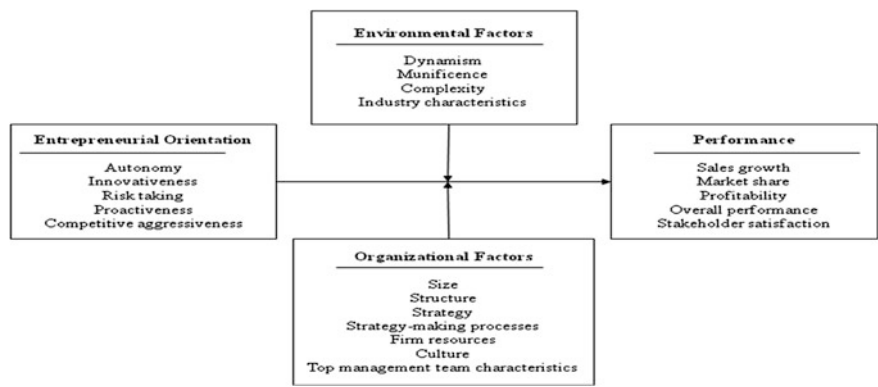


Fig. 75.2 Conceptual framework of entrepreneurial orientation

75.4 Discussion and Conclusion

Corporate entrepreneurship is a rich word, which can be understood as a field of study or a construct. As a field of study, it contains a number of theoretical constructs of entrepreneurial orientation and corporate entrepreneurship. As a construct, then we can use it to conceptualize the entrepreneurial activities of the enterprise level (Ireland et al. 2009). Clarifying the definition and scope of the theory of corporate entrepreneurship, studying the evolution of the construct, and identifying the research focuses and trends will benefit future research and the development of the corporate entrepreneurship theory.

Based on the literature review we made in this study, it's not hard to see that corporate entrepreneurship, as an interdisciplinary field of study among strategic management, innovation and entrepreneurship, has been and will be more popular as a forefront research subject. Further research effort on the research focuses and directions which mentioned in this article may lead to certain progress in the field, especially empirical studies that can provide evidence to those conceptual models and propositions discussed about the link between corporate entrepreneurship and performance. At the same time, study the subject in a specific context, like global economies and emerging economies as the background may provide new perspectives and lead to innovative research achievements.

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# Chapter 76

## Study on the Relationship Between the Executive Incentives and Business Performance in Listed Companies of Manufacturing Industry

Xiao-xuan Kou, Ao-bo Dong and Lei Zhang

**Abstract** This paper has chosen annual report data of 442 listed companies in manufacturing industry as research samples, which were listed in Shenzhen Stock Exchange and Shanghai Stock Exchange in 2010. This paper analyzes the factors which affect the company's performance by using statistical analysis tool spss18.0. We try to study the correlation between executive incentive and business performance, by using the hypothesis testing and linear regression method. On the basis of the above studies, we make a few suggestions about the executive incentives combining with the new trend of today's social development of listed companies to improve the corporate performance at the end of the paper.

**Keywords** Company performance · Compensation · Executive incentives · Listed companies

### 76.1 Introduction

With the development of global economic integration, China's enterprises faced with unprecedented challenges and opportunities. In recent years, the development of China's listed companies is active, the quantities of those companies are ever-increasing and the company structure is also optimized continuously, more and

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more scholars and entrepreneurs have focused on the governance of the listed companies. There is information asymmetry between consignor and agent in the process of corporate governance (Gang 2000). How to incent executives to maximize interests while pursuing self-interests, that is we should continue to explore and study.

In recent years, based on some mature researches of foreign academics, such as “principal-agent theory” and “stakeholder theory”, scholars conducted localization study. Kun and Hengqi (2010) studied on executive compensation incentive effect on the operating results of the company of the wholesale and retail industry. Duan Chunming studied the relationships of executive incentive and external audit; Ge Chunyao researches the effectiveness of executive incentive of commercial banks in China, and so on. Due to different study perspectives, the conclusions are not the same.

Based on the predecessors’ research results, we select the manufacturing industry which is more stable as the study object and focus on the current incentives for executive of listed companies, such as “which measures are most effective?”, “What degree of motivation is?”, “How to set up an efficient executive incentive mechanism?” and so on.

## 76.2 Research Assumption and Framework

At present, most of reformed companies adopt the model of shareholder governance, maximize the benefits of shareholders, improve the business performance (Cheng 2004). In numerous incentives most companies choose salary incentive as the main incentive. In order to build up the relation further between executive and company, many companies take the company share as a means of motivation, and achieved a very good incentive effect (Xing et al. 2007). There are very few companies use restricted stock, stock options, stock appreciation rights and other means, but these methods practice relatively late, the range is small and has no representative (Qifeng and Ding 2001). In order to learn more about the performance of listed companies in manufacturing and the relation between executive compensation and executive shareholding, we will study the impact of company performance which is conducted by different salary groups and different ownership groups of stock by using the method of Group Method of Regression.

**Hypothesis 1:** There is positive significance correlation between performance of listed companies and executive compensation in manufacturing industry. There is inconsistency of interest between shareholders and managers according to the principal-agent theory. In order to avoid the risk and cost which is raised by moral hazard and asymmetric information, shareholders are likely to sign the reward versus performance contract with the managers (Turban and Greening 1997). Therefore, company performance and managers’ salaries are closely related. It is reasonable for executives to get high salary though improving performance.

**Hypothesis 2:** There is positive significance correlation between performance of listed manufacturing companies and executive shareholding ratio.

According to Maslow's hierarchy of needs theory, executive will demand a higher level of motivation when physical compensation being satisfied (Melly 2005). In order to improve the level of motivation, executive shareholding plans become a popular incentive for listed companies in recent years.

## 76.3 Research Sample and the Sample Selection

### 76.3.1 Sample Selection

We choose 612 listed companies in manufacturing industry which issue A-share as original sample in Shenzhen Stock Exchange and Shanghai Stock Exchange. We collect data from the website of Shenzhen and Shanghai Stock Exchange, Genius net and Database of Guo Taian and so on. We also get rid of some unreasonable data according to the following principles:

1. Excluding listed companies which are marked ST, \*ST, S\*ST, SST and PT for the badly performance, and issued audit views by registered accountants of retained views, refused to express views and negative views.
2. This study mainly focuses on highly concerned A-share listed companies. Because of the influence of information disclosure if the A-share listed companies issue B-share and H-share, we get rid of those A-share listed companies which is issued B-share and H-share meanwhile.
3. Due to vulnerable abnormal fluctuations of performance, and unsound internal operation mechanism, the newly listed companies are not included in the sample since 2008.
4. The sample which is lack of relevant performance indicators is rejected.

Based on the above principles, we selected a total of 442 listed companies as the ultimate study samples which have perfect information and internal structure.

### 76.3.2 Variable Definition and Research Model Definition

#### 1. Dependent Variable

We adopt the ROE as index of company performance. ROE reflects the profitability of the company.

#### 2. Independent Variable

The first one is the top three executives total annual salary, for the accuracy of datum, we take logarithms on salary in the regression equation model. The second one is executive shareholding ratio.

We will do group research for further understand of effects of variables on the dependent variable. First, according to the company's top three executives of the distribution of total salary, the sample data is divided into five groups: 1 million below, 1–1.5 million, 1.5–2 million, 2–2.5 million, 2.5 million above. Second, the sample data are divided into five groups in terms of Executives shareholding ratio: 0, 0–0.01, 0.01–0.1, 0.1–10, 10 % above. We will do the regression analysis based on the above groups.

### 3. Control Variable

**Company size.** Company performance is not only influenced by management efforts, but also impacted with management capacity and the available resources (ZhaoY 2002). At the same level of incentives and shareholding ratio, there are companies of different size and performance. So, company size is the control variable of the company performance (Trevor et al. 2008).

**Independent Director Ratio.** There is no direct interest between independent directors and company. So, independent directors are likely to take the benefits of stock-holders at first, and do objective evaluation of executive performance. This will indirectly affect the company's performance.

**State-owned Shareholding Ratio.** In the company's ownership structure, state-owned shareholding belongs to the state, SASAC on behalf of countries to exercise ownership, which led to the vacant of owner of State-owned shareholding. No real owner directly led to insufficient supervision of executive of listed companies. The larger proportion of state-owned shareholding, the less supervision of company executive and larger powers of executive implementation (Lucian and Yaniv 2005). State-owned shareholding ratio will affect the company's performance.

**Number of Meetings of the Board of Directors,** Lipton and Lorsch (1992) point out that, the meeting of the board of directors benefits and the fulfillment of responsibility. And the stakeholder, directors could take the interests of stock-

**Table 76.1** Variables' symbol, meanings and declaration

Variable type	Variable name	Variable meaning	Variable declaration
Dependent variable	ROE	Company performance	Net profit/average owner's equity
Independent variable	Salary	Executive compensation	The top three executives total annual salary
	SRatio	Executive shareholding	(Total number of managerial ownership)/(the number of shares)
Control Variable	Asset	Company size	Total assets
	DRatio	The independent director Ratio	(The number of independent directors)/(the total number of the board)
	FST	The proportion of state-owned shares	(The number of state-owned shares)/(total number of shares)
	Num	Number of meetings of directors	Number of meetings of directors

holder first and protect their interests, and then impact on company performance (Table 76.1).

Build up model and regression equation based on Hypothesis 1 and Hypothesis 2:

$$ROE = \beta_0 + \beta_1 * \ln(salary) + \beta_2 * SRatio + \beta_3 * \ln(Asset) + \beta_4 * DRatio + \beta_5 * FST + \beta_6 * Num + \mu$$

ROE is the explained variable,  $\beta_0$  is constant,  $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$  are coefficients of explanatory variables,  $\mu$  is random error term, the others are explanatory variables.

76.3.3 Description of Sample Statistics

According to the data from 2010 listed manufacturing companies, we do the statistics description to each variables, Table 76.2 shows the results.

It can be seen from Table 76.2, the minimum total annual salary of top three executives of listed companies in Chinese manufacturing industry is 145,900 yuan which is different to the maximum annual salary 8,067,500 yuan hugely. The standard deviation is 11,01,403.547, indicating that there are large differences between the mean value and the company’s top three executives of the total annual salary distribution.

Figure 76.1 shows, the top three total salaries mainly concentrate in on the range of 800,000 yuan to about 1,500,000 yuan. There is several one extremely high salary. Salary standard deviation is large which indicates that total concentration different.

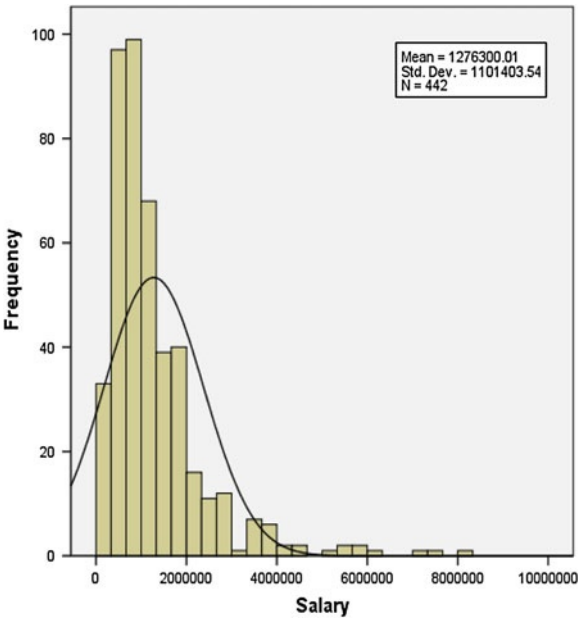
Statistical analysis of the frequency percentage which drawn from Table 76.2 and Fig. 76.2 shows that executive shareholding ratio most companies (about 83.3 %) of manufacturing industry is zero. The highest executive shareholding ratio is 0.5587, the standard deviation is small, and the numerical distribution is relatively centralized.

Table 76.2 Description of sample statistics

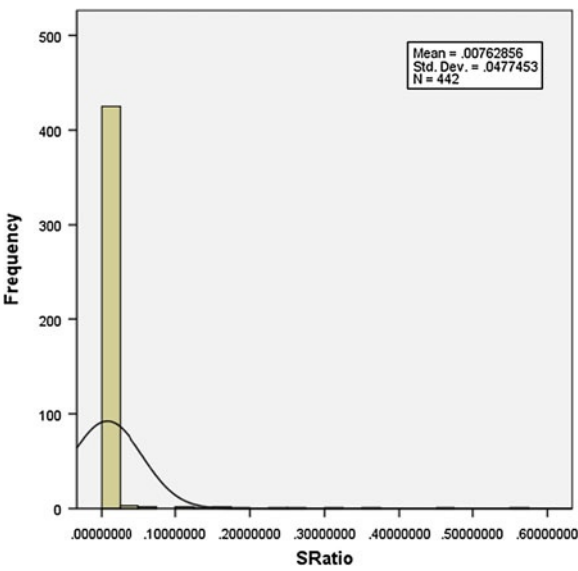
	N	Minimal Value	Maximal value	Mean value	Standard deviations
ROE	439	−9.911979	0.760529	0.07853312	0.489744946
lnSalary	442	11.890677	15.903354	13.7855133	0.731867156
SRatio	442	0.0000000	0.5587196	0.00762856	0.047745334
lnAsset	441	18.847228	26.156299	21.8712261	1.064026171
DRatio	442	0.2500000	0.571429	0.36425067	0.050288314
FST	442	0.0000000	0.682644	0.06630257	0.148661327
Num	442	3	38	8.64	3.960
Salary	442	1,45,900	80,67,500	12,76,300.01	11,01,403.547

Data sources Database of GuoTaiAn: <http://www.gtarsc.com/>

**Fig. 76.1** The top three executives total annual salary histogram



**Fig. 76.2** Executive shareholding ratio histogram



76.4 Empirical Analysis

Based on the above description, correlation analysis and regression model analyses of sample data are necessary.

From Tables 76.3 and 76.4, we can get conclusions as below:

1. There is a significant positive correlation between the performance of listed companies of manufacturing industry and the executive salary in the level of 1 % that shows that improving the company's executive salary can significantly improve performance, Hypothesis 1 is valid. In five salary groups, total salary coefficient  $\beta_1$  always be positive which is matches Hypothesis 1 exactly. In the salary group ① to ④ variable coefficient is significantly increases. It indicates that companies salary incentive effect significantly when three executives of listed companies totaled to two million yuan. The incentive effect is decline but still effective when salary totaling more than two million yuan. It can be seen that high salary do good effect on executive incentives.
2. There is a negative correlation between corporate performance and the executive shareholding ratio, significant (0.917) is very poor, this indicates that the executive at shareholding and company performance have no significant linear correlation which is different from above result. Through the group regression study, the executive shareholding ratio coefficient  $\beta_2$  present a irregular jumping ( $-0.034, -140.76, 228.819, -1.069, -0.071$ ).As the increasing of the shareholding ratio. Only when the executive shareholding ratio is in 0.01–0.1 %, its coefficient is positive 228.819 significantly. It shows that the company will receive a huge incentive effect when company takes the measure of stock ownership incentive in this case. But if shareholding ratio is below or above of this scope, the coefficient is negative and is not notable. Without prerequisites, the conclusion of executive shareholding ratio and company performance has significantly positive is obviously wrong. Hypothesis 2 is rejected.
3. From Table 76.3 we can see that the relationship between the control variable and company performance is not significant. Size and proportion of State-owned shares, the number of Board of Directors show a significant sensitivity.

## 76.5 Conclusion Analysis and Suggestion

### 76.5.1 Conclusion Analysis

This paper analyzes the annual reports of 442 listed companies of manufacturing industry since 2010 through total descriptive analysis. This paper also analyzes the impact of performance which is conducted by executive salary and executive shareholding ratio. Through a series of empirical analysis, in the manufacturing industry, salary incentive is significantly better than equity incentive, and show a very good stability. Research found that, in a certain salary range, performance increase will be higher than the level of salary increase when raise the level of salary. There is no regularity between executive shareholding ratio and corporate

**Table 76.3** Correlation coefficient and significant matrix between each variable

ROE	In salary	S ratio	In asset	D ratio	FST	Num
ROE	1	0.169 <sup>a</sup> (0.00)	0.083 (0.084)	0.030 (0.533)	0.020 (0.677)	0.013 (0.788)
In salary		1	0.364 <sup>a</sup> (0.000)	0.061 (0.204)	0.018 (0.712)	0.151 <sup>a</sup> (0.000)
S ratio			1	-0.039 (0.414)	-0.058 (0.220)	-0.10 (0.831)
In asset				1	0.180 <sup>a</sup> (0.000)	0.156 <sup>a</sup> (0.001)
D ratio					1	0.007 (0.886)
FST						1
Num						

*Note* <sup>a</sup> related to the 1% level

Table 76.4 Correlation coefficient and significant matrix between each variable

Group type	Salary group 1	Salary group 2	Salary group 3	Salary group 4	Salary group 5	Share holding group 1	Share holding group 2	Share holding group 3	Share holding group 4	Share holding group 5
Model	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Constant	-0.803 (0.000)	-1.133 (0.000)	-7.582 (0.098)	-0.524 (0.132)	-1.197 (0.011)	0.803 (0.000)	-1.494 (0.171)	-1.477 (0.008)	-0.356 (0.703)	-0.335 (0.831)
lnSalary	0.054 (0.000)	0.080 (0.000)	0.373 (0.031)	0.054 (0.074)	0.107 (0.001)	0.054 (0.000)	0.113 (0.088)	0.050 (0.024)	0.024 (0.748)	0.018 (0.748)
SRatio	-0.034 (0.770)	-0.285 (0.581)	2.543 (0.839)	116.668 (0.767)	0.399 (0.213)	0.034 (0.770)	-140.76 (0.915)	228.819 (0.009)	-1.069 (0.436)	-0.071 (0.709)
lnAsset	0.009 (0.251)	0.009 (0.295)	0.087 (0.648)	-0.011 (0.432)	-0.007 (0.730)	0.009 (0.251)	0.007 (0.834)	0.029 (0.210)	-0.019 (0.736)	0.018 (0.794)
DRatio	-0.050 (0.722)	-0.117 (0.543)	1.099 (0.734)	0.403 (0.179)	0.130 (0.729)	0.050 (0.722)	-0.065 (0.914)	0.673 (0.021)	-0.373 (0.453)	-0.606 (0.751)
FST	0.009 (0.839)	-0.109 (0.080)	0.489 (0.744)	0.019 (0.809)	-0.233 (0.519)	0.009 (0.839)	0.104 (0.679)	-0.041 (0.724)	0.048 (0.892)	1.146 (0.583)
Num	-0.001 (0.486)	-0.002 (0.336)	0.000 (0.994)	-0.004 (0.412)	-0.007 (0.230)	0.001 (0.486)	-0.010 (0.478)	-0.006 (0.576)	-0.003 (0.757)	0.001 (0.951)
	R <sup>2</sup> 0.165 F 7.425 (0.000)	R <sup>2</sup> 0.071 F 0.647 (0.693)	R <sup>2</sup> 0.071 F 0.647 (0.693)	R <sup>2</sup> 0.359 F 1.585 (0.212)	R <sup>2</sup> 0.355 F 2.930 (0.022)	R <sup>2</sup> 0.165 F 7.425 (0.000)	R <sup>2</sup> 0.071 F 0.647 (0.693)	R <sup>2</sup> 0.071 F 0.647 (0.693)	R <sup>2</sup> 0.359 F 1.585 (0.212)	R <sup>2</sup> 0.359 F 2.930 (0.022)

performance. But it will show a significant positive correlation in the context of a certain proportion. This indicates that equity incentives mechanism was premature.

Therefore, companies can design a well-designed incentive mechanism and receive a better incentive effect in the future.

### **76.5.2 Suggestion**

#### **1. Perfect the Incentive Mechanism Further**

Salary incentive is a common approach. Senior management staff will realize their value with higher salary. The phenomenon of executives gets stagnancy and slack with a higher fixed salary suggests that short-term, high fixed income evoke inertia (Chourou and Abaoub 2007). So, unfixed, larger changed bonus should be enhanced in the incentive mechanism. It is also feasible to increase executive responsibility, improve the social status and ability and promote the executive physically and mentally (Gabaix and Landier 2008).

#### **2. Focus on the Effect of Equity Incentive**

Table 76.4 shows that equity incentives in a certain range effect on company performance significantly. Equity incentives not only enable executives to enjoy normal high salary and bonus, but also can share profits due to share size and grow with the company in a long term to realize the value (Qiu 2011).

#### **3. Establish Long-term Incentive and Restraint Mechanism**

It is vital to balance relations of executive incentive and company short-medium-long term goals. This is because excessive short-term incentives can stimulate to take short-term management action, and damage the long-term interests of enterprises (Xu 2011). But focusing on the long-term interests of the company and ignoring the interests of executive would make the executive lack of enthusiasm, and that could lead long-term objectives fail. Therefore, there must be a general short-medium-long term incentive plans to formulate executive incentive. It is necessary for outstanding executive to develop and award benefit. This is also essential for solving the problem of persistence and availability of the executive incentives.

#### **4. Focusing on the Combination of Incentives and Corporate Culture**

Corporate culture impacts on executive performance effectively. There are two cultural factors: one is the corporate history and traditions, especially the policy history which is about corporate incentives for executive; the other is the concept of corporate culture. Incentive system should have continuity as far as possible. The reform of incentive system should be constructed step by step, and try to avoid huge changes (Zheng 2011). Let the new incentives and incentive ideas gradually

formed a new habit, and then new executive incentive system can be truly implemented and operated properly.

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# Chapter 77

## A Review of Institutional Theory and Entrepreneurship

Hao-zhe Chen

**Abstract** Institutional theory is one of the major theories underpinning not only organization and management research, but also entrepreneurship studies. In this paper, we will review the existing literatures that employ institutional perspective to understand entrepreneurship and those applying entrepreneurial perspective to address the “paradox of embedded agency” which impedes the endogenous development of the institutional theory to understand the current status of the field and future research possibilities.

**Keywords** Institutional theory · Entrepreneurship · Institutional entrepreneurship

### 77.1 Introduction

Institutional theory has been applied in many domains ranging from institutional economics and political science to organization theory since the 1970s. Not until Shane and Foo’s works on franchising success appeared did the researchers realized its explanatory power in entrepreneurship research, which previously were based on the resource-based theory (RBV) of the firm that overlooks the impact of culture, legal environment, tradition and history to entrepreneurial success. Meanwhile, the institutional theory has been challenged with the “paradox of embedded agency” that is, the paradox of how actors enact changes to the context by which they, as actors, are shaped. Commonly, this paradox is addressed by researchers who identified institutional entrepreneurship and tried to explicate its underlying mechanism. This paper thus intends to answer these three questions: (1) Why and how could institutional theory be applied to entrepreneurial studies? (2)

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How does institutional entrepreneurship work? (3) What does the combination of institutional theory and entrepreneurship contribute to these two domains of research? We will first discuss the two core concepts underpinning the topic—institutions and entrepreneurship, and then we will conduct a literature review from selected papers published on top management journals and present three major research streams: (1) institutional environment and entrepreneurship; (2) legitimacy building and entrepreneurship; (3) institutional entrepreneurship. Afterwards, we will focus on institutional entrepreneurship with its precedents, consequences and underlying mechanisms. Finally, we will discuss the future research possibilities.

## 77.2 Core concepts

### 77.2.1 *Institutions*

Institutions are taken-for-granted rules, norms, and beliefs that justify social arrangements and behaviors. It is viewed as performance scripts for repeated activities, deviations from which are costly or regarded as illegitimate.

Organizations function in an institutional environment that implements some degree of pressures which are commonly known as “institutional pillars”: the regulative, which guides behaviors through sanction and conformity, usually in form of governmental legislation and industrial agreements and standards; the normative, which guides behaviors through by defining social appropriateness, represented in values and norms; and the cognitive, which guides behaviors through subjectively constructed frames and meaning that used to interpret the world (Scott 1995).

The fact that institutional arrangements provide continuity and stability is explained in different ways across different disciplines. From a institutional economics perspective, institutions economize on transaction costs by reducing uncertainty and mitigating opportunistic behaviors, Coase 1937; Williamson 1985. While sociologists emphasize how institutional arrangements grant legitimacy, a generalized perception or assumption that the actions of an entity are desirable, proper or appropriate (Suchman 1995), research on cognitive processes takes institutions as shared cognitive frames that give meaning to inherently equivocal informational inputs by directing sense making processes (Gioia and Chittipeddi 1991).

Though institutional research focused on the isomorphic process brought about by institutional forces and the resilience of institutional prescriptions, there has been interest in how non-isomorphic change works to create, maintain, transform or disrupt institutions (Lawrence and Suddaby 2006).

### ***77.2.2 Entrepreneurship***

Entrepreneurship is the process of exploring the opportunities in the market place and arranging resources required to exploit these opportunities for long term gain. According to Schumpeter, entrepreneurship is the introduction of new technologies with creative destruction. From a sociological perspective, entrepreneurship is associated with deviations from some norm (Garud and Karnøe 2001), its novel ideas are not readily accepted by actors committed to existing institutional arrangements from which they derive vested interests. Cognitive sociology takes entrepreneurship as recombination of seemingly unrelated ideas from different knowledge domains (Koestler 1964). Anyway, entrepreneurship emerges with the liability of newness, matures with politics and ongoing negotiation, succeeds with legitimacy acquisition, in which some entrepreneurs choose to change and creation rather than conformity and obedience.

### ***77.2.3 Institutional Entrepreneurship***

The juxtaposing of institutional pressure of conformity and entrepreneurial forces to change asks for a coherent concept, institutional entrepreneurship, which offers comprehensive understanding of how and why certain new practices or new organizational forms come into being or certain well-established.

Thus come the term institutional entrepreneurship, which was initially introduced by DiMaggio (DiMaggio 1988) as a way to reintroduce actors' agency to neo-institutionalism who believed institutional change results from exogenous shocks that challenges existing arrangements. Eisenstadt (1980) first applied the notion of institutional entrepreneurship to characterize actors who serve as agents for institutional change by leveraging resources to create new institutions in which they see an opportunity to realize interest (DiMaggio 1988).

The "structure-agency" debate (or the paradox of embedded agency which refers to the problem of how and why actors shaped by institutional environments become motivated and enabled to promote change) also calls for answers to the underlying mechanism of institutional change. By combining structure and agency in some degree of mutually constitutive duality, Giddens's work on "structuration" and Bourdieu's notion of "habitus" are stating that structure is both the medium and outcome of action since agency is distributed within the structures (Garud et al. 2007).

## 77.3 Data and Method

This paper examines literatures selected from top journals on organizations, management and entrepreneurship, considering its cross-disciplinary characteristics, with a relatively high SSCI impact factor on institutional theory and entrepreneurship from 1990 to 2011. We searched EBSCO and JSTOR employing search terms *institutional theory*, *entrepreneurship*, *institutional entrepreneur*, or *institutional entrepreneurship* (Table 77.1).

Finally, 44 articles were identified and we highlighted three major research streams: the institutional environment and entrepreneurship, legitimacy building and entrepreneurship, and institutional entrepreneurship.

## 77.4 Findings

### 77.4.1 Institutional Environment and Entrepreneurship

Institutional environment both enables and constrains entrepreneurial opportunities. From transactional economics perspective, a well-established institution with more favorable market incentives and availability of capital could facilitate the creation of new ventures, while a weak and underdeveloped institutional environment tends to increase the transaction cost involved in entrepreneurship. More regulations from the government also result in more rules and procedural requirements that entrepreneurs should comply with, while lack of institutions aiming at protection for property rights in emerging economies renders ventures to building costly informal institutions such as managerial ties with key governmental officials (Bruton et al. 2010).

**Table 77.1** Journals selected for review

Top journals selected	SSCI impact factors (2008)	Articles
Academy of management journal (AMJ)	6.1	8
Academy of management review (AMR)	6.1	5
Administrative science quarterly (ASQ)	2.9	3
Entrepreneurial theory and practice (ETP)	1.7	15
Journal of business venturing (JBV)	2.1	7
Journal of international business studies (JIBS)	3.0	3
Organization science (OS)	2.6	2
Strategic management journal (SMJ)	3.3	1
Total	—	44

### ***77.4.2 Legitimacy Building and Entrepreneurship***

Entrepreneurs must engage in legitimate activities to prove its value, thus overcome the liabilities of newness and increase the prospects of survival. Different from established organizations who could gain legitimacy and access to key resources from stakeholders and society by past performance, new comers has limited or no record of trust-gaining performance with which to be judged.

Regarding to the three institutional pillars, three dimensions of legitimacy emerges. Regulative legitimacy confers new ventures rights of private ownership and industry existence. Normative evaluation of legitimacy concerns the congruence with professional standards and commercial conventions. Cognitive Legitimacy grants actors the acceptability by its cultural environment. Different institutional environments ask for distinctive legitimacy seeking and building strategies for start-ups and ventures, foreign alliance partners wishing to enter emerging economies like China, India and Latin America cannot ignore the value of understanding local approaches to management and cultures toward entrepreneurship (Bruton et al. 2010).

### ***77.4.3 Institutional Entrepreneur***

When entrepreneurs start a venture, they often face an environment where relatively little coordinated actions and well-established standards exist. No matter in emerging or mature field, institutions may still undergo development and are narrowly diffused. Chances are that entrepreneurs play the role of institutional entrepreneurs “who have an interest in encouraging particular institutional arrangements and who leverage resources to create new institutions or to transform” DiMaggio 1988; Bruton et al. 2010; Fligstein 1997. These entrepreneurial activities often occur in an organizational field where organizations and occupations whose boundaries, identities, and interactions are defined and stabilized by shared institutional logics created by them.

Literature review shows that the research into institutional entrepreneurship mainly focus on these aspects: (1) the determinants for institutional entrepreneurship; (2) the mechanisms of institutional entrepreneurship.

#### ***77.4.3.1 The Determinants of Institutional Entrepreneurship***

First, two main categories of determinants that have so far received considerable attention are (1) field-level determinants, (2) individual-level determinants.

### *Field-level determinants*

External pressures and crises are identified by Child et al. Greenwood et al. (2002), Greenwood et al. Child et al. (2007), Fligstein Bruton et al. (2010) as field-level determinants for institutional entrepreneurship. Based on the literature on institutional change, Greenwood et al. Child et al. (2007) suggest that external pressures in the form of social upheaval, technological disruption, competitive discontinuities, or regulatory changes might result in institutional entrepreneurship by disrupting existing standard of actions and behaviors. Meanwhile, political pressures resulting from changes in power and interests may also motivate individuals to reconsider the status quo of the existing institutional arrangement (Oliver 1992).

Another important field-level determinant is organizational field characteristics, such as the structure of the field (e.g., heterogeneity, institutionalization) and the position of the organizations (e.g., central, peripheral) within that field (Greenwood and Hinings 1996; Greenwood and Suddaby 2006; Maguire et al. 2004). Seo and Creed (2002) pinpoint the importance of institutional contradictions that cause institutional incompatibilities and drive embedded agents to act collectively as institutional entrepreneurs. Beckett (1999) suggests that strategic action takes place in relatively highly institutionalized organizational fields, but Fligstein (1997) proposes that it might be caused by uncertainty in the field.

### *Individual-level determinants*

Actors' social position and specific characteristics are the main enabling factors to institutional entrepreneurship at individual level. Social position might influence both actors' perception of the field (Dorado 2005) and their access to the resources needed (Lawrence 1999). Central members are confined and contextualized by the institutions of the field which prevents them from recognizing alternative practices, while peripheral organizations are less integrated with institutionalized practices and standards and prompt to make change (Oliver 1992). Dorado (2005) defines actors' social position as "the position in the structure of social networks." Maguire et al. (2004) study the institutional entrepreneurship in the field of HIV/AIDS treatment advocacy in Canada and suggest that institutional entrepreneurs' "subject positions" provide both legitimacy in the eyes of diverse stakeholders and the ability to bridge those stakeholders, thus guarantees access to necessary resources.

Actors' specific characteristics are a determinant less studied but also contributing to institutional entrepreneurship. Mutch (2007) suggests that institutional entrepreneurs are able to take autonomous reflexive stance at troubling matters, while Fligstein, 1997; 2001 labels them as skilled actors whose "skilled social actions revolve around finding and maintaining a collective identity of a certain social group and effort to meet their interests."

### 77.4.3.2 The Mechanisms of Institutional Entrepreneurship

Three major tactics are employed by actors in the organizational field to complete the institutional entrepreneurship process: (1) Framing; (2) Resources mobilization; (3) Theorization.

#### *Framing*

Institutional entrepreneurs tend to depict their preferred institutional arrangement as appealing to the widest possible audience by generating discourse and texts. According to (Leca et al. 2006), such framing strategy includes two steps: specification and justification. Specification works on exposing existing contradictory institutional logics and diagnosis of the organizational failures while justification proposes the suggested plans as superior to the previous arrangements, which makes a reason for de-legitimizing. Rao (1998) found that framing had a powerful legitimizing effect in the establishment of consumer watchdog associations.

#### *Resources mobilization*

Tangible resources such as financial assets can be utilized to bypass the sanctions exposed by existing institutional arrangements and authorities and make up the loss of being illegitimate, Child et al. 2007; Greenwood and Suddaby 2006. Intangible assets such as social capital, legitimacy and formal authority are mobilized to make cooperation and collective action based on political tactics. Garud et al. (2002) show how Sun Microsystems was able to persuade systems assemblers, software firms, and computer manufacturers to form an alliance to confront Microsoft's Windows by collectively devising common technological standards. Levy and Scully (2007) utilize Machiavelli's conception of power to depict institutional entrepreneur as a "Modern Prince" who acts as an organizer and agent of a collective group, often leaders of social movements and alter, shape the material and organizational contested field they operate in.

### 77.4.3.3 Theorization

Theorization is the practice of developing abstract categories and items into chains of cause and effect with which the institutions are organized and diffused. There are regulative and normative theorization with the former constitutes legal articles that establish and exert mandatory new rules and practices, and the latter works through professionalization of certain field, which includes the development of certification contests (Rao 1994), the establishment of standards (Garud et al. 2002) and the enforcement of professional associations (Child et al. 2007).

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# Chapter 78

## Analysis of Industrial Engineering in South China University of Technology

Jian-jun Yu, Wen-hui Zhou and Yu-ting Shu

**Abstract** South China University of Technology performs some new experiments in industrial engineering education and obtains some effectiveness, and these experiences can provide reference for other universities. In the paper, industrial engineering characteristic is introduced, and industrial engineering education is analyzed. Demand analysis and importance evaluation of industrial engineering are performed. Competition ability of industrial engineering is analyzed. Industrial engineering employment data of South China University of Technology are collected, and the reasons for good employment are analyzed. Analysis results show that education innovation can improve industrial engineering of South China University of Technology.

**Keywords** Industrial engineering · Education innovation · Demand · Competition ability

### 78.1 Introduction

Industrial engineering comes from the scientific management of Taylor, and is one of seven engineering subjects of America. Industrial engineering has also been paid attention to by education world and industry world in China. The demand for industrial engineering rapidly increases. In order to form the characteristic of South China University of Technology (SCUT) for industrial engineering and to reinforce the competition ability of industrial engineering student of SCUT, SCUT implements some exploration for industrial engineering and obtains some results. In order to improve industrial engineering education, it's necessary to analyze the

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industrial engineering of SCUT. In the last few years, some scholars have researched industrial engineering. Hu (Wu 1998) summarized the formation and development of industrial engineering subject. Qi and Wang (1999) reviewed the development of industrial engineering in China and put forward the new concept about CIE. Luo (2000) analyzed the application trend of industrial engineering and summarized four characteristics of industrial engineering. Lu (2004) established box of knowledge for industrial engineering. Chen (2005) analyzed the industrial engineering internationalization of Huazhong University of Science and Technology. Wang and Guo (Wang et al. 2011) put forward innovative teaching method for industrial engineering. Sun (2011) analyzed industrial engineering of Georgia Institute of Technology. Ding (Ding et al. 2011) analyzed the practice teaching of industrial engineering and illuminated its importance. Xue (Xue et al. 2011) proposed to build a kind of practical teaching system of the surface-point-surface mode oriented to industrial engineering talents. Du (Du et al. 2012) studied the case of Shanghai Ocean University and put forward the construction thinking and content of the innovation practice base.

## 78.2 Demand Ascertain

Firstly, status about industrial engineering of ten representative universities in China is collected, which include Tsinghua university, Tianjing university, Xian Jiaotong University, Shanghai Jiaotong University, Chongqing University, Sichuan University, Zhejiang University, Nanjing University, Nanjing University of Aeronautics and Astronautics and Northwest Polytechnical University. Here, five universities of them establish industrial engineering specialty in mechanical school, and the other five universities of them establish industrial engineering specialty in management school. The students in mechanical school pay more attention to cultivating practice ability of engineering. They are accomplished in engineering drawing, principle of mechanics, and related courses, but lack economic and management knowledge. The students in management school pay more attention to cultivating management skills and humanism accomplishment, but ignore mechanical technologies. Secondly, status about industrial engineering of Hong Kong university of Science and Technology, Michigan University, Purdue University, Georgia Institute of technology. They have special engineering school. In these universities, industrial engineering is a big branch of engineering, and mainly cultivated talents for manufacture before, and now pay attention to basic theory teaching includes physics, mathematics and operational research. They are not like engineering, and not like management, but like natural science. Industrial engineering belongs to inter discipline of technology and management, which requires students to have solid engineering base and master modern economic and management knowledge and industrial engineering theories (Table 78.1).

The intercommunion with teachers of industrial engineering department in SCUT is finished, and their opinion about SCUT industrial engineering

**Table 78.1** Industrial engineering of representative universities in China

No	University name	Subjection school
1	Tsinghua University	Engineering
2	Tianjing University	Management
3	Xian Jiaotong University	Management
4	Shanghai Jiaotong University	Engineering
5	Chongqing University	Engineering
6	Sichuan University	Management
7	Zhejiang University	Engineering
8	Nanjing University	Management
9	Nanjing University of aeronautics and astronautics	Management
10	Northwest Polytechnical University	Engineering
11	Hong Kong University of Science and Technology	Engineering
12	Michigan University	Engineering
13	Purdue University	Engineering
14	Georgia Institute of technology	Engineering

development is obtained. They think that students should participate in the teaching actively, or else teaching effectiveness can't be guaranteed no matter how teachers teach hard. Teachers hope that excellent undergraduates continue to study as graduate student in industrial engineering department of SCUT, even to study as doctor candidate, so they hope that these students can master the basic knowledge in undergraduate phase, especially the ability of modeling and programming. Graduate students need read lots of English paper, so teachers hope that these students have good information retrieval ability and English ability.

The conversation with in industrial engineering undergraduates and the students of other specialty is finished. The conversation are involved with many questions, for example, what will you do? What work will you look for? What abilities should you think industrial engineer have? What do you think you lack in undergraduate phase? What aspects do you think SCUT and school do well? What aspects do you think SCUT and school do badly? What courses do you think very important? How will you run industrial engineering if you are dean of industrial engineering department? By the conversation with undergraduates, detailed demand of students is obtained which are very useful for industrial engineering development. In students' opinion, industrial engineering specialty can provide students with platform of self-fulfillment, and they can enhance integrative ability by industrial engineering learning. They hope that they can study easily and have much free time. They hope that there are some selective professional courses and general selective courses, for example history, geography, law. They also hope that there are teachers to guide them and help banish the perplexed psychology.

At the other hand, the communion with employers is implemented, and some information about employment demand is obtained. For example, operation department of Sinotrans Guangdong Co., Ltd recruits logistics modeling analyst, and the job content includes analysis and design of logistics supply chain system, analysis and design of decision aided system, evaluation and application of news

technology, optimization of support system, implement, operation, management and control of solution. The job requires that the candidate can use data analysis software to collect and analyze the data, and can use logistics software and simulation software to configure and optimize the net resource of logistics supply chain system.

In addition, the communion with parents of students is implemented, and some useful information is obtained. They hope that the pressure to student from school isn't too large and their children can grow up healthily and happily. They require the school to ensure the safe of students. They hope that teachers teach students in real earnest, and impart useful knowledge as much as possible. Their intense hope is that their children can obtain ideal job after graduation.

### 78.3 Demand Analysis and Importance Evaluation

All kinds of demand about industrial engineering graduate are collected. The demand includes graduate quality demand, for example, the government requires that the students have sense of social responsibility, and employer requires that the students have good skills for work. The demand also includes teaching system demand, for example, students require that teachers can show the course emphases effectively. The demand also includes teaching condition demand. The demand is analyzed and filtered, and some mainly demand is distinguished.

- intense sense of social responsibility
- good ideology and morality
- competent for job
- powerful learn ability
- adapt work environment
- have creative mind
- active involvement in class
- have advanced study potentiality
- obtain ideal job
- access to good university
- business establish potentiality
- happiness

Here, intense sense of social responsibility and good ideology and morality originate from the government demand. Competent for job, powerful learn ability and adapt work environment are demand of employer. Creative mind, active involvement in class and advanced study potentiality originate from the teacher demand. Obtaining ideal job, access to good university, business establish potentiality and happiness are student demand.

Then questionnaire is designed based on the above demand, and distributed to teacher and students of industrial engineering. Students include junior, senior, Grade 1 graduate student, Grade 2 graduate student. 100 questionnaires are

**Table 78.2** Demand statistical result

Object	Demand	Subtotal score	weight
Government	Intense sense of social responsibility	123	0.085
	Good ideology and morality	123	0.085
Employer	Competent for job	125	0.087
	Powerful learn ability	133	0.092
Teacher	Adapt work environment	127	0.088
	Have creative mind	125	0.087
	Active involvement in class	100	0.069
Student	Have advanced study potentiality	115	0.080
	Obtain ideal job	124	0.086
	Access to good university	117	0.081
	Business establish potentiality	110	0.076
	Happiness	120	0.083
		1442	1.000

distributed in total, and 78 questionnaires are taken back. Because some student have prejudice, and fill in questionnaires freely, so there are only 52 valid questionnaires. The score of different persons in same item is totaled up, and subtotal score is obtained. Then the subtotal score is normalized and the weight is obtained. Namely, every subtotal score is divided by total score. Weight is the importance degree of demand. The statistical result is Table 78.2.

Statistical result shows that powerful learn ability gains maximal score, and its score is 133. Its weight is 0.092, and this indicates that powerful learn ability is the most important demand. Teacher and students often emphasis that university is the place to cultivate the learn ability and the most important ability for student is the learn ability. Society changes from minute to minute nowadays, and science and technology updates rapidly. It's the person who has powerful learning ability that can adapt the society. Adapting work environment gains second score. Every student will be faced with looking for job, so it's reasonable for adapting work environment to become important. Adapting work environment requires university paying attention to practice teaching, and cultivating students' operation ability and the ability of solving problem. Being competent for job and having creative mind both rank the third. Being competent for job has similar reason to adapting work environment to gain the high score, and they all require that undergraduate education should pay attention to cultivating the practice ability of student. Having creative mind has similar reason to powerful learn ability to gain the high score. Active involvement in class ranks last. And the reasons maybe include: firstly, questionnaire object is mainly students, and they don't want to bring forward too many demands for themselves. Secondly, the students which transfer into industrial engineering from other specialties have generally powerful learning ability, and won't spend lots of time on the theoretical knowledge which is regarded as detaching reality by the students. Thirdly, the teachers pay less attention to

teaching than research and prepare the lesson deficiently, and accordingly their lessons are tedious and students won't listen to the teacher in class positively.

78.4 Competition Ability Analysis

Based on demand analysis, market orientation is planned for new specialty. More consultation and investigation are performed. The level of SCUT industrial engineering is compared with other universities. Satisfaction degree of new specialty to every kind of demand is analyzed, and market competition ability of SCUT industrial engineering, improved industrial engineering and other universities is obtained. Firstly, adopt expert marking method to evaluate satisfaction degree to every kind of demand of Tsinghua university, Xian Jiaotong University and SCUT industrial engineering, then every score multiply by the corresponding weight, and the summarized result is just market competition ability. The calculation matrix is as Table 78.3.

78.5 Employment Analysis

Industrial engineering graduates of SCUT master lots of both engineering technology and management knowledge, and have good organization ability and cooperation ability. They win the favor of overseas-funded enterprises, joint-venture enterprises and large-scale state-owned enterprises. Employment range of industrial engineering graduates of SCUT is extensive. They are competent for the industrial engineer, the manufacture engineer, the system engineer, the quality

Table 78.3 Calculation matrix of market competition ability

Demand	Weight	Tsinghua University	Xian Jiaotong University	SCUT	improved
Intense sense of social responsibility	0.085	4	4	4	4
Good ideology and morality	0.085	4	4	4	4
Competent for job	0.087	3	3	3	3
Powerful learn ability	0.092	5	3	4	4
Adapt work environment	0.088	4	4	3	5
Have creative mind	0.087	5	4	3	5
Active involvement in class	0.069	5	4	3	3
have advanced study potentiality	0.080	5	4	3	4
Obtain ideal job	0.086	5	4	4	5
Access to good university	0.081	5	4	3	4
Business establish potentiality	0.076	4	4	5	5
Happiness	0.083	3	3	4	4
Competition ability		4.325	3.738	3.585	4.181

**Table 78.4** Graduate states of industrial engineering (2 + 2 + 2)

	Postgraduate recommendation (%)	Study- abroad (%)	State-owned enterprise (%)	Overseas-funded enterprise (%)
2006 class	53	16	19	12
2007 class	63	3	9	25

engineer, logistics engineer and manager in the manufacturing enterprise and the service industry, and they can also become the civil servant, the manager and the consultant in the government or the consultant corporation. First and second period students of industrial engineering (2 + 2 + 2) had graduated successfully, and their graduate states are as follows (Table 78.4).

The employment statistical data show that student employment of industrial engineering is better than student employment of other specialties. Most of industrial engineering students continue to study for further education, and some students get admitted to famous universities overseas. Other students obtain good employment, and every student gets several employment offers generally. Finally these students all enter into large scale national enterprises or well-known foreign companies, and their salary is high. Industrial engineering employment is analyzed, and the reasons for good employment are summarized. Satisfactory employment is because of these reasons as follows.

**78.5.1 Industrial Engineering Characteristic**

Industrial engineering is the doctor for enterprise which can solve many problems for enterprise. Industrial engineering can diagnose enterprise problem and find the bottleneck, and accordingly adopt scientific methods to solve the problem. Industrial engineering can increase the production efficiency, improve the product quality, reduce product cost and increase benefit for enterprise. As the big manufacture country, China has lots of manufacture enterprises, and most of these enterprises are not excellent and their management level is low. But most enterprises start to pay attention to industrial engineering and have strong interest and demand for industrial engineering. However, industrial engineering starts late in China, and industrial engineering education period is less than 20 years. So China is short of industrial engineering talent now.

**78.5.2 Industrial Engineering Evolvment**

As the vigorous subject, industrial engineering develops continually. The industrial engineering of Taylor period 100 years ago mainly aims at manufacture and industrial engineering graduate mainly enter into manufacture enterprise. With the

ceaseless expansion of industrial engineering, industrial engineering has extended to service industry. In the last few years, service industry pay attention to industrial engineering very much and many service enterprises recruit industrial engineering graduate. Hence industrial engineering graduates may enter into aviation enterprise, bank, telecom enterprise, post system.

### ***78.5.3 Industrial Engineering Difference Between China and Other Countries***

Industrial engineering originated in America and has the long history with more than 100 years. Other developed countries, for example Japan, also develop industrial engineering early. But industrial engineering starts in China very late. In 90s of last century, Xi'an Jiaotong University and Tianjin University begin to make experiment for industrial engineering education. The time difference results in large gap of industrial engineering level between China and other countries, especially, the gap in industrial engineering education is larger. Industrial engineering education level of universities in America and other developed countries is higher greatly than that in China. This makes many students hope to study further industrial engineering overseas.

### ***78.5.4 Geographical Location of Perl River Delta Region***

Perl River Delta region is the manufacture center of not only China but also the whole world. All kinds of manufacture enterprises are located in Perl River Delta region. Most of these enterprises still adopt traditional and simple management methods, and there are big spaces for improvement in production cost, quality, time and other aspects, so these enterprises urgently need industrial engineering talent. Especially, there are many Taiwan fund enterprises in Perl River Delta region, for example, Foxconn. These Taiwan fund enterprises pay attention to industrial engineering very much, and recruit industrial engineering talent very year. SCUT is located in core of Perl River Delta region, and industrial engineering graduate of SCUT has more opportunity to work in well-known enterprise naturally.

### ***78.5.5 Industrial Engineering Education Innovation of SCUT***

Industrial engineering is inter-discipline which is involved with both technology and management. Industrial engineering requires student to master the knowledge and technology of both technology and management. The object of industrial

engineering is to cultivate the inter-disciplinary talent. Under the advocacy and proposal of Pro, Xu Xuejun and substantial support of many aspects, SCUT adopts innovative education mode for industrial engineering, and implements industrial engineering (2 + 2 + 2) strategy. Some excellent second grade students with science specialty are selected to enter into school of business administration to study industrial engineering. Thus both the skill of engineering and the knowledge of management can be taken into account. On the other hand, these students are selected from many candidates, so they are relatively excellent. In addition, they transform from original specialty to industrial engineering midway, and they perform the acquaintance and analysis in advance, so they are more rational than high school graduate who select industrial engineering. Most of these students like industrial engineering really and truly, and are fit for industrial engineering. In this way, the comprehensive quality of industrial engineering will be excellent, and the employment ability will be powerful.

## 78.6 Conclusion

Finally, Industrial engineering is an emerging subject in China, and industrial engineering education is still in explore phase. South China University of Technology performs some new experiment in industrial engineering education and obtains some effectiveness, and these experiences can provide reference for other universities. In the paper, industrial engineering is introduced, and industrial engineering education is analyzed. Industrial engineering demand is analyzed, and the significance of all kinds of demands is ascertained. Competition abilities of industrial engineering of South China University of Technology and other several well-known universities are analyzed. Industrial engineering employment data of South China University of Technology is collected, and the reasons for good employment are analyzed.

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# Chapter 79

## New Media: A Rising Way for Public Involvement in China Based on Case Study

Chun Li

**Abstract** Because traditional forms of political participation, such as voting and membership in political parties in China is not as efficient as expected, new media to some extent has paved a new way for Chinese citizens to express their request and engage the process of public policy-making. As to the relationship between new media and public involvement, there are two kinds of theoretical framework, Competition framework and Promotion framework. In this paper, two Chinese cases has been introduced, describing and explaining how new media reshape Chinese public involvement in East China and proves that the promotion framework is suitable for analyzing China's case. In the end, it explains why new media is a rising way in Chinese public involvement and furthermore reveals some dilemmas faced by Chinese new media as the way for public involvement.

**Keywords** Case study • China • Competition framework • New media • Promotion framework • Public involvement

### 79.1 Introduction

With the growth and expanded development of new media, the research on the relationship between new media and public involvement has been being multiplied greatly, in particular what role new media plays in reshaping political participation. During the globalization time, China has inevitably also been being influenced by the new media as well as the western political development, especially in public involvement.

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As far as new media is concerned, it is one of the most fast-developing industries in contemporary China, in particular the Internet and mobile phone. It's reported that according to the 23rd Statistics Report on China Internet Development, published by China Network Information Center, by the end of 2008, the popularizing rate of Internet in China was 22.6 %, exceeding the world average level of 21.9 %, and Chinese Internet-users are more than 298 million, even the broadband-users are up to 27 million (Chinese Internet Popularizing Rate Exceeding World Average 2009). Besides, the number of Cell phone-users is more than 50 million (China being Digital Giant 2008). With the fast development of new media, Chinese government leaders, President Hu Jintao and Premier Wen Jiabao, also begin to pay more and more attention to these newborn things. A number of analysts pointed out that the two leaders' visits could be seen as the strong signal that Chinese top leaders gradually attach more and more importance to the newly-developing new media, and Chinese new media starts its new epoch, playing an increasingly important role in political arena. Some scholars also hailed the two visits, and believed that with new media Chinese people are gradually able to exert their influence on governments. Although there are some people who hail the rising way of new media as an effective path for public involvement, however, others express their worry that huge public involvement might result in disorder, even turmoil and disable the governments' efficiency.

It is interesting to find that in contrary to the decrease of social capital and public participation in USA in accordance with Putnam's research, the rising of new media triggers more public involvement in China. To what extent, new media reshape Chinese public involvement? How does that process happen? What obstructive factors will Chinese new media encounter in near future while pushing the public involvement in China? All these questions are on Chinese current research agenda.

## 79.2 Definition and Theory Framework

Generally speaking, the concept of "New media" can be traced back to 1967, when P. Goldmark, the then director of Broadcasting and Television Technology Institute at Columbia Broadcasting System, proposed the concept in an EVR commodity development report for the first time, indicating the new media forms based on radio wave and video, and much different from the traditional printed media. In this paper, public involvement is defined as the citizens of certain electorate district input their request, need, support, objection and satisfaction evaluation of public policy by various ways into public administration system, so as to influence the public decision-making process as well as public management, and finally satisfy their need or fulfill their political ideology.

As for the relationship between new media and public involvement, there are mainly two different theoretical frameworks, which could be tagged as

*Competition framework* and *Promotion framework*. The former raises the standpoint that new media depletes the social capital and consequently decreases public involvement in real political system, but the latter argues that new media promotes public involvement via the convenient and various communication channels, especially with a lot of proofs of survey and data.

In the competition framework, it's believed that the more time people spend in surfing on internet or communicating via cell phones, the less they would like to participate in the real community. New media competes against public involvement. In this framework, it is further divided into two sub-frameworks, titled as displacement theory and cultivation theory (Dutta-Bergman 2006). Displacement theorists indicates that within the limited time if people spend more time consuming media in their private spaces, they have less time for public involvement in their real communities (Putnam 1995; Shah et al. 2001). Particularly, Putnam (1995) posits that the surge in media consumption has contributed to the decline in the amount of time individuals spend in their offline social network, because of decreased social capital, which is afterwards defined as the "connection among individuals-social networks and the norms of reciprocity and trustworthiness that arise from them" (Putnam 2000); (Putnam 1995). The other cultivation theorists argue that heavy readers or heavy viewers of new media are guided by the world that new media constructs with various stories of murder, cheat and violence, so that individuals do not participate in their communities due to the decline of trust to others (Gerbner et al. 1980). Turkle (1995) argued that the Internet provides an escape from the physical world by providing a more anonymous virtual world where interactions need not be intimate (Turkle 1995). Nie and Erbring (2000) have found that increased Internet usage is related to feeling of social isolation and lower levels of community participation (Nie and Erbring 2000).

In contrast, the promotion framework generally supports the standpoint that new media plays a positive role in promoting people's participation in their real communities, because new media connects people much more easily and quickly. In Hampton and Wellman's (2003) study of the effects of living in a wired suburban subdivision on social capital and community involvement, the Internet especially supports increased contact with weaker ties. In comparison to non-wired residents of the same suburb, more neighbors are known and chatted with, and they are more geographically dispersed around the suburb. Not only did the Internet support neighboring, it also facilitated discussion and mobilization around local issues (Hampton and Wellman 2003). Dutta-Bergman (2006), based on the theory of channel complementarity,<sup>1</sup> argued that individuals who participated in online communities to post and read thoughts about the attacks were also more likely to participate in real communities (Dutta-Bergman

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<sup>1</sup> The theory of channel complementarity was proposed by Dutta-Bergman in 2004 and 2005, providing a framework for understanding the relationship between the consumption of different channel types that share similar functions.

2006). It is interesting that Kraut (1998) showed that increasing levels of Internet usage results in a decrease in social participation; but in his new paper published in 2002 he revised his conclusion and re-concluded that new media including new computer and television gave the positive effects of using the Internet on communication, social involvement, and well-being. Michael Stern and Don Dillman (2006) with a 2005 random sample mail survey of 1,315 households in a rural region of the Western United States suggest that increased Internet usage is positively related to nominal and active levels of community participation and even supporting affective networks outside the local area. Particularly this study examined the relationship between Internet usage and community participation in rural regions rather than only in large metropolitan areas that was done previously. Karen Mossberger et al. (2008) define digital citizens “as those who use the Internet regularly and effectively—that is, on a daily basis”, and found that daily Internet use increases the likelihood that users are politically involved and benefit economically (Karen Mossberger et al. 2008). Stephen Coleman (1999) discussed whether new media have profound effects upon the traditional representative model of the democratic process, and put forward the notion of media democracy, which means that an informed citizenry is one who can consent more knowingly, scrutinize the political process more simply and obtain access to government services more readily (Stephen Coleman 1999).

In China, within academic circle on new media and public involvement, there also generally could be divided into two groups according to their standpoint. One group, the mainstream theorists, actively supports the role of new media in public involvement, particularly the Internet. (Lu Jia-yin and Sun Xu-pei 2008; Wang Xiu-jun et al. 2006; Ke Jian 2008; Xu Li-ming and Jiang Yan-yan 2008; Liu Rui and Tian Chun-miao 2008; Li Bin 2006; etc.) Another group expresses their worry about the negative effect of new media in arousing public involvement and they try to persuade people with possible disorder resulted from disorderly public involvement aroused by new media, even leading to anarchy. Thereupon, they propose more regulation on new media (Yun-Chu 2007). (Yun-chu 2007; Guo Xiao-an 2008; He Xiao-hua 2006; Gu Guang-wei and Zhang Jing-Chao 2008; Zhang Ya-yong 2007; etc.) Besides, Tang Li-ping (2007) also put forward her pessimistic opinion that Internet democracy could not fundamentally change the representative democracy, and would not become the main national democratic system (Tang Li-ping 2007). Although there are so many research results on the relationship between new media and public involvement in China, few of them has deduced their conclusion by case-study method.

As to the two research framework proposed previously in this part, which one is more suitable to analyze Chinese experience? This paper tries to explore this issue with two latest Chinese cases, embodying how Chinese people use new media to participate in local governance.

### 79.3 Methodology

In order to explore the process of Chinese citizenry's involvement in governance, this paper take the case study as the main research method. As Yin (1994) summarized, there are at least four important varieties of written forms of case studies, which are classic single-case study, multi-case version, question-and-answer format, and multi-case studies with no separate chapters or sections devoted to the individual cases (Yin 1994). This paper tries to make use of the question-and-answer format with two cases, so as to reveal what factors pushing Chinese public involvement with new media. Furthermore, in the analysis of process, it could be deduced that what are the negative factors that prohibit the further development of public involvement via new media.

As far as the case study is concerned, what is difficult as well as crucial is how to select proper cases. Case study analysis focuses on a small number of cases that are expected to provide insight into a causal relationship across a larger population of cases. This presents the researcher with a formidable problem of case selection. According to Gerring's research on *Case Study Principles and Practices*, there are two important dimensions: representativeness and causal leverage, which to a large extent determine the selection of cases. Gerring (2007) supplied nine kinds of techniques of case-selection: typical, diverse, extreme, deviant, influential, crucial, pathway, most-similar, and most-different (Gerring 2007). In this paper, typical case selection method is applied, and selects two cases: PX project in Xiamen and Zhou Jiugeng's degradation in Nanjing. In detail, the dimensions of case selection are the following: widely influential, informative, and effective. Firstly, the two selected cases in this paper had attracted nationwide attention thanks to new media, even were noticed by some foreign media or scholars; secondly, they are informative, because the process are highly competitive between governments and the public, and moreover the process were reported at large; thirdly, during the two cases, public involvement effectively influenced local governments' public decisions, which displayed the power of citizenry as well as new media. With the two typical cases, this paper can also display the roadblocks that Chinese new media faces at present.

Here, the two cases have been introduced briefly. The first one is PX project in Xiamen, well reflecting how people in Xiamen City influenced public decision-making process of municipal government's with the assistance of new media, including cell phone short message, Internet BBS, and so forth<sup>2</sup>; the second one is Zhou Jiugeng's degradation, which depicted how people, beginning from Nanjing City, started up the anti-corruption procedure, and even exerted a lot of pressures into local official anti-corruption bureaus to push the investigation and punishment of corrupted officials.<sup>3</sup>

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<sup>2</sup> Some details of the case were edited from South Weekend, a Chinese newspaper.

<sup>3</sup> Some details of the case were edited from China Business Focus, a global publication in English.

## 79.4 Analysis and Discussion

Generally speaking, China's cases obviously demonstrate the above-mentioned promotion framework, that is to say, in China the new media greatly push the public involvement positively. Chinese people can be more successful to express their interest request and furthermore input their opinion into political system, more powerful to influence the public decision-making process, with the competency of new media and the increase of citizenry right. As for the case of Xiamen PX project, the citizens succeeded via new media in standing on their right of protecting a safe and sanitary environment. In the second case, the people, both in Nanjing and outside Nanjing, participated via Internet in the anti-corruption process and finally resulted in the degradation of corrupted official inspiring. With the two nationwide influential cases, we could come to a conclusion that Chinese new media is to a large degree reshaping the public involvement as well as the local political system.

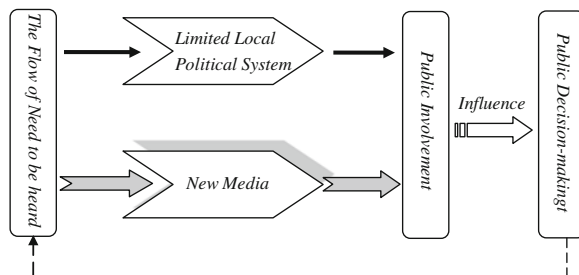
Nevertheless, in contrary to the Western experience, the western-style promotion framework of studying the relationship between new media and public involvement is not completely fit for the research context of China, since at the early stage China has been developing in a very different way politically, economically and socially. Thus, there are much more different causal factors that reshape Chinese public involvement and political system via new media.

### ***79.4.1 Why Can New Media Push Public Involvement in China?***

In order to elaborate the causal factors, we need probe at least the following five dimensions: diversification of social interest, increasing civism and democratic idea, limitation of contemporary political participation system, fast rise of new media, and acquiescence of central government.

Firstly, with the amazing development of market-oriented economy, different economic sectors and various industries are growing like mushrooms in China. Consequently, people have been gradually classified into different interest groups, producing diversified social interest groups. The rise of different social interest groups inevitably leads to contradiction or conflict, and then fosters the need to influence the political system as well as public policy, public decision-making. At the same time, the democratic thought in traditional socialist theory, accompanying with western democratic idea during the Reform and Opening since the end of 1970s, has been substantially aroused step by step, especially resulting in the rise of people's civism and awareness of citizenship. In order to protect and increase their accumulation of interest, in addition, some others aspire after the democratic ideology; they need more ways and channels to influence governments' public decision-making at all levels, which increasingly push the public

**Fig. 79.1** Relation between new media and public involvement in China



involvement in China. However, Chinese contemporary political participation institutions could not accommodate such huge request of public involvement yet. Moreover, some Chinese local governments are hesitant to respond satisfactorily to the public request, which is displayed in the two cases described previously in this paper. The local governments were powerful enough to ignore public representative's proposals as well as public request. Hence, there is a big gap between people's request and current political participation system, which of course accumulates the political pressure day after day. It is fortunate that the fast-developing new media functions as an outlet for the pressure, with which people could express their interest request, and more or less exert some impact on local governments' public decision-making. It is to a large extent because of the malfunction of traditional political participation that new media push the public involvement in China. At this point, new media is an alternative for people's request of public participation; or a temporary solution for governments to cool down the political pressure (see Fig. 79.1). It is seen that new media function as the wider channel for people's request-expressing, transmitting more civic information into public decision-making system.

Therefore, although Chinese experience is also applied to the promotion framework, they are quite different while studying the role of new media in pushing public involvement. In western political system, the traditional forms of political participation have been perfected, and with civism western people are used to expressing their interest request and even exerting pressure on political system. Accordingly, new media just play a supplementary role for public involvement. For example, Cornfield (2000) once explained how does the Internet foster smarter candidate-voter (or grassroots activist-decision maker) communication? First, the Internet accommodates multimedia presentations, so that the electorate's suitor may be judged on more than just their looks. Second, the Internet allows each member of the citizenry to set his or her own space in evaluating candidates and ballot propositions (Cornfield 2000). It could be seen that Internet supplied the supplementary function in improving public voting. However, in China, the democracy system need to be further improved, and people need more education, more knowledge, as well as more practices to participate in political system. At present, new media is playing a alternative rather than supplementary role while improving the public involvement due to the limitation of political participation system.

In the end of this part, it is necessary to mention that the acquiescence of central government is another positive factor in pushing Chinese public involvement. Despite some scholars blame Chinese central government for the slow pace of political reform, particularly for the authoritative regime, Chinese central government is gradually sparing more and more space for the development of new media, especially in pushing public involvement in China. On April 13th, the State Council, Chinese central government, issued a national human right plan, National Human Right Action Plan of China (2009–2010), for the first time, which shows the standpoint to guarantee civil and political right, including the right to be informed, the right to participate, the right to be heard, the right to oversee (Full Text: National Human Rights Action Plan of China 2009). It supports the use of new media to express their request for local governments.

### ***79.4.2 Dilemmas of New Media While Pushing Public Involvement in China***

While new media is increasingly playing a rising role in pushing public involvement in China, its rise is an alternative way for assisting the function of contemporary political system. If new media was expected to exert more influence on China's political system, satisfying more citizens' request for public involvement, it unavoidably faces some dilemmas, which would refer to deeper and greater political reform.

#### **79.4.2.1 Public Involvement Institutional Innovation**

This paper holds the standpoint that to a large extent due to the incrementally wider gap between the limit of political participation and increasing request of civic participation, new media has been chose as a temporary outlet for cooling down social pressure and satisfying citizenry's need of civic right. However, with the enlargement of public involvement via new media, Chinese civism are greatly aroused and pursue more opportunities and channels to participate in political system, which would further widen the wide gap between citizenry's request and current public involvement institution, consequently following with more or less social instability or what is worse, turmoil, which definitely can not be accepted by contemporary political system. Huntington (1968) had pointed out that the relationship between social mobilization and political instability seems reasonably direct. Urbanization, increases in literacy, education, and media exposure all give rise to enhance aspiration and expectations which, if unsatisfied, galvanize individuals and groups into politics. In the absence of strong and adaptable political institutions, such increases in participation mean instability and violence (Huntington 1968). Thus, with the development of new media in public involvement,

what is more important would be to a degree the innovation of contemporary political system, especially institutional innovation of civic participation, so as to accommodate more public involvement. Take Internet filtering system for example. Government filtering systems are meant to stop citizens from accessing parts of the Internet deemed too sensitive, but it can be easily used by local governments as a tool to constrain citizenry's involvement. Some foreign research found that state-mandated filtering is predominantly clustered in three areas: East Asia, Central Asia, and the Middle East/North Africa (Tony Carrizales 2009). In Xiamen case, these depressing phenomena had been demonstrated. Therefore, the innovation of Internet filtering system may be the first step for reforming public involvement institution. Nevertheless, it has to be mentioned that Chinese public involvement institutional innovation may be not inevitably led to west-style political system. China could and should explore her special political development way.

#### **79.4.2.2 China's Political Culture and Civism**

Public involvement institution can function effectively only in the fit context of political culture. Particularly, an important precondition of public involvement via new media is relevant civism. It's generally believed that the U.S. tradition of citizenship in the context of liberalism is rooted in individual right, free market, and the right to pursue one's "own vision of good life". Besides, public involvement is accompanied with decentralization between government and civil society. And "the type of social, economic and political environment is a key factor of success for decentralization." (Manoranjan Mohanty et al. 2007) Whereas, Chinese political culture attaches more importance to the function of governments as well as the collective ideology, which means to some extent does not highlight public input into political system. Thus, in China, public involvement via new media functions without the best political context. Moreover, it has been also reported that some private interest-hunting groups intentionally exert pressure in order to meet their own excessive interest, even with spreading social rumors taking advantage of Internet anonymity or irresponsibility. These kinds of out of self-controlled participations show the absence of civism, leading to disorder of public involvement and furthermore backfire, setting back the effectiveness of new media. If the new media are expected to function more importantly in China, it's necessary to educate people's awareness of responsible participation, and cultivate Chinese civism and citizenship.

#### **79.4.2.3 Digital Divide**

Digital divide is a worldwide roadblock for improving public involvement via new media, and it is more severe in developing countries. As a matter of fact, the digital divide is an issue not only of computer access but also of high-speed broadband access and, increasingly, of online skills as well. Online education competencies

**Table 79.1** Basic statistics of internet distribution in China in 2005

	Netizen (%)	Ipv4 (%)	Domain name (%)	Website (%)
East China	57.8	62.4	78.5	79.9
Central China	22.1	21.3	11.5	11.3
West China	20.1	16.3	10.0	8.8
Total	100	100	100	100

*Sources* China Internet Network Information Center. Report on the development of Chinese internet, [www.cnnic.net](http://www.cnnic.net), 2006

may be more important and also make the issue of digital divide more complicated. Digital divide will induce more inequality between social groups or different districts. Kraut (2002) put forward that, consistent with a “rich get richer” model, using the Internet predicted better outcomes for extraverts and those with more social support but worse outcomes for introverts and those with less support (Robert Kraut et al. 2002). Similarly, this is a big dilemma for Chinese new media in pushing public involvement as well as improving social equality. As we all know, China is a big country with quite different districts where new media grows much different. Take Internet for example (see Table 79.1), in eastern districts, people can easily influence the public decision-making process with advantage of technical information infrastructures as well as well-educated competency; but in the inland China, there are broad poor rural areas where people even do not know what is Internet or mobile phones. Again referring to the Xiamen case, according to the latest news, PX project has been transformed to Zhangzhou city, another comparatively less-developed city, 60 km or so away from Xiamen. It’s also reported that local people would like to express their opposition following the example of Xiamen citizens; however, they failed to influence local governments and Fujian provincial government because of their less competency of manipulating new media. To a degree, it embodied that the digital divide of skill in using new media led to different outcomes between different cities.

## 79.5 Conclusion

In this paper the relationship between new media and public involvement has been elaborated and found that Chinese experience can also be applied to promotion framework, that is to say, new media has to a large extent improve the public involvement in China, too. Nevertheless, in respect that China develops in a further more different context, the reasons why new media can improve public involvement in China obviously differentiate from Western experience, with Chinese new media as alternative way for public involvement rather than a supplementary way in West. Moreover, Chinese new media faces at least three roadblocks to improve public involvement further: the limitation of public involvement institutional innovation, China’s political culture and civism, and digital divide.

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# Chapter 80

## Balanced Scorecard of Manufacturing Enterprises Based on Flexible Strategy

Ying-ban He and Bo Wang

**Abstract** This paper studies the balanced scorecard of flexible strategy and its related questions. It builds a flexible-strategy human resources support system and a balanced scorecard based on flexible strategy in manufacturing enterprises. The features of balanced scorecard are also stated. Besides, this paper builds a two-dimension model to analyze key performance indicators based on flexible balanced scorecard and value stream. Related examples are given.

**Keywords** Balanced scorecard · Flexible strategy · Human resources support system · Key performance indicators · Two-dimension model

### 80.1 Introduction

In the turbulent environment of market economy, present enterprises are facing more pressure and challenges. They have to adopt more flexible strategies to adapt the environment and achieve development. Human resources support system and strategic performance management are key supporting factors of flexible strategy (Chavan 2009; Bonfim et al. 2004). Therefore, constructing related system and performance management frame become important issues to enterprises developing.

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## **80.2 Flexible Strategy and its Human Resources Support System**

### ***80.2.1 Flexible Strategy and its Types***

The so called flexible strategy means the integrative action plan that enterprises promote their own continuous competitiveness when they actively adapt changes, make use of changes and even create changes in dynamic environments. Comparing to common strategy, flexible strategy can be understood as strategy that pay attention to flexibility of enterprises, whose characteristic is improving agility and adjusting, reflecting capability of enterprises. Scholars studying manufacture flexibility regard that like quality strategy, flexible strategy is an extension of manufacture strategy (Kaplan and Norton 2004). To manufacture enterprises, flexible strategy can be regarded as strategy level of manufacture flexibility in enterprises. The enactment and implement of appropriate flexible strategy can not only make enterprises adapt changing external environment quickly, but also obtain competitive predominance by conforming inner sources in enterprises (Li and Wang 2010; Crandall 2002).

Types of flexible strategy start from different points of view. If considering of flexible influencing factors or flexible basic dimension, flexible strategy can be divided into time flexible strategy emphasizing reflecting speed and range flexible strategy emphasizing reflecting spread. If considered from the level of organization structure and operation, organization flexibility can be divided into three levels: strategy level, tactics level and operation level. To manufacture enterprises, main types of flexible strategies in strategy level include flexible strategies of new product and market. If taken tactics level into account, which is closely related to strategy level, flexible strategies of mix of products and product quantity should also be added in. Flexibility of equipment, material, route and production schedule in operation level can be regarded as operational part of the two levels above.

Flexible strategy of new products should be based on the flexibility in research and development area, which is involved with the flexibility of new technology and products design platform. New technology flexibility is referred to the speed and quality in the process of new knowledge and technology coming into being and being brought into the business operations. Flexibility of products design platform means it's extendable and adjustable and the design tools can perform various operations as well. We can take the time from the development to the launch and the changeability of new products as the measure of new products' flexibility. Shorter time in research and launching, more varieties in new product spic, stronger flexibility the organization will have.

Market flexible strategy aims to increase the reaction and adaptation of new products, which requires the enterprises have the abilities to cut down the delivery period and adjust according to the change of delivery time. Meanwhile, the channels and modes of marketing, the after sales services and other related activities should also adjust when the firm's external environment changes.

The product quantity flexible strategy aims to improve the abilities of expanding the capacity and operating economically at different levels of output (different quantity and lot size), which reflects the enterprises' ability to cope with demand fluctuations.

Product portfolio flexible strategy aims to improve the system's ability to produce different products. The key to cope with demand uncertainty is to provide diversified products rapidly, in low cost and high quality. Then product portfolio flexible strategy can make the enterprise to coordinate and produce different products, which can be measured in three aspects: cope, time and cost. The scope means that the manufacturing system can change the scope and range. If there are more kinds of products, there will be more commodities to circulate in certain period, and the flexibility will be higher. The shorter the time took to change the product variety, and the lower of the cost taken place, the higher of the flexibility.

As the accelerating changes of the competitive environment, flexible strategy has been widely recognized and valued (Zhang 2011; Guimarães et al. 2010). There are more and more research on the analysis and formulation of flexible strategy. However, any success does not consist in strategy formulation, but also on effective implementation. Flexible strategy is no exception. There is scarce research on the implementation of flexible strategy before, especially the study on how to implement it by performance management and other strategy implementation means. Meanwhile, there are few researches on the combination of performance management and flexible strategy. So it's necessary to have in-depth study of the flexible strategy oriented performance management.

### ***80.2.2 The Human Resources Support System of Flexible Strategy***

Based on system theory, the system target of human resources support system matching to flexible strategy is effectively supporting the implementation of flexible strategy. The output of system is the human resources strategy and the input of system is the human resources effectively supporting flexible strategy of organization. The environment of system includes inner environment factors and outside macro environment factors. System structure is mainly constituted by procedure system and support system of human resources support system.

Human resources support system is established mainly based on the related management functions in the whole life cycle of human resources management. Besides the human resources planning, the input of the system mainly consist of reasonable position, responsible match between the personnel selection and configuration, accurate assessment of individual ability and achievement, various forms of training aimed to different levels of employees, and incentive mechanisms corresponding to different assessment results. Human resources support system includes institution security system and dynamic adjustment system, whose whole conceptual model is as Fig. 80.1.

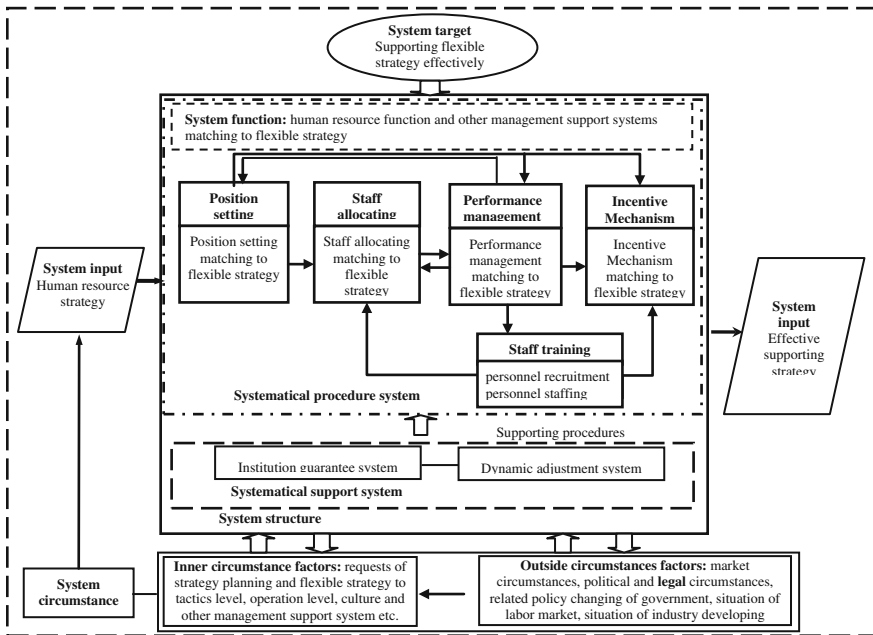
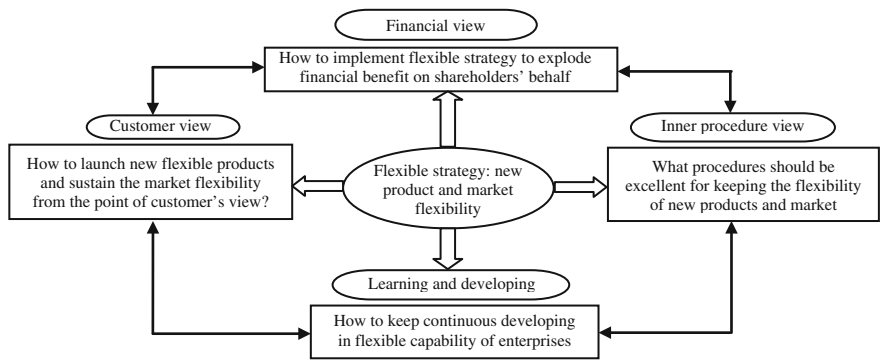


Fig. 80.1 Conceptual model of human resources support system based on flexible strategy

### 80.3 The Balanced Scorecard Based on Flexible Strategy

The core component of human-resource support system is the performance management of flexible strategy (Flores et al. 2009; Farrokhi et al. 2012; Kelly and Ravenscroft 2007). In recent years, the Balanced Scorecard (BSC) has been widely acknowledged as an effective way of strategic performance management. This management method, raised by Kaplan and Norton in the early 1990s, is based on researches on some famous enterprises which are outstanding in this field. Not only does this method emphasize on measuring performance, but also taking into account long-term and short-term effects, financial and non-financial aspects, internal and external areas as well as motivation and results (Li and Wang 2010; Kongar 2004). It also plays a crucial role in the classification of strategic themes of four interrelated levels—the financial level, the customer level, the internal operating level and the learning and development level.

The performance management of flexible strategies refers to a management method which is oriented by flexible strategies and also supportive of it. BSC based on Flexible Strategy is in common with common Balanced Scorecard in following aspects—they are both powerful tools of strategy implementation and crucial frameworks of strategy classification. Also, their premises are both established strategies while the premise of BSC of flexible strategies is flexible strategies. On the contrary, the differences between BSC based on Flexible



**Fig. 80.2** The balanced scorecard of flexible strategy in manufacture enterprises

Strategy and common Balanced Scorecard are as follows—BSC based on Flexible Strategy regards the implementation of flexible strategies and interests of customers and shareholders as its premise, the ensurement of flexible support is the major target of its internal processes and development dimensions. Also, BSC based on Flexible Strategy ranges over a certain degree of flexibility in index decomposition and index value’s credibility in four dimensions. This paper presents an example of BSC of flexible strategies in manufacturing industry, as shown in Fig. 80.2.

BSC of flexible strategy based on enterprises can be used to establish performance objectives of the department. The flexible expression for different administrative departments, aiming at ensuring the strategic flexibility of the whole enterprise, serves as support of various branches’ functions. It can be measured by requirements and classification index of BSC of flexible strategy. For example, flexible embodiment of Department of Production Management mainly aims at ensuring flexibility of new products and market. Flexible embodiment serves as a necessary flexible production process and the ability to adapt to rapid changes.

Targets of post-performance based on flexible strategies are the classification of department’s flexible performance targets. As for the setting of post-performance targets, not only should we consider post’s environment and duty, but also take internal and external customers’ needs and expectations into account (Aldrich 2007). Flexible strategy-oriented performance management requires the establishment of an effective mechanism to allow rapid adjustment and modification of the post’s duty and privilege with the change of enterprise strategy. We should also take into account inter-departmental processes and internal and external customers’ requirement to suppliers in order to relate the post target with corporate strategic objectives.

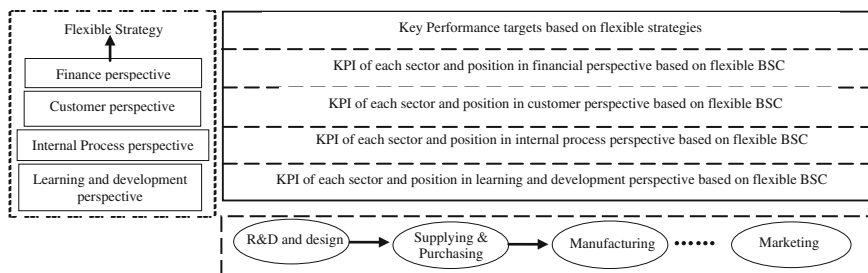
## 80.4 Key Performance Indicators Based on Flexible Balanced Scorecard

A key performance indicator (KPI) plays a crucial role in the establishment of performance management target process based on BSC (Liu et al. 2010; Northcott and Taulapapa 2012). KPI, based on BSC, is the measurement of controlled parts in key business activities.

KPI based on flexible strategies is in common with common KPI in following aspects—they are both powerful tools of strategic performance management as well as the main carrier of BSC's classification and realization. Both of their premises are developed strategies and BSC based on strategy, while KPI based on flexible strategy's premise is flexible strategy and BSC based on flexible strategy. Therefore, compared with common KPI, the selection of KPI based on flexible strategy's targets sets the ensurement of flexible support for enterprises as its basis. Meanwhile, it has a certain degree of flexibility in classification of BSC's index value (either basic value or challenge value) in four dimensions.

The establishment of classification framework for KPI based on BSC is a crucial section for performance management based on flexible strategy. In particular, it is important for the departmental key performance indicator system for the reason that post KPI is based on that of its department. The paper, setting manufacturing enterprises as background, proposes a KPI classification model based on BSC and value process (as shown in Fig. 80.3).

The longitudinal axis of the model is composed of four dimensions of BSC. It is the KPI of the corporate level and can be extended to the strategy map of BSC. The horizontal axis of the model is the value process of the enterprise. Each process always corresponds to the enterprise's sectors (not necessarily one-to-one correspondence). It is a KPI framework of BSC. The specific operation should first be the establishment of BSC of flexible strategy, and then the classification of various dimensions, namely the KPI on the corporate level or the strategy map. We should also make clear the functions and divisions of labor in each process (or department). Then we can proceed with departmental KPI design based on the two-dimensional crossover.



**Fig. 80.3** The two-dimension model of the decomposition of KPI based on flexible balanced scorecard

Constructed of the four dimensions of the balanced scorecard, the vertical axis of the model, as the key performance indicators at the company level, can be expanded to be a strategy map based on the balanced scorecard. The horizon axis is the value stream of the company, with each process corresponding to some specific departments (not necessarily to be one-to-one).

This is a framework of building key performance indicators of each department based on the balanced scorecard. In specific operations, with the decomposition of all dimensions, a balanced scorecard based on the flexible strategy, namely a map of key performance indicators or a strategy map at the company level, should be made firstly, while each process (department) clearly knows its functions and divisions. Thus the design of key performance indicators of each department based on this two-dimensional crossover can be carried out.

80.5 Examples

CW Mold Company is a full funded branch of the huge CW Group operating home appliances, owning total assets of more than 50 million Hong Kong dollars. With a high starting point, high technology and high investments, the company engages in research and development, precision manufacturing and technical services at a suit, providing the design and manufacture of kinds of molds from small precisions molds like mobile phone shells and micro-motors at most to large injection molds such as TV shells, auto parts and molds weighing up to 50 t. While based upon domestic market, the company positively participates in the international market competition.

The flexible strategy of CW Group is dominated by flexibility of new products and supplemented with market flexibility. As a subsidiary branch of CW Group, CW Mold Company’s flexible strategy shall comply with CW Group and be strategy at operation and strategy level supporting the group strategy under the guidance of it.

As the main purpose of the flexible strategy of new products is to increase the ability of increasing new products, that is the ability of manufacturing system to launch new products timely and modifying the functions and appearance of the

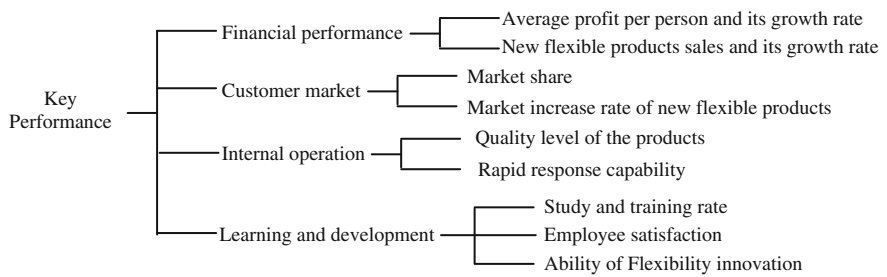


Fig. 80.4 Key performance indicators of flexible strategy in CW molding company



existing product available on the market to satisfy customer demands rapidly by introducing and fabricating new parts and products. While the purpose of the flexible strategy is to enhance the ability of the enterprise to adapt to or to influent the market, the enterprise should have the ability of shortening the delivery time and adjusting to correspond to the delivery change request, and at the meantime have the strain capacity of marketing channels, marketing mode, customer service and the marketing related activities under the external environment changes. Therefore, the product flexibility of the CW mold company should be built to ensure the flexibility of the manufacturing system, which includes a flexible mold and manufacturing system, as well as the flexible production plan, so as to ensure mix flexibility and volume flexibility of the mold products. The balanced scorecard and key performance indicators based on the flexible strategy at the company level is shown in Fig. 80.4.

The main processes of the company consist of research and development design, supply purchase, production quality inspection, marketing and after-sales service. With the two-dimension model, BSC and key performance indicators at the company level can be decomposed to each department. The framework of the decomposition and the example are shown in Table 80.1.

On this basis, decomposition of key performance indicators of positions will form an index system of flexible performance management. After index systems being built from top to bottom, and a performance management process being constructed by performance planning, performance guidance, performance evaluation and performance rewards, the whole performance management system will be accomplished, which will be an effective support of flexible strategy.

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# Chapter 81

## Enterprise Human Resource Matching Model Based on Job Analysis and Quality Assessment

Shao-hui Yun

**Abstract** The effective human resource matching has been the focus of enterprise management in both theoretical and practical area. This paper first reviews the human resource matching theory and models from scholars at home and abroad. Then a model of enterprise human resource matching based on job analysis and personnel quality assessment has been put forward. In this model both job analysis and personnel quality assessment are thought important and the mechanism of them has been explained systematically. Finally some suggestions and expectations are put forward on future research.

**Keywords** Human resource matching • Job analysis • Quality assessment • Person-organization fit

### 81.1 Introduction

An ancient Chinese fable said that the west neighbor had five sons, the first one was honest, the second one was smart, the third one was blind, the forth one was bow-backed and the last one was crippled. Then the west neighbor arranged the honest one to be engaged in agriculture, the smart one to be engaged in business, the blind one to be engaged in fortune-telling, the bow-backed one to lay up ropes and the crippled one to be engaged in doubling thread. The story of the five sons of the west neighbor tells us that every individual has different advantages and disadvantages and the excellent manager should found the advantages of different employees and put them in the most suitable position.

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From the microcosmic point of view of enterprise management, human resource matching refers to the process that matching different types of human resource to appropriate position by assessment, selection, placement and training. Thus the human resource can combine with other economic resources effectively to realize real economic activity and create maximum economic benefit and social results. Human resource matching is the significant work in enterprise human resource management because on the premise of the same person and position, different placement and matching style can result in totally different effect (Mingzheng 2001). Human resource matching is the beginning and destination of human resource management in respect that the purpose of human resource management is to set the correct people to do the correct things and make the fully use of human resource.

## 81.2 Literature Review

The previous human resource matching models can be classified into two main types. One is quantitative model which is developed based on complex mathematical method and the other is qualitative description model which often reflected by flow chart.

### 81.2.1 *Quantitative Human Resource Matching Model*

#### 1. Human resources allocation based on fuzzy mathematic

Kwak et al. (2003) reviewed the existing human resource allocation models for a Certified Public Accountant (CPA) firm. They pointed out some major shortcomings in the previous mathematical models and adopted a fuzzy set approach to solve human resource allocation problems. A solution procedure was proposed to systematically identify a satisfying selection of possible staffing solutions that could reach the best compromise value for the multiple objectives and multiple constraint levels. The fuzzy solution could help the CPA firm make a realistic decision regarding its human resource allocation problems as well as the firm's overall strategic resource management when environmental factors were uncertain.

Jing and Wei (2007) also presented a human resources allocation method which could objectively evaluate the staff's quality to some extent. The hypothesis of the model was that despite the subjectivity and fuzziness of employee selection and placement in management practice, there should be rationality to some extent. They had set up a relationship matrix of basic quality and different jobs. According to fuzzy mathematic transfer theory, a model which could choose the most propriety job for every staff is was put forward and a practical example was offered.

## 2. Enterprise human resource allocation model based on BP neural network

Bin-yang and Hong-bo (2009) developed an enterprise human resource allocation model based on BP neural network. The model was based on the theory of HRM that the allocation of enterprise human resource must meet the correspondence of personal ability level and position required ability level. With the development of new technology, market environment and the enterprise itself, the former or existed allocation would be broken and new ability-position matching should be established. Thus the enterprise human resource allocation was a dynamic process and personnel turnover probability was one of the important indexes in enterprise human resource allocation. Based on the analysis and comparison of the characteristics in human resources department business process, they pointed out a number of factors concerning human resource allocation decisions and established a corresponding prediction model according to Artificial Neural Network Theory which was analyzed by simulation software Matlab.

## 3. Distribution Model of Human Resource Based on CMMI

Wei et al. (2006) developed a human resource distribution model based on Capability Maturity Model Integration (CMMI). The model used both quantitative and qualitative method. During the implementation of CMMI, all personnel of the organization could be divided into different types according to organizational structure and professional position role. Based on the classification, the statistical information of all personnel and capacity factor of different professional position roles in different department could be obtained. Finally the distribution model was designed using linear programming method and LINDO 6.1 had been used to get the solution of linear equations.

### ***81.2.2 Qualitative Human Resource Matching Model***

Wei-liang (2003) proposed a dynamic matching model of person-position about human resource matching. The model indicated that enterprise human resource matching should be started from the definition of vacancies on the basis of human resource planning, followed with job analysis which could determine the duties, responsibilities and job requirements. On the basis of the former two activities, the requirements of knowledge, skills and personality of candidates was clarified. Then indexes of personnel testing should be designed and corresponding measuring instruments should be chosen. Finally scientific selection procedure should be conducted in order for the candidates being allowed or refused to the organization.

Yan (2008) developed both static and dynamic human resource matching model on the basis of three factors, e.g. quantity, quality and person-organization fit. The static model considered that the human resource matching procedure was an

organic system of internal and external labor supply and described the institutional mechanism of human resource matching. The dynamic model of human resource matching has taken time dimension into account. The external environment and internal composition of organization's human resource matching system would be changed at different time, and the same for position demand and personal ability. The key point of the dynamic model was that it considered three types of matching, e.g. person-position fit, person-person fit and person-organization fit.

### ***81.2.3 Comments on the Existed Human Resource Matching Model***

The quantitative models of human resource matching mentioned above have taken human resource allocation as a dynamic process and used some relevant mathematical model to get the solution. But most of the quantitative models have put their stress on the allocation of human resource quantity in an organization. Although some models have considered staff quality and the difference in ability, however, they did not pay much attention to the scientific mechanisms and technologies of human resource allocation. Besides, the fitness of the quantitative model of the organization's conditions is limited, it can only be used in specific organization, and the universal application of the models is restricted.

On the contrary, the dynamic matching model of person-position has emphasized profession and technology to research an organization's allocation and involved the basic activities such as job analysis and quality assessment, and that is the direction that human resource management experts should follow. However, the description of person-position matching is so simple that it does not throw light on how to use job analysis and quality assessment results to allocate person reasonably. The three elements raised by the static human resource allocation model still remain to be discussed.

To date, the study of person-organization fit has made some achievements. Morley (2007) combined the papers explore new avenues of enquiry in the person-organization (P-O) fit domain and showcase international theoretical and empirical work on the P-O fit construct. van Vuuren et al. (2007) compared two different assessments of P-O fit. Silva et al. (2010) adopted a person-organization fit framework to examine whether employees' perceptions of organizational strategy for adaptation predicted their commitment to their organization and their intentions to stay.

From now on, scholars both at home and abroad have agreed that quantity and quality elements should be included in person-position matching, person-team matching, and person-organization fit models. Although organizational dynamics human resource allocation pays attention to the importance of the job analysis and quality assessment, it does not give us a scientific station about the process and

application of quality assessment. Therefore, the existing model puts much attention to job analysis but not enough to personal quality assessment.

This paper argues that job analysis and personnel quality assessment are the two basic aspects of human resource management. To make a rational allocation of human resources need to do two types of work at the same time and attaching equal importance to both. The human resource matching model presented below based on job analysis and quality assessment of is the reflection of this idea.

### **81.3 The Current Situation of Human Resource Matching of Domestic Enterprises**

Though human resource matching is very important, there are some sorts of irrational phenomena in human resource matching practices in many domestic enterprises. The mismatch of human resource will directly result in many management problems such as lower enthusiasm, organization inefficiencies and poor implementation of organization strategy. The current situation of human resource matching of China's enterprise has been summed up as follows.

*First, coexistence of enterprises human resource shortage and human resource waste*

Under the condition that the business competition is more and more complex, the internal and external survival environment of enterprises in preliminary stage of development are getting worse, and the effectiveness and efficiency of such enterprises are comparatively low. Thus it is hard to attract appropriate human resource to satisfy the development of the enterprise. More over, the reservation of present talents is difficult since the same reason. On the one hand, the necessary talents of such enterprises are not enough. On the other hand, the present human resources are seriously wasted because of the emplacement and mismatching of person and position, person and team, or person and organization.

*Second, inefficient human resource utilization*

Many problems are generally existent in domestic enterprises such as irrational organizational structure, the low management level of managers, conflict between internal leading members and different departments, etc. Particularly, in some family enterprises, the human resource matching emphasizes the role of friends and relatives of the manager instead of the one with high capability. The position in the enterprise is set not because of something must be done but because of someone is there. More over, the organizational behavior is eager for quick success and instant benefits without long-term planning. All of the above will finally result in low efficiency of human resource and weaken the internal cohesion of the organization.

*Third, deficiency in job analysis and talent assessment*

Since scientific job analysis and talent assessment procedure are lacking in many domestic enterprises, the tasks, duties, responsibilities and other requirements of

positions are indistinct. Simultaneously, the recruiters usually are not familiar with the knowledge, skills, abilities and other characteristics that the candidates should possess. Thus it is difficult to realize the person-position matching in selection and primary placement stage. After the required talents are allocated in corresponding position, training and development of present talents are usually paid little attention or even ignored by managers which will result in continuously existence of mismatching in person and position.

## **81.4 Human Resource Matching Model**

### ***81.4.1 The Theoretical Foundation of the Model***

At present, the subject of human resource matching shows the characteristic of diversification, independent and personalized. The human resource matching and optimization should overcome such poor practice as subjectivity, unidirectional, blindness and empirical and should realize bidirectional, dynamic, and matching in human resources allocation. Bidirectional is to realize the common development of the staff and organization through the rational allocation of human resources while dynamic means that human resources allocation need to consider adapting to the development of both the organization and the staff with timely adjusting and optimizing. Coordination is to consider the holistic benefits of the organization through the rational allocation of human resources to achieve optimal organizational performance and reflects the synergy effect. Matching is that employees should not only fit to jobs, but also suitable for group; not only fit to physical environment, but also suitable for psychological and social environment.

In order to realize bidirectional, dynamic, and matching of human resources allocation, it is need to the comprehensive understanding of all kinds of position requirement and the qualities of employees. Only through two dimensions of matching of job analysis and personnel quality assessment, the right people could be put in the right positions.

Job analysis is the foundation of human resource management and also is a basic management activity to get detailed information about jobs. Personnel quality assessment is a series of methods to assess the comprehensive ability of individual. Mark Cook and Xiao Ming-Zheng think quality assessment is to use scientific methods to collect information in the main activity in a short time or directly collect from the characterization information collected by some quality characteristics and inference process. Peng Jian feng and Rao Zheng think quality assessment is a kind of science professional methods and tools to collect material, through the measurement and assessment of the individual behaviors, to predict the future tendency of the performance assessment of activities.

Job analysis can provide job information, especially information of qualified requirements, while personnel quality assessment makes possible the effective

assessment on the knowledge, skills, and abilities and other characteristics. Comparing assessment result with position to the quality requirements can realize effective matching of person and jobs, person and the team, person and organization and then realize the optimization of human resources allocation.

#### ***81.4.2 Human Resource Matching Model Based on Job Analysis and Quality Assessment***

Based on the above theoretical analysis, a human resource matching model based on job analysis and personnel quality assessment has been put forward. In this model the human resource matching process has been putting into the larger environment of the whole organization system. First and foremost, the human resource strategic planning has been formulated under the direction of enterprise strategy. Then the dynamic human resource matching process could be carried out centered on the human resource value chain and grounded on information provided by job analysis and personnel quality assessment.

#### ***81.4.3 Human Resource Value Chain***

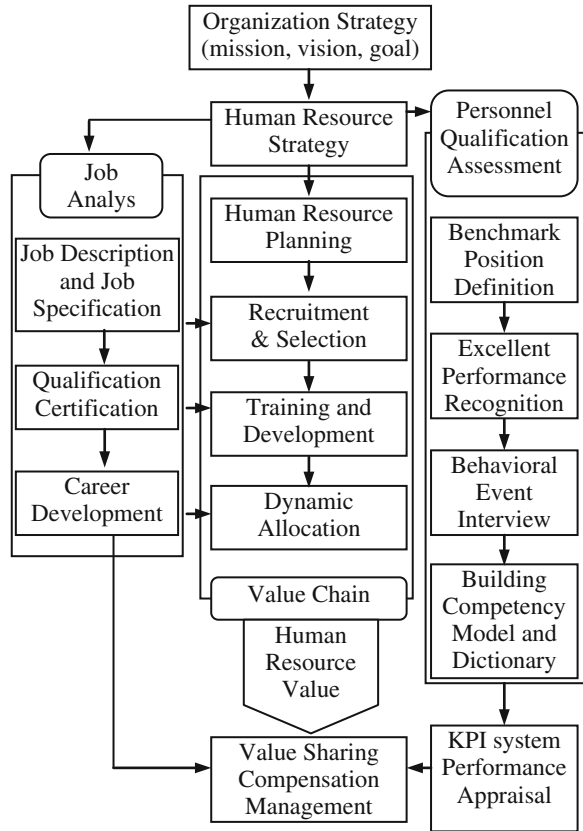
The modules of human resource management consist of the human resource value chain. The HRM process is an ongoing procedure that tries to keep the right people in the right positions. It includes human resource planning, recruitment and selection, employee socialization, training and development, performance appraisal, promotions, transfers, demotions, separations, and compensation management. The human resource value chain can be divided into three parts, e.g. value creation, value appraisal and value sharing.

##### *Firstly, value creation process*

Internal or external candidates are attracted into the organization by recruitment and selection process, which is called primary placement of human resource. The primary placement is important because performance of the organization is directly correlated to employees hired and the competencies they bring to the job. Employees who are not a good fit tend to make mistakes and/or leave often resulting in high turnovers rates and poor organizational performance (Fig. 81.1).

Then the new employees are trained to work more effectively by training and development procedure. Training can help ensure that employees have the basic skills to work with new technology and ensure employment security by providing new ways for employees to contribute to the company when their jobs change, their interests change, or their skills become obsolete.

**Fig. 81.1** Human resource matching model based on job analysis and personnel quality assessment



*Secondly, value appraisal process*

The performance of employees will be appraised and such dynamic allocation decisions as promotions, transfers, demotions and separations will be made after performance appraisal. Performance appraisal is the process through which an organization gets information on how well an employee is doing his or her job. It is a formal, structured system for measuring and evaluating an employee's job-related attributes, behavior and outcomes. Performance appraisal can provide the supervisor useful information to identify the strengths and weaknesses of an employee's performance and a format enabling managers and employees to jointly establish future development and growth plan for the employees.

*Thirdly, value sharing process*

Different employees will get different compensations due to the contributions they made or the values they have created. This process is value sharing process which reflects a variety of factors. The purposes of compensation management are the followings. First it can induce some employees who are unequal to their work to change jobs. Second, it can help some employees learning and acquiring new skills necessary. Third, it can reward excellent employees for their hard working

and contributions to the organization. The compensation management process should regard both the importance of different positions and the performance of the incumbents.

In order to realize the effectiveness of the human value chain, perfectly optimized human resource matching is critical and the two basic human resource management module- job analysis and personnel quality assessment are indispensable.

#### ***81.4.4 Job Analysis***

Job analysis is the process of getting detailed information about jobs. It defines a job in terms of its specific tasks, duties, responsibilities and the quality and skills needed to perform within the role successfully. The former is called job description and the later is known as job specification. Job description lists the objectives, responsibilities, main tasks of the job, the conditions under which the job is to be done, and its relationship to other jobs. Job specification defines the specific skills, education, experience, and quality that an individual must have in order to perform effectively in the position. Job analysis is considered as the building block of several interrelated HR activities.

In this human resource matching model, the important role of job analysis is reflected in the following aspects. Firstly, information offered by the job analysis in forms of job description and job specifications is considered as the back bone of upper management decisions regarding recruitment and selection of the staff. Secondly, job analysis is considered very essential when it comes to compensation activities since compensation usually determined based on the required qualities of each job. Thirdly, performance appraisal means comparing the actual performance of employees to the performance standards of a certain job. The performance criteria of each position getting from job analysis can be used as a reference to determine the specific activities and performance standards of a certain job. Fourthly, since job analysis reveals the required knowledge, skills, abilities and other characteristics (KSAOs) of a job, we depend a lot on it when designing a certain training program for this job. Finally, job analysis will help employees understanding the career development of certain position and preparing to future promotion.

As for the application of the model in given enterprise, the first step is to carry out systematic job analysis of key positions in order to establish well-defined job description and job specification. Such methods as observation, interview, critical incidents and structured questionnaires can be used in job analysis. Then the information should be not only kept in archives but also applied in the correlative HR procedures such as recruitment, selection, training, development, performance appraisal, compensation management and career development.

### ***81.4.5 Personnel Quality Assessment***

Job analysis is one important process which helps solving the problem of the nature of positions and requirements to the incumbents. The other important process is personnel quality assessment which can provide the competencies of candidates or incumbents. Personnel quality assessment is the process to getting information of quality of working staff based on psychological measurement method. It can provide basic reference to such human resource management procedures as recruitment, placement, appraisal, promotion and training by developing a competency profile.

In this model, competencies have been defined as underlying characteristics of a person which result in effective or excellent performance which include personal skills, knowledge, motives, traits, self-image and social role. In order to establish the competency model, first position should be defined in the organization. Then excellent performance of a person in relevant should be recognized. On the basis of the excellent performance and benchmark position, such techniques as Behavioral Event Interview (BEI) should be used in building the competency model and dictionary. When there is a need to fulfill a position, the competency model could be matched with job specification and the proper person with correct quality will be found and allocated to the position.

## **81.5 Conclusion and Suggestion**

### ***81.5.1 Conclusion***

The human resource matching theory and models of scholars at home and abroad has been reviewed firstly. And the advantages and weaknesses of quantitative and qualitative model of human resource model have been analyzed. Then a model of enterprise human resource matching based on job analysis and personnel quality assessment has been put forward. In this model both job analysis and personnel quality assessment are thought important and the mechanism of them has been explained systematically. The human resource matching process has been putting into the larger environment of the whole organization system. First and foremost, the human resource strategic planning has been formulated under the direction of enterprise strategy. Then the dynamic human resource matching process could be carried out centered on the human resource value chain and grounded on information provided by job analysis and personnel quality assessment.

### **81.5.2 Suggestion**

In future research, we must strive to combine researches on job analysis, personnel assessment, human resource planning, placement, matching, training, etc., and strengthen understanding and usage of professional techniques in human resource management area. Furthermore, dynamic analysis should be added into existing research results to increase their integrity and effectiveness. More human resource management methods and techniques should be developed and improved in the process of initiative staff placement and matching. At the same time, we should learn from advanced academic research achievements abroad taking into account the unique character of domestic enterprises. We should better address the practical problems of China's enterprises and provide better services for the enterprises to improve organizational effectiveness and human resource management level.

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## Chapter 82

# The Initial Research on the Governance of Chinese Football Environment

Yue Li and Yu-hua Wu

**Abstract** Focusing on the problems encountered in the development of Chinese football, this paper conducts the research on the systematic environment of Chinese football, as well as the various internal and external influence factors. It uses AHP to determine the weight coefficients of various influencing factors, which provide scientific reference for the study of Chinese football environment system, so as to distinguish the priorities of various governance activities and to manage effectively.

**Keywords** Analytic hierarchy process (AHP) • Football • Weight

In recent years, continuous declining level hits Chinese football industry, “aligned” with scandals such as black whistle, associated or fake games, and gambling, makes Chinese football sports environment even worse. The research on Chinese football environment governance not only has the effect on the improvement of football clubs’ management efficiencies, but also contributes to a more systematized, standardized and normalized environment of Chinese Football League, thus eventually improve the overall performance of Chinese football industry and also fans’ satisfaction.

When talking about the constraints of Chinese football development, someone believes Chinese Football Association (CFA) should be blamed, for its disappointing management ability of the executives; someone accuses for the lack of capable coaches, who can train their athletes towards the latest trend of technique and tactics; while most people deem that the present situation of Chinese football should impute to the wicked Chinese football environment. Analysis on factors that influence Chinese football environment should based on scientific theories so as to discover the weights of every factor and effectively regulate Chinese football environment.

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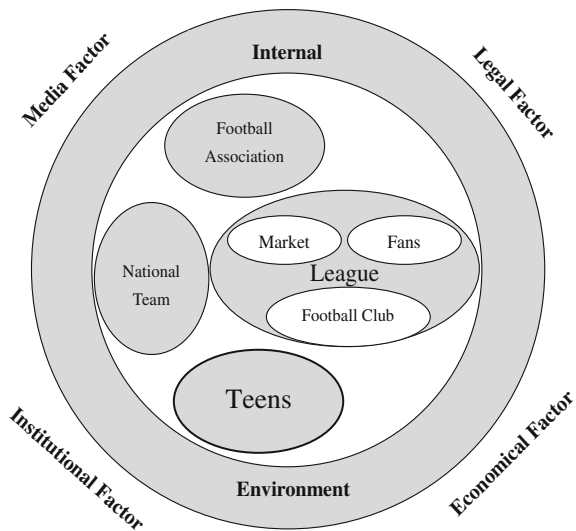
### 82.1 Chinese Football Environmental System Structure

In accordance with the system analysis theory, we need to analyze the integrant factors, relationships and systemic function in football environment (Wu 2008). This paper will put Chinese football environment as a great system and divide it into internal and external environment, internal environment refer to the football system in the pure football sense; external environment refer to the system that closely related to football outside the pure football sense. Whether the internal or external environments both can affect and restrict Chinese football, sometimes they can even play a decisive role (Wu 2002). As for the internal environment, football association, league, football club and national team all are key factors which can affect Chinese football; while in external environment, economic condition, political legal environment and news media are key factors too. Professional football may be affected by social economy environment and cultural psychological environment with different level as well (Ko 2006; Zheng 2010). Figure 82.1 shows the structure of Chinese football macro system.

### 82.2 Empirical Research on Factors that Influence Chinese Football Environmental System

Basically there are 4 steps to construct the system using AHP mode 1 (Sati 1990; Kong and Liu 2009):

**Fig. 82.1** The structure of Chinese football macro system



82.2.1 Division on Selected Parameters

Several representative factors are chosen for research. Based on the analysis above, 12 parameters that influence Chinese football environment are determined: Chinese Football Association (S), market (M), football fans (F), national team (T), athletes (P), administrative staff (Ma), coach (C), investors (I), teens training (Y), economic condition (E), political and legal system (L) and news media (N).

82.2.2 Construction of Hierarchical Structure

Hierarchical structure is constructed based on the selected parameters and issues to be solved, as shown in Fig. 82.2.

82.2.3 Construction of Judgment Matrix of Each Layer and Sheer Level Model

In line with the methods and principles to build the judgment matrix, and confirmed by experts and project team members, the judgment matrix of each layer is constructed as below:

- 1. A-B layer judgment matrix as shown in Table 82.1

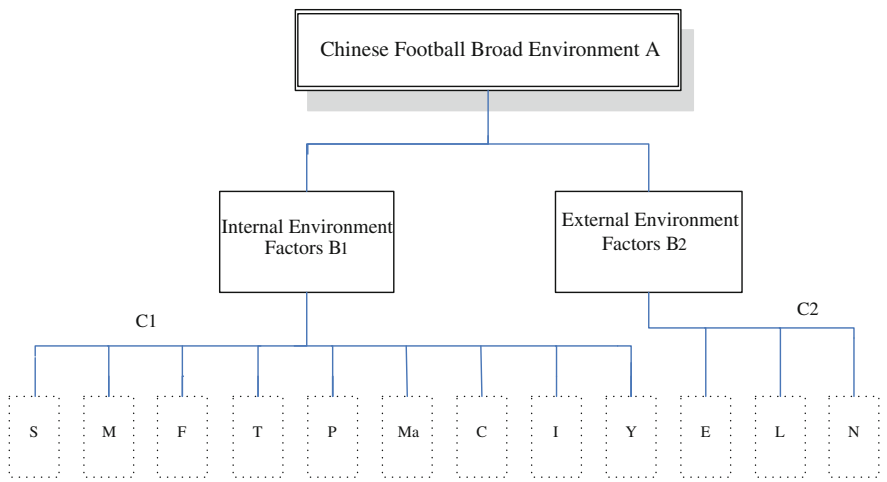


Fig. 82.2 Hierarchical structure chart

**Table 82.1** A-B layer judgment

A-B	B1	B2
B1	1	3
B2	1/3	1

Through calculation the judgment matrix of feature vector and characteristic value are as follows:

$$W = (0.75, 0.25), \lambda_{\max} = 2$$

Through the judgment matrix consistency test, computing  $C.I. = 1$ ,  $C.R. = 0.0 < 0.1$ , it is indicated that the consistency of judgment matrix can be acceptable.

2. B1-C1 layer judgment matrix as show in Table 82.2

Through calculation the judgment matrix of feature vector and characteristic value are as follows:

$W = (0.137, 0.058, 0.037, 0.058, 0.36, 0.036, 0.198, 0.02, 0.095)$   $\lambda_{\max} = 9.35$ ,  $C.I. = 0.044$ ,  $C.R. = 0.03 < 0.1$ , the consistency of judgment matrix can be acceptable.

3. B2-C2 layer judgment matrix as shown in Table 82.3

Through calculation the judgment matrix of feature vector and characteristic value are as follows:

**Table 82.2** B1-C1 layer judgment

B1-C1	S	M	F	T	P	Ma	C	I	Y
S	1	3	4	3	1/4	4	1/2	6	2
M	1/3	1	2	1	1/6	2	1/4	4	1/2
F	1/4	1/2	1	1/2	1/7	1	1/5	3	1/3
T	1/3	1	2	1	1/6	2	1/4	4	1/2
P	4	6	7	6	1	7	3	9	5
Ma	1/4	1/2	1	1/2	1/7	1	1/5	3	1/4
C	2	4	5	4	1/3	5	1	7	3
I	1/6	1/4	1/3	1/4	1/9	1/3	1/7	1	1/5
Y	1/2	2	3	2	1/5	4	1/3	5	1

**Table 82.3** B2-C2 layer judgment

B2-C2	E	L	N
E	1	1/5	1/3
L	5	1	3
N	3	1/3	1

Fig. 82.3 Sequencing result

Football Player	Political Legal Environment	Coach	Football Association	Teens Training	News Media	Market
0.270	0.159	0.148	0.103	0.071	0.065	0.044
National Team	Fans	Management Staff	Economic Condition	Investors		
0.044	0.028	0.027	0.026	0.015		

$W = (0.105, 0.637, 0.258)$ ,  $\lambda_{\max} = 3.04$   $C.I. = 0.021$ ,  $C.R. = 0.04 < 0.1$ , the consistency of judgment matrix can be acceptable.

82.2.4 Calculation of Combination Weight of Parameters from Each Layer

The sequencing of layers is defined from top to bottom. On the very top, the single ordering level is the sequencing. The whole sequencing result comes out by calculating these parameters, as shown in Fig. 82.3.

82.3 Results Analysis

Evaluation of consistency of the hierarchical sequencing results:

To verify the consistency of the hierarchical sequencing results, the amount of inspection that corresponds to single ordering level should be calculated (Wu and Li 1999).

Assume: CI is consistency index of hierarchical sequencing;

RI is random consistency index of hierarchical sequencing.

The formula is:

$$C.I. = \sum_{i=1}^m a_i C.I._i \tag{82.1}$$

C.I.<sub>i</sub> is the consistency index for A<sub>i</sub> corresponds with judgment matrix of Layer B;

$$R.I. = \sum_{i=1}^m a_i R.I._i \tag{82.2}$$

$R.I._i$  is the random consistency index for  $A_i$  corresponds with judgment matrix of Layer B.

Applying them to:

$$C.R. = \frac{C.I.}{R.I.} \quad (82.3)$$

Thus the results are derived:

$$C.I. = 0.75 \times 0.044 + 0.25 \times 0.021 = 0.03825$$

$$R.I. = 0.75 \times 1.46 + 0.25 \times 0.52 = 1.225$$

$$C.R. = 0.03825/1.225 = 0.03 < 0.1$$

The results show that the hierarchical sequencing satisfies consistency test, hence these results are valid.

## 82.4 Conclusion

According to the proportion results come from the analysis of each factor that influence the development of Chinese football, this paper puts forward some reform proposals for the factors with higher proportion.

- A. Regarding the internal factors like players, coach and football association, the sustained improvement of Chinese football players and coach's literacy and professional quality is advised. Teenage athletes' fundamental trainings and technical movements should be seriously treated so that to form their own technical styles, pay attention to the construction of the reserve forces as well. Meanwhile, CFA's identity and authority distribution should be further clarified, to increase the organization integration efforts, explore the giant department system where its functions are united organically, and improve the coordination and collaboration mechanism between different departments (You 2009).
- B. As for external factors including political and legal environment, structural reform of Chinese football should be intensified, factors involved in current planned mechanism should be removed, and market management mode should be applied. Keep on adjusting the directions, and regulate the development of the football industry towards its innate rules as a professional football sports and industry. Meanwhile, specific legal system should be constructed, so that relevant Chinese football regulations will be gradually progressed (Wong 2009; Xing and Zhu 2008).

To conclude, this paper researches Chinese football environment system structure by using systematic scientific theories, analyzed its inherent sub-systems and factors, and constructed a mathematical model to define the influence power

and the weights of each factor to Chinese football environment using modern management science; therefore priorities are set to regulate Chinese football industry purposefully and effectively.

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# Chapter 83

## Study on the Performance Evaluation of the Parent-Subsidiary Corporation's Financial Management and Control

Xi Zhao, Guo-hong Li, Jia-yin Liu and Hang Xu

**Abstract** Focusing on 84 listed parent corporations, this paper examines their performance after implementing financial management and control, adopting two methods, financial index analysis and factor analysis. Next, a comparison was made among different industries concerning financial performance, and also a trend analysis on years after conducting financial management and control. A conclusion can be drawn that not all corporation undergoing financial management and control meet their goals successfully. Therefore to optimize corporate resources and maximize their performance, an effective pattern of financial management and control should be established in accordance with certain industry characteristics and the specific internal and external environment in which the company stand.

**Keywords** Parent-subsidiary corporation · Financial management and control · Performance evaluation · Factor analysis

### 83.1 Introduction

In recent years, with the acceleration of economic globalization, many companies are faced with internal management issues deriving from complex corporate structure and expanding size. Being the inevitable choice for most companies, Parent-Subsidiary Corporation have made significant progress on financial management and control. However problem emerges accompanying with the progress: firstly, irrational structure designs. When designing their organization structure, some companies fail to integrate financial management with internal and external

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environment (Jensen 1993; Mcgrath 1997). As a result, they are unable to relocate resources reasonably. Second, devoid of the awareness on account of financial management and incomplete control techniques, risk concerning the loss of asset is aggravated (Mcgrath 1997). Thirdly, conflicts within the company arouse when parties within the corporation fail to recognize their function (Jensen and Meckling 1976). Last, as the group members are independent legal person, and capital is the main link connecting members within the group, in order to make the company become one economic composition, financially enhancing the integration of control has become very necessary.

## 83.2 Case Study

### 83.2.1 *Sample and Index*

Samples are chosen from companies listed on the main board of the Shanghai Stock Exchange (hereinafter referred to as SHE) and Shenzhen Stock Exchange (hereinafter referred to as the SZSE) from 2009 to 2011. As the group's consolidated financial statements is prepared by parent company, according to the December 31, 2009 stock holding ratio, screen in 50 % and above, which have control over the company. Then, on the basis of the information concerning financial control disclosed in financial reporting and internal control evaluation report eliminates those who does not disclose or not clearly disclosed by the company. Finally, some listing corporation financial condition are in the presence of abnormalities, or continuous loss of two years of above, or insolvent, if these companies are taken into the sample, the validity and applicability will be greatly affected. Thus eliminate the PT, ST, \*ST listing corporation. More over leave out companies with data omission or deletion of the index. After screening, a total of 84 listing corporation meet the requirement.

In order to thoroughly evaluate the company's performance, this paper choose 15 indicators reflecting the company profit ability, cash flow ability, operation ability, growth ability and the debt paying ability, respectively.

### 83.2.2 *Hypothesis*

The fundamental purpose of parent company financial management and control is to regulate subsidiary financial operation, to achieve final group benefit maximization. In order to highlight the focus of this paper, put forward the following research hypothesis:

1. The financial data is true and reliable

We suggest that listing Corporation financial report is true and reliable, and its disclosure has been audited; the compilation of financial data strictly abide by the laws and regulations and related financial system requirements.

2. The parent company financial control goal is to realize the group benefit maximization

Financial management and control plays a core role in the group of the whole control system. Its establishment is beneficial to strengthen the group's cash flow and the use of risk prevention, and is conducive to the assets operation, r the cost reduction (Kose 1998).

3. The selection of the financial index is appropriate

This paper selects 15 financial indexes which comprehensively reflecting profitability, operating cash flow ability, operation ability, growth ability and the debt paying ability. It is highly relevant with the company's performance evaluation.

### 83.2.3 Factor Analysis

This paper uses factor analysis method to study the performance of company which going through financial management and control (Beaver 2008). The starting point is to use fewer independent factor variables instead of the original variables, to extract the information. The public factor is expressed as a linear combination of the original variables to get the factor score. And then take the public factor variance contribution rate as weight to calculate integrative factor scores. The model is as the following.

$$F_j = \sum_{i=1}^m w_i Y_{ij} \quad (83.1)$$

$$W_i = \sum_{i=1}^m \lambda_i \quad (83.2)$$

Among them,  $F_j$  is the  $j$  object composite score;  $w_i$  is the public factor weight.

## 83.3 Result

According to the SPSS output of the common factor variance contribution rate and factor score coefficient matrix, the performance from ula for each year can be established by using the factor scores model. Finally we can calculate the general performance for every sample and on every year. In order to make a comparison between different industries, we divide the sample into six categories, mining industry, manufacturing industry, energy and building transportation, wholesale

and retail industry, the real estate industry and other industries. A comparison was made among different industries concerning financial performance, and also a trend analysis on years after conducting financial management and control.

83.3.1 Horizontal Comparison

According to Figs. 83.1, 83.2, 83.3: in 2009, the mining industry performance scores the highest, followed by the wholesale and retail industry and real estate industry. In 2010 mining industry performance still keeps the lead, the only difference is that the general performance of manufacturing industry has greatly improved. The wholesale and retail industry scores the highest. Comprehensive performance shows, to a certain extent, the effectiveness of financial management behavior. It can also be seen in the figures that, in 2009, the

Fig. 83.1 Performance in 2009

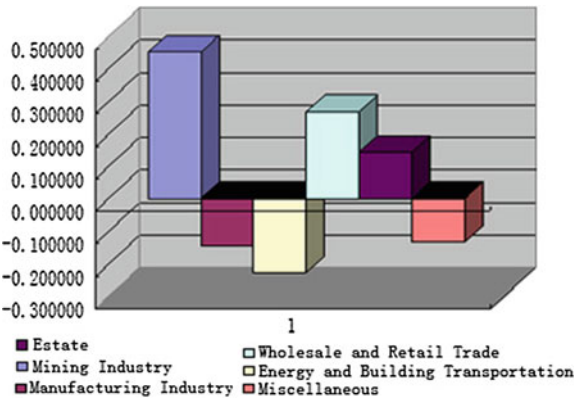
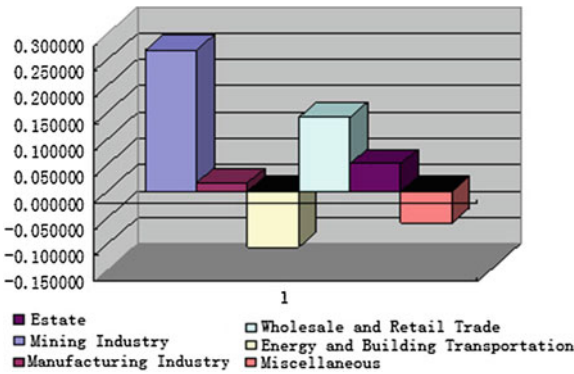
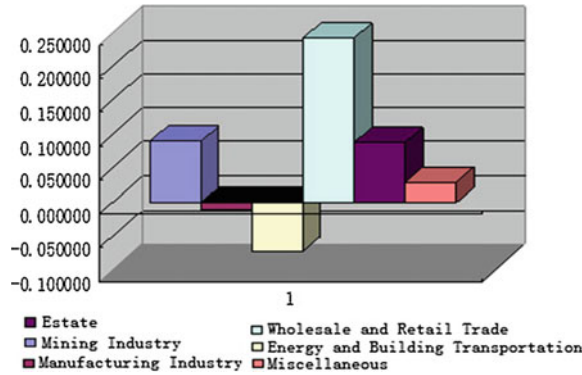


Fig. 83.2 Performance in 2010



**Fig. 83.3** Performances in 2011



performance of manufacturing, energy and building traffic industry is negative. Firms from these sectors should try to find the reasons for the low performance evaluation, taking the industry characteristics into consideration. And also from a financial perspective, strengthen the subsidiary of the financial management and control. Financial control, investment control and financial risk control are all the groundwork for the financial control system. They secure the maximization of group performance, and support the whole group to remain invincible among intense competition.

**83.3.2 Trend Analysis**

In order to understand the annual performance movement of each industry, we divide the group into 6 groups: the mining industry, manufacturing industry, energy and building transportation, wholesale and retail trade and real estate.

1. The mining industry of integrated performance trend is decreasing year by year. In view of the mining industry with its own characteristics, its biggest problem is how to financially integrate and control important information and resources. The parent company needs to reasonably allocate and monitor resources and funds available to subsidiary, ensuring the rational use of resources and assets. The first thing is to improve the utilization of funds and management, clearly track the flow of funds. Second, regular maintenance of the fixed assets and timely recovery of the idle fixed assets can help to enhance the recovery of funds. Finally, the parent company should perfect the financial supervision mechanism to avoid the waste of funds and assets, and to record funds and assets flow, reduce asset loss (Jensen 1993) (Fig. 83.4).
2. Manufacturing performance scores overall is first increased and then decreased. In 2009 and 2011 comprehensive performance scores are negative, whereas, in 2010 it gains a positive but not very high score. China is a manufacturing country, but with the increasingly fierce market competition, manufacturing

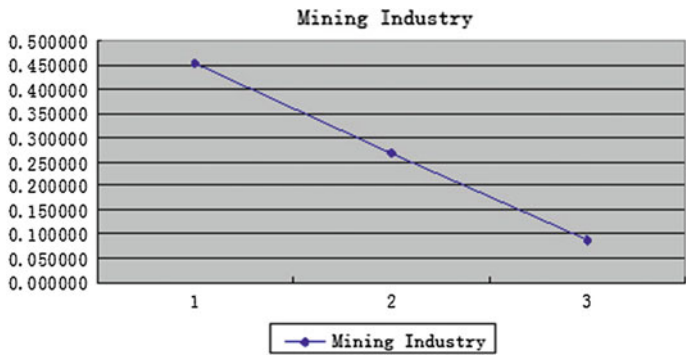


Fig. 83.4 Mining industry performance trend

management environment and the market environment has undergone a series of great changes. All the time since, financial control in terms of cost is the headache for manufacturers. Traditional manufacturing cost control system is limited and inaccurate especially in terms of cost allocation and accounting in the production process. Huge waste drags down the company’s core competitiveness significantly. Regarding the manufacturing industry, intensive cost control mode must be established to cast off this kind of situation. The parent company need to improve the cost control system of execution and supervision, and constantly adjust the cost accounting and allocation mode, having a clear idea of production, supply, sales process costs took place in subsidiary companies (Fig. 83.5).

3. In Energy and building transportation area the annual performance is negative, but the trend was increasing year by year. Financial management structure in most companies is not perfect, and devoid of a comprehensive and effective financial information network (Sandretto 1993). An excellent organizational structure helps to delegate power and keep the control process on a clear, efficient and orderly course. First of all, this group should adopt the mixed financial control mode, directly control subsidiary which makes the greatest

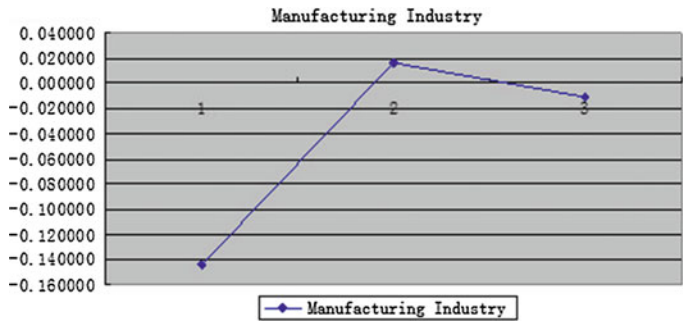


Fig. 83.5 Manufacturing industry performances

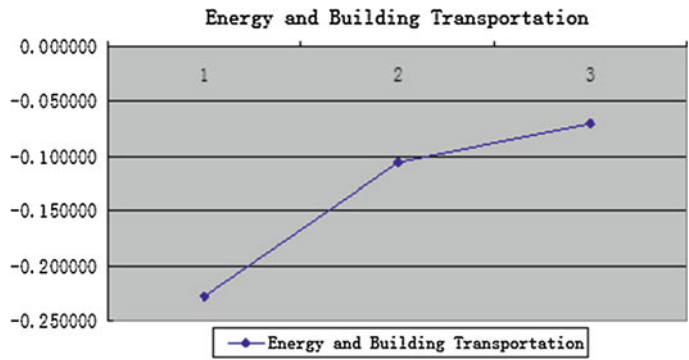


Fig. 83.6 Energy and building industry performance

contribution. Apply a centralized management over funds and resources; avoid weakening the executive power of the subsidiary. Namely, the parent-sub-sidiary company relationship of administrative subordination change for the property management mode. Secondly, financial software should be unified to strengthen the centralized management of financial information, optimize the network environment (Fig. 83.6).

4. Wholesale and retail trade integrated performance scores were decreased and then increased above the 0 level. The form of Wholesale and retail trade in China is fragmented, and came to form at a relatively late time scale. The traditional financial control mode is simple bookkeeping and accounting, lack of management and prediction. Therefore, to the wholesale and retail industry, the key is to improve the financial management control mode, so as to better survival and development. Parent company should strive to introduce high-quality personnel and training, strengthen financial accounting and financial analysis. The financial analysis, especially, should not only attach importance to afterwards analysis, but also the accuracy of analysis, to provide a reliable

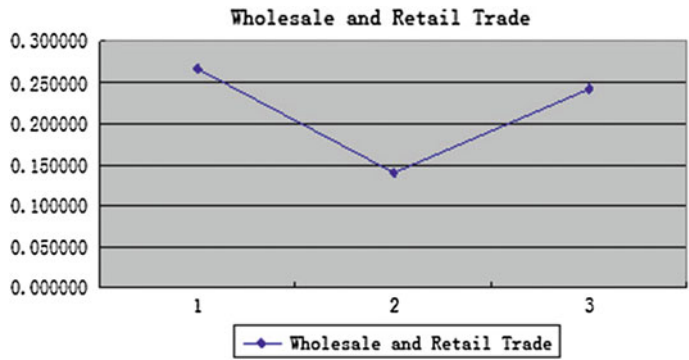
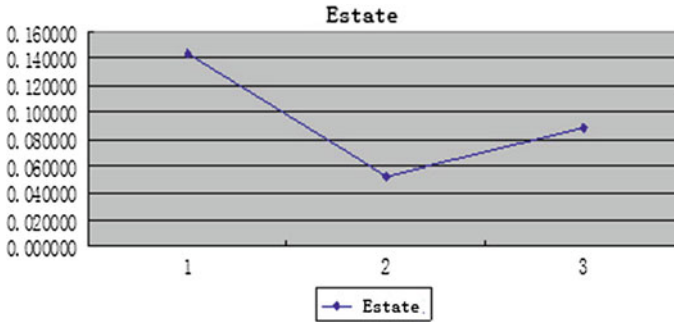


Fig. 83.7 Wholesale and retail industry performance



**Fig. 83.8** Estate industry performance

- data base for the group’s scientific management. Large wholesale and retail group also should improve control over the logistics costs management, as a reasonable cost control contributes to the group profit (Fig. 83.7).
5. Real estate industry comprehensive performance score is also a first down after the increasing tendency. Real estate industry is one of pillar industries of China. The financial control issues are mainly concentrated in three aspect capital, investment and cost. Real estate company is characterized by large investment, long construction period, slow turnover of capital. Therefore, one issue to deal with is the return of capital. Parent company financial management should be strengthened to guarantee the safety and high efficiency of fund circulation. At the same time, the investment arrangement of the subsidiary company should closely monitored and managed. Parent company should pay special attention to company cost, because cost in estate is bigger and relatively more complex, the parent company should perfect the budget control and regulate the cost analysis, by implementing a internal and external audit mechanism (Fig. 83.8).

### 83.4 Conclusion

Enterprise groups play a decisive role in economic development, and to establish a scientific and sound financial management and control system is essential for the group’s survival and development. Good financial control system helps to ensure that the group runs normally, and to gain an invincible position in the increasingly intense international competition.

First of all, the parent company has special property right relation, so its financial control system appears a multi level composite structure. The parent company, referring to the group’s overall strategic, prepares for annual plans and decompose them to affiliates; subsidiaries then establish their annual budget, and reports to the parent company (Levinsohn 2003). The parent company is also responsible for the entire group fund distribution, control, supervision and

assessment. The subsidiary operates financial activities under the monitor of the parent company.

Secondly, according to the empirical data and results can be seen, even though each group company has undergone the implementation of financial control, given the industry's own characteristics and problems, focus are different. Moreover, the financial aspects of the content are different in control modes and means, for different industries, the financial control is not universal. Parent company must combine the life cycle with development strategy, the strategic objectives of the group and the financial control mode to strive to achieve the maximization of group performance (Mcgrath 1997).

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# Chapter 84

## A Research on Innovation and Development of Ethnic Tourism Service Products Based on the Theory of Industrial Engineering: A Case Study in Brocade of Hainan Li Nationality

Xiaohuai Wu, Yan Li, Liwei Zhang and Kunlong Wang

**Abstract** Based on the theory and technology of Industrial Engineering, this paper reviews the history of Industrial Engineering of the western developed countries. It takes the sustainable development for Ethnic Minorities in China Programme-Li Brocade of United Nations Development Programme (UNDP) as the case to search a human-oriented, scientific and proper approach to dig the resources of the ethnic tourism according to the Hainan local economy. Furthermore, the authors analyze the obvious features of Li-Brocade as a tourism resource and discuss the development strategy of the ethnic tourism.

**Keywords** Industrial engineering · Development of tourism resources · Application

### 84.1 Introduction

As an applied interdisciplinary, Industrial Engineering has constructed a relatively complete system including researches, education and profession, related to industry and service, through hundreds of years development in the Western developed countries. It has been over a decade since the concept was introduced into China. During the period, it was adopted by plenty of research institutes, universities and enterprises and brought a certain level of economic efficiency for the Chinese market. Nonetheless, the application of industrial engineering in our country is in its infancy, and is limited in manufacturing field (Jing et al. 2001).

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The tourism service industry has profoundly affected domestic economy, being a significant role in the service industry. Because of that, we devote ourselves to search a proper approach to innovation and development of Chinese tourism service products, studying on the theory and application of Industrial Engineering in the western developed countries.

## 84.2 The Definition and Development of Industrial Engineering

In terms of the definition of Industrial Engineering, the official version from the Institution of Industrial Engineering (IIE) in 1995 is widely accepted and it was revised lately. “Industrial Engineering is concerned with the design, improvement, and installation of integrated system of people, material, information, equipment, and energy. It draws upon specialized knowledge and skills in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design to specify, predict, and evaluate the results to be obtained from such system. (IIE 2010)” It can be seen, Industrial Engineering is an activity combining planning, designing, evaluation and innovation. It is also the center of development and innovation of the travel service products.

Industrial engineering could be traced to the Industrial Revolution (Guo 2004). The real beginning of the Industrial Engineering was Frederick W. Taylor’s (1856–1915) scientific management and Frank B. Gilbreth’s (1868–1924) motion study. American Institute of Industrial Engineers (AIIE) was founded in 1948, and announced the official definition of industrial engineering for the first time in 1955. In the 1950s, Industrial Engineering established a relatively complete discipline system, for which many universities in the United States had set up a department of Industrial Engineering. By the 1970s, there had been more than 100 universities in the United States having the major of Industrial Engineering. The production method-Just in Time (JIT) adopted by Toyota and Total Quality Control (TQC) were the achievement after the concept of Industrial Engineering was introduced and applied in Asia. Since Michael E. Poter proposed Value Chain concept, Industrial Engineering was applied in service, administration, health, and education industries. Industrial Engineering assisted operators successfully pass the transformation between stages of management, by system strategies. It is characterized by systematic and comprehensiveness to pursue overall efficiency of enterprises (Li 2001). The Chairman of the Hong Kong Institute of Industrial Engineers, Mr. Mo Ruhu indicated “the service is also an industry, and has its own process of manufacturing and sales. Therefore, industrial engineering could be used in the service industry” (Qi 1998).

### **84.3 The Application of the Theory of Industrial Engineering into the Sustainable Development of the Tourism Service Products**

There are four main functions of the Industrial Engineering, namely, planning, designing, evaluation and innovation. The problem-solving channels of the industrial engineering are:

1. define the problem, figure out the cause of it
2. analyze the problem, search references, record the status, understand the constraints, and discuss the problem
3. seek solutions to the problem
4. evaluate all the solutions, and choose the best
5. plan an action, and take it
6. assess the effectiveness of the action, and update it

Li-Brocade over 3,000 years, is one of the earliest cotton textiles in China and a unique product in Hainan. Most of it was for women's skirts and other daily necessities. During the period of the Chinese Great Cultural Revolution, Li-Brocade had to be confronted the unprecedented disaster as one of the "four olds" (old ideas, old culture, old customs and old habits) to be eliminated. It was endangered (Hainan Nationality Institute 2006). However, Li-Brocade was listed in the national intangible cultural heritage lists as the first batch in 2006.

Since then, plenty of scholars put forward a proposal to protect Li-Brocade and Li culture or ethnic traditional heritage of arts and crafts from different angles. Zhao (2000), identified certain appropriate measures to preserve national culture of Li or Miao nationality in the actual situation of Hainan Province. Zhao Yihung launched an idea, the importance of innovation in the process of Li-Brocade's heritage and development (Lin 2004). Wang (2008) suggested several approaches to exploit Li-Brocade as for the problems was figured out when he surveyed the teaching stations in Fanmao Village. Su (2009) best illustrated with the case study of Jinkeng Hongyao Rice Terraces Scenic Area of Guilin in Guangxi Province that the strategies to the sustainable development of the national culture hinged on the physical aspect, spiritual aspect and regulation system under the background of tourism. Xiong (2010) investigated the contemporary modalities to which Li-Brocade could be transferred via the design perspective. Zhang (2010) indicated the specific measures and the issues of the Rural Tourism Development in the context of international tourism of Hainan, through the concept of rural tourism.

On 12 December 2011, United Nations Development Programme (UNDP), China International Center for Economic and Technical Exchanges (CICETE), Wuzhishan Municipal Government, Hainan Province signed a project document on Sub-project on Protection and Development of Li-Brocade in Hainan Province under Culture-based development of Ethnic Minorities in China Programme (the Project for short). The project aims to assist the pilot communities to boost Li-Brocade products, because the profit from Li-Brocade could improve the effective

protection, heritage and sustainable development of itself, and vice versa. Wuzhishang municipal government will empower local ethnic communities to implement pilot culture-based development project. We, as the members of the project, visited Fanmao village to conduct the field investigation. The development and innovation of tourism products concern with the adjustment of products' packages with the elapse of time and geographical environment to bring the rational flow of passengers and cargo. While we investigate the Fanmao Village, the hometown of Li-Brocade, the feasible strategies and approaches should be created. Also, we need seek out the best one through the analysis and assessment of them.

Specific strategies and approaches as follows:

### ***84.3.1 Tourism Planning in Fanmao Village Based on the Theory of Industrial Engineering***

1. Overall objective: to build Fanmao Village as “the hometown of Chinese Li-Brocade”. Attracting the potential consumers of Li-Brocade, Li-Brocade will be closer to the market channels and consumer segment to achieve its sales in the atmosphere of Li Nationality cultural tourism.
2. The resources of Fanmao Village tourism: Fanmao Village is located in the west of Wuzhi Mountain area of Hainan Province-Chongshan Town, 500 m away from the downtown. There are 5 natural villages (Fanmao, Fujian, Shifen, Shihao, Fanba) under the jurisdiction of Fanmao Village. The community population is 330 householders with 1,219 people.  
The first cooperative of Li Nationality was established in Fanmao Village in Chongshan Town of Wuzhi Mountain area in 1954. From 1960s to 1970s, becoming a “Pilot Village” brought it the fame. It was visited by many State and Party leaders, such as Zhude, Chen Yonggui, Xu Shiyu. Fanmao Village, known for the “Li-Brocade Village”, has vigorously develop Li-Brocade industry since the reform and opening policy, which has a state-level intangible cultural heritage inheritor of Li-Brocade-Liu Xianglan, two teaching stations of Li Brocade.
3. The idea of the development: To rely on the influence of the national attraction—Wuzhi Mountain and the United Nations’ intangible cultural heritage—Li-Brocade, the local government should exploit more appropriate tourism projects. The earnings from the tourism could be used in the heritage protection to achieve the sustainable development of Li-Brocade and its culture.
4. Developing and positioning: The hometown of Chinese Li Brocade and the culture and travel resort of Li Nationality Village.
5. Functional layout: Under the influence of the resource conditions, functional roles and the new city urbanization, the village is proposed to plan the layout of “one center, two zones, and three districts”. “One center” indicates a service

center of village culture and entertainment; “two zones” present a cultural experience and exhibition zone of Li-Brocade and a travel and leisure zone with native folk houses; “three districts” refers to a comprehensive reception district, a rural tourism district of Li Nationality, and a singing and dancing customs experience district (Table 84.1).

**Table 84.1** Positioning Fanmao village

Layout	Tourism functions	Position
Village service center	Rural area, culture, entertainment, commerce, hygiene	At the former site of Fanmao brigade/in Fanmao village
Cultural experience and exhibition zone of Li Brocade	The culture of Li Brocade, the exhibition and sales of Li Brocade	At the teaching station in Fujin village
Travel and leisure zone with native folk houses	Folk houses, agriculture, the scenery of tropical forest, centennial trees	In Fanba village
<i>Three districts</i>	Comprehensive reception district	In former site of Fanmao brigade/in Fanmao village
	Rural tourism district of Li nationality	In Fujian village
	Singing and dancing customs experience district	At the basketball court in Fujian village

**84.3.2 The Innovation and Development of Tourism Products Based on the Theory of Industrial Engineering**

1. Current situation: Wuzhi Mountain and Fanmao Village are initially able to provide the original products that may be finely processed into commodities, including four broad categories-agricultural by-products, featured delicacies, hand-made crafts, souvenirs.
2. The plan of development
  - The principles of development: to support Fan Mao village to gradually form a diversified tourism product system around the core-Li-Brocade so as to make the village become the veritable “hometown of Li-Brocade”.
  - The goals of development: in accordance with the need of Hainan international tourism, the crafts and souvenirs of Li-Brocade should be extended widely.
  - The measures of development: More specifically, Fanmao Village could adopt the combination style measures to organize the experienced brocade artists, inheritor of Li Brocade and textile experts to study intensively on Li-Brocade. Based on the elaborative study, teaching stations would cultivate weavers’

creative capacity of Li Brocade. Therefore, Li-Brocade may also combine and bring along other products, such as Li-medicine, Li-songs and dances, Li-wedding ceremonies in a same industrial chain. The combination blow style marketing strategy that Li-Brocade is regarded as the main chain to connect the sideline products together has all the products in Fanmao Village developed side by side through mutual cross-fertilization.

- About the development of a series of souvenirs of Li-Brocade, the performance of dance and singing should be videoed and burned in a DVD; the history of Li-Brocade and other cultural books should be edited, those portable and functional souvenirs, such as T-shirts and postcards with Li-Brocade cultural should be produced.

### 3. The plan of marketing

- To consolidate the traditional sales channels. With the potential of market development, the sales of Li-Brocade need adopt multi-channel, multi-network, the various forms of sales in order to establish a sales network and to ensure the entire procedure of the operation smoothly. In particular, the Village should consolidate and develop specialty stores, shopping streets, distinguishing counters and sales points.
- To improve the appearance of the packaging of Li Brocade products. The packaging design of Li-Brocade could either invite bids or alternatively collect in the society. For example, packaging design, brand logo design, propaganda language and corporate culture, etc. may come from both nation and abroad. Moreover, a design competition could be taken into account.
- To take advantage of ethnic festivals to promote. The operators could completely utilize the ethnic festivals (March 3rd in lunar calendar, national games and the Expo) to exhibit, promote, sell and deal with after-sale services of Li-Brocade products.
- To demonstrate the process of knitting Li-Brocade at the scene. The process of knitting Li-Brocade definitely makes it more attractive to the tourists who would like to look over the shoulder of an ethnic weaver making Li-Brocade. It is available to build up an exhibition hall of intangible cultural heritage in the teaching station to help the tourists learn and understand the long history and characteristics of the primitive products. The experience of watching and knitting Li-Brocade for the tourists will be popular and a positive strategy to market products.
- Accompanied by the construction of international tourism in Hainan Province, Li-Brocade will become fully integrated into the economic circle of Sanya tourism and be decorated perfectly and demonstrated to the public over time and space. The marketing of Li-Brocade implement two strategies-“to attract tourists to the village” and “to sell Li-Brocade outside the village” so that it may further contact with consumers and expand its marketing channels to achieve the sales and cultural diffusion of Li-Brocade.

The “to attract tourists to the village” strategy refers to figuring out the highlighted junction of hand-made crafts and Li-Brocade tourism in Fanmao Village and creating a new famous brand of “The hometown of Li-Brocade-Fanmao, China”. It may stimulate the comprehensive development of Li Nationality’s community participatory tourism and form a featured Li Village to strongly attract increasing tourists to visit the village. Thereby, the sales of Li-Brocade would be fulfilled.

The “to sell Li-Brocade outside the village” strategy indicates that tourism development of Fanmao Village and construction of international island tourism are to be compared and analyzed in order to search the bond of them. We should encourage the Li-Brocade to be promoted outside the village by the “Five combination strategies”, taking the place of only selling in the small village. The united Li-Brocade and the construction of international tourism in Hainan Province better the sales of Li-Brocade, and expand the influence of it widely.

### ***84.3.3 To Take Community-Led (Participatory) Mode of Development***

As for the community-based organizations (or associations and cooperatives), we learned that the project area was lack of formal or appropriate community-based organizations or associations or economic cooperatives. There were a few of small-scale organizations such as two Li-Brocade teaching stations and a dancing team of Li Nationality in Fanmao Village, but the majority of the cultural development and the sales activities were organized, promoted and operated by local government (government procurement) and private companies. The ethnic community people is only a product producer (as a labor supplier), not a product owner to participate in the management and supervision of these culture development activities. Concern on the two Li-Brocade teaching stations, currently, they are lack of formal organization and management structure, lack of organization regulations and lack of competent personnel of administrative management, financial management, technical skills and quality control and market development. They are not able to play substantial roles in helping the community people (in particular, women) to manage their culture resources, promote the knowledge and technologies on the livelihood development, obtain the needed information, techniques and fund supports and promote the market development.

Therefore, we suggest that there is an urgent need for the Project to mobilize a working team comprising relevant institutional specialists and participatory action coordinator (NGOs) to conduct the community organizing and development of community of Fanmao Village (including the development of human resource in the organization, financial and business management, culture product technologies and market). To empower community people to undertake ethnic culture (Li-Brocade) development activities and to use and manage their culture resources and

the benefits from these resources are also important in the Project. Through the concrete development of community organizations, the ethnic community people may have their own organizations representing their own interests to develop their culture products, obtain needed technologies, assistance, access to markets, and benefit from the developments.

We also noted that it is essential to deal with the relationship between government, business, and community sophisticatedly to successfully reorganize FanMao village community. It is suggested that we need draw attention to fostering and supporting the community organization and cultivate the village's self-development capabilities. In the meanwhile, the trust and close cooperation between all stakeholders (government, business and community) should be strengthened, and the profits of all stakeholders in the development of Li-Brocade industry are closely linked and affect each other.

An effective platform should be created for cooperation between the three parties as we mentioned above taking advantage of Li-Brocade as the resources of the Intangible Cultural Heritage. Consequently, we will analyze, manage, and integrate the existing cooperation and development modes so that it could be improved. To establish a series of reasonable principles and methods of cooperation and benefits' distribution to ensure the successful protection and development of Li-Brocade, bringing the community organizations maximum benefits.

In addition, it is found out that although Li Nationality is living in Fanmao village for a long time and it still keeps some ethnic customs and practice Li traditions through the historical transition and social changes, they have insufficient ability of community organization, inhabiting an under-developed situation, and they long for the positive supporting and leadership of the external organizations. In the primary stage of the development of the community-based organization, the government and enterprises will support and lead them in terms of the organization, mechanism and capacity-building for three or four years in order to form a legitimate community-based organization and cultivate a larger number of indigenous managers and technicians. At last, the government and enterprises will gradually withdraw from the dominant position of the community organization work after a period of time when they support and help the native people and local community-based organization will takeover the management and operation to gain the greatest advantage in the market directed economy.

Last but not the least, there are no capitals and savings in Li-Brocade production units. To support the initial operations of culture-based community organizations for culture and tourism development, we suggested that a development fund from various source including government funds, private donations and NGOs to be mobilized to support the community organizations for the improvements of management skills, culture production technologies, culture and tourism program design, market development and other capacity building activities. Development fund can be also provided to members of culture-based community organization as a credit to support Li-Brocade production, family-based restaurants and guest houses for village tourism development to ensure the sustainability of the funds. The development funds should be managed by community organization

through the community driven development approach (using the Development Fund Management Handbook prepared by World Bank under the China Poverty Reduction Project as a reference), and should establish a series of fund management principle and method to ensure the fairness and transparency of fund use, make a rolling fund system and benefit to majority community people.

## 84.4 Conclusion

Through the optimization and reorganization of various existing resources to achieve greater efficiency, innovation and development of the products and institutes, the theory of Industrial Engineering is a vital industrial technology with small amount investment or even without investment to improve benefit. It is a proper industrial technology for the conservation-oriented and benefit-oriented society. Based on the theory of Industrial Engineering, the development and innovation of a tourist commodity, Li-Brocade, is a complicated task. On the purpose of innovation and development of ethnic tourism service products, we will continue to have further analysis of specific issues.

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# Chapter 85

## A Study of Performance Evaluation on Facility Management of City Integrated Transport Hub

Gao-feng Luo and Hong Ke

**Abstract** This paper aims to build up an indicator system of performance evaluation on facility management of city integrated transport hub to enhance the facility management level. The facility management of City Integrated Transport Hub only carried out performance evaluation from the financial aspects in the past without fully considering other important factors. Therefore, this research proposes a new performance evaluation system for facility management, which is called *Balanced Scorecard*. Based on the theory of balanced scorecard, this article builds up an indicator system of performance evaluation on facility management of integrated transport hub in four dimensions, which includes customer, finance, internal operations and organizational growth in order to achieve financial and non-financial balanced performance evaluation to complement performance evaluation on facility management.

**Keywords** City integrated transport hub · Facility management · Indicator · Performance evaluation

### 85.1 Introduction

Integrated transport hub is the convergence point of traffic intersection in various modes of transport network and a collective that consists of capital equipment and mobile device which are connected by some transport (Hong and Lu 2001). With the rapid development of economy, the pressure of city transportation is gradually increasing. To ease tensions between urban population and transport, city integrated transport hub is an important choice of modern city public transport and the

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facility management of it grows ever more important. The reasonable system of performance evaluation on facility management of city integrated transport hub is an important mean to discover, solve the problems and improve the facility management level in time. The performance evaluation system of facility management can also provide facilities designer the information of facilities operation and ensure the life cycle of facility management of city integrated transport hub succeed.

With gradually deepening of research on facility management, the research on performance evaluation on facility management also takes rapid development. The importance of performance evaluation on facility management has been fully affirmed. Performance evaluation on facility management focusing solely on financial evaluation before has been widely criticized. Akhlaghi pointed out that performance evaluation on facility management pays more attention to the financial aspect and unit cost, and with little consideration of other important factors in facility management (Akhlaghi 1994). Uniformly, Dilanthi Amaratunga pointed out that from the evaluation model of financial angle could not give assessment to the invisibility and intelligence of facility management, and need the elements such as service of high quality, high skills in facilities management, the satisfaction of customer and other (Amaratunga and Baldry 2000a). As the study on the facility management investigated further, researchers pointed out that we should strengthen the research on non-financial indicator of performance evaluation system. Surrounded with performance evaluation only emphasizes financial evaluation and this evaluation system is lack of full response to organizational strategy, as a multi angle method of performance evaluation system, the Balanced Score Card has been widely studied (Chang 2007).

The Balanced Score Card has made up for the insufficiency of the traditional financial indicator. With this method, the performance evaluation is no longer judging the facility management only from the financial indicators, but through the factor of strategy results and other factors. As a new performance evaluation method, Balanced Score Card includes multi level indicators that have causation. It has been fully used in the application research and recognized widely. For example, Dilanthi Amaratunga, Richard Haigh and other scholars presented With the Balanced Score Card, the facility management of British public health have established the key factors and evaluation methods from the angle of customer, financial, internal business processes, organizational learning and growth and the management level have been raised (Shiqiang and Jingbo 2007; Kulatunga et al. 2007). In addition, Amaratunga and Baldry have also researched on performance evaluation on facility management in the field of higher education with it (Amaratunga et al. 2002). Through investigation discovery from lots of case, Alberto Felice De Toni and many other scholars find that Balanced Score Card which has been used as a performance evaluation method gets 69 % of the total sample size in the different industries, this signs that Balanced Score Card has become an important method of performance evaluation on facility management (De Toni et al. 2004).

In summary, Balanced Score Card did not only make up for traditional performance evaluation methods of facility management, but also get application in different areas widely. It is necessary to introduce this method into the performance evaluation on facility management of city integrated transport hub to compensate for the weakness of financial evaluation on facility management of city integrated transport hub.

## **85.2 The Analysis of Balanced of Facility Management of City Integrated Transport Hub**

City integrated hub project has the characteristics of public goods. Based on this project properties which decide that project have to serve the public, it is necessary to consider the public demand and the economic target. We can say that the city integrated hub operation management is a multidimensional goal management activities. It makes the facility management with more complexity. The value of hub management not only makes the best economic benefit but also provides high quality service for passengers though effective facilities management.

Therefore, we need to consider the balance of various interrelated goals, and this provide Balanced Score Card an operate space in performance evaluation to facility management of city integrated transport hub. This balance comprises operation management and strategic objectives to facilities management, the balance of financial goals and non-financial goals of hub operation organization as well as the value balance among stakeholder groups.

### ***85.2.1 The Balance Between Operation Management and Strategic Objectives***

At present, the domestic large-scale infrastructure management is carried out mainly from the simple perspective of property management and lacks of understanding the completeness of facilities management. It also leads to simply consider the safety operation of the facilities, operation cost of work in the facilities management process and ignore the influence of facilities management to the hub operation strategy and the strategic target of project. Therefore, performance evaluation on facility management of city integrated transport hub should evaluate from the operation of the facility and facility level strategic level.

### ***85.2.2 The Balance Between Financial Goal and Non-Financial Goal***

Because of the project properties of city integrated transport hub, the purpose of hub facility management isn't only to optimize operation cost, but also to increase infrastructure service effectiveness and efficiency. Therefore, in the process of performance evaluation to facility management of city integrated transport hub, we should not only pay attention to the hub facility technical level and operation cost, at the same time also should pay close attention to the ultimate operation effect of city integrated hub facility and to achieve the balance between financial goal and non financial target.

### ***85.2.3 The Balance of Demand of Stakeholder Groups***

The organization of city integrated transport hub relates to various social man—a group with economic benefits and interacted and effected multiple relationship (Fan 2002). Around the related interest groups, the operation of city integrated transport hub relates multiple core stakeholders, including government departments, hub operation, facilities, as well as hub user (passenger, shopping and leisure visitors). The performance evaluation should have respect to the balance of interests of stakeholder groups.

## **85.3 The Construction Principle to the Indicator of Performance Evaluation**

### ***85.3.1 The Measurement of Indicators***

The center principle of performance evaluation on facility management from the angle of organizational strategy is to make the indicators, whether the financial or non-financial indicator measurable (Brackertz and Kenley 2002). Especially for the non-financial indicators, the majority of qualitative indicators should be easily measured.

### ***85.3.2 The Comprehensiveness of Indicators***

Although it already recognized that the performance evaluation on facility management needs a lot of work to do, they often ignore some important elements in

the evaluation (Amaratunga and Baldry 2000b). Therefore, the indicator system should be as complete, comprehensive as possible to response the whole content of performance evaluation on facility management of city integrated transport hub; On the other hand should grasp the key factors and outstand the key, but not exhaustive. According to the facility management characteristic and the existing key issues of indicator of city integrated transport hub to set indicator.

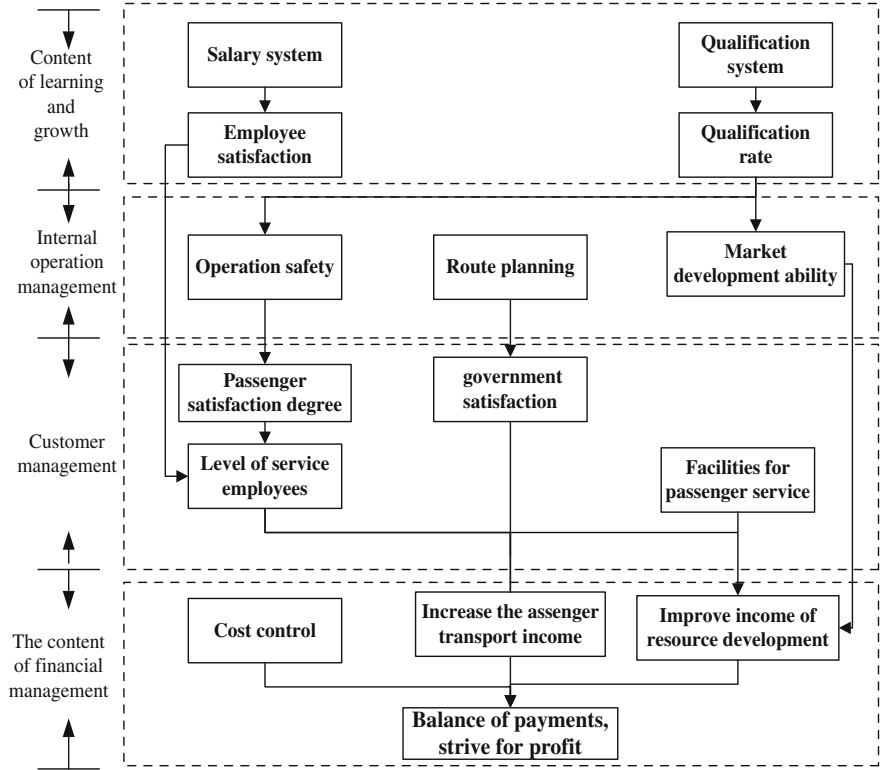
### ***85.3.3 The Correlation of Indicators***

In order to obtain greater efficiency, we need to clearly link the facilities management process with environment, organizational structure and strategic intentions of the organizational, and make performance evaluation on facility management from the perspective of strategic and operation management (Then 1999). Comprehensive evaluation indicator system can fully reflect the various factors of performance, but the indicator system should be excluded from the indicator correlation and eliminate setting duplicate indicator that causes evaluation distortion and appears unreasonable phenomenon. There should not be too much information and make the indicator covers inclusive, but completely independent indicator cannot constitute an organic whole, therefore indicators should have logic relation.

## **85.4 The Indicator System of Performance Evaluation on Facility Management**

The design of Performance indicators must linked clearly with strategic goal and it is possible to avoid the inconsistent between internal control system and strategic target (Zisong et al. 2006). The main function of facility management is to carry on resource management in the level of strategic and support operational, it mainly includes four aspects: the management of financial resources, material resources management, human resources management, information and knowledge resources management. Therefore, as a strategic measure system, Balanced Score Card can select performance indicators from financial, customer, internal operation management, learning and growth four dimensions, these indicators are derived from the corporate vision and strategy, and the change of strategic objectives is root of performance indicator. The facility management strategy and operation support interface of city traffic hub are shown in Fig. 85.1.

We should carry out performance evaluation on facility management of city integrated transport hub from the perspective of strategic management and operation management. The indicator design of performance evaluation should be based on the facility management strategy and operation support interface of city



**Fig. 85.1** Support interface of the management strategy and operation to city integrated transport hub

integrated transport hub, based on four perspectives of Balanced Score Card to meet the demand of facility management strategy of city integrated transport hub.

**85.4.1 The Indicators of Finance**

Based on ensuring city integrated transport hub core function, the establishment of business development facilities of city integrated transport hub is for the purpose of value added, to promote the whole project value. In the business development facilities of city integrated transport hub we need to consider the business interest to meet the demand of commercial profit, added value of facilities of business development and operation management agents. At the same time, the construction of city integrated transport hub site could bring a large number of passengers, and could develop a variety of derivative resources, this not only can satisfy the demands of passenger, but also can dig greater profit space (Fang and Yilin 2008). The facilities of commercial hub development can be the carrier of this process.

However, it should be noted that, in order to avoid a single financial indicator generated by misleading information, it must achieve balance between financial goals and non-financial goals.

### ***85.4.2 The Indicators of Customer***

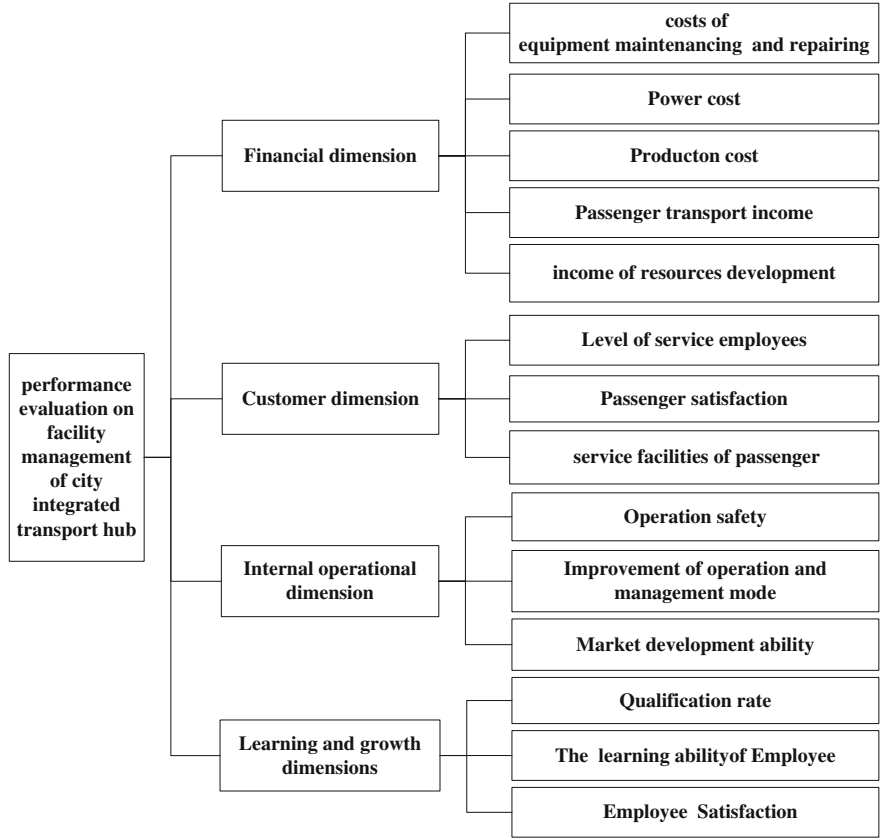
City integrated transport hub belongs to the public service facilities, in addition to be able to maximize the interests of the stakeholders, realize the value the hub, it should also be able to maximize the overall function of comprehensive transportation terminal equipment, to realize public interests, customer dimension indicator of facility management of city integrated transport hub reflects the hub facility service functions and the degree that meets the needs of users, client dimension indicator of facility management of city integrated transport hub includes the passenger satisfaction, employees' service level and service facilities of passenger and so on.

### ***85.4.3 The Indicators of Internal Operation***

Based on clear facility management system interface, City integrated transport hub need add the requirements of service, culture and other auxiliary functions of integrated transport hub together to determine the object of the operation and management and other specific contents of management (Shaoyan and Yilin 2010). The internal operation management of city integrated transport hub includes safety management system, which is the safeguard level of internal operation management mechanism. Internal operation management must carry on centralized monitoring control and management in the hub operation process in order to ensure user's safety. Conclusions as a result, the core indicators of internal operation dimension include the complexity of the operation management mode, operational safety and the development ability of market.

### ***85.4.4 The Indicators of Learning and Growth***

The indicators of learning and growth reflect the demand of improving the level of facilities management of city integrated transport hub, and the framework of a long term of promoting the facilities management level of city integrated transport hub. With such support of salary and qualification system, the indicators of learning and growth fully mobilize the enthusiasm of the staffs, encourage employees to master the required skills and abilities of facilities management of city integrated transport hub. This thus links the employee behavior with objectives of hub facility



**Fig. 85.2** The indicator system of performance evaluation to facility management of city integrated transport hub

management, organization strategy effectively. Conclusions as a result, the indicators of learning and growth mainly include qualification rate, employee satisfaction and the learning ability of employee.

The indicator system of performance evaluation on facility management of city integrated transport hub is shown in Fig. 85.2.

**85.5 Conclusions**

City integrated transport hub belongs to the public service facilities, performance evaluation system to facility management of integrated transport hub for facility management department is an important means of timely detection of problems, solving the problem and improving the level of facility management. In view of the

previous performance evaluation of the facility management focusing on the research of financial indicator only, based on the method of Balanced Score Card, the paper realizes the balance of financial and non-financial indicators on facility management of city integrated transport hub. Therefore, this study analyses the balanced demand to performance evaluation on facility management of city integrated transport hub and combines with the four perspectives of Balanced Score Card to construct performance evaluation system on facility management of city integrated transport hub on the basis of the construction principle.

Facility management of city integrated transport hub should not only consider its economic aim but also serve the social public, and consider the public demand. Therefore, the paper should research on the performance evaluation to facility management of city integrated transport hub with the help of the balanced score card, its purpose is to complement and optimize the performance evaluation to facility management of transport hub. Through the research, the paper makes up for the insufficient of performance evaluation to financial indicator of integrated transport hub as far as possible.

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# Chapter 86

## An Empirical Study on Consumer Satisfaction with Community Commerce: Taking Hangzhou as an Example

Biao Nie, Xu-feng Shu and Jia-jia Zuo

**Abstract** With the acceleration of urbanization, the community commerce has increasingly become a new growth point in the development of urban commerce. This essay presents an evaluation system for the satisfaction with community commerce, and analyzes the factors influencing the satisfaction with community commerce in Hangzhou by Structural Equation Model (SEM) and SPSS. It reckons that systematic planning, introduction of brand stores, enforcement of management, and professional training for improvement of store owners and staffs' qualities are important tools to boost the development of community commerce and raise the satisfaction with community commerce.

**Keywords** Community commerce • Community commerce satisfaction • Consumer satisfaction • Structural equation model

### 86.1 Introduction

With the development of urbanization and economy, community building has attracted more and more people's attention as a new form of commerce. Many domestic and foreign scholars have done a lot of theoretical researches on the definition, development model, distribution condition of Urban Community Commerce which has indicated direction on the path for our country's community commercial development (Fornell 1992; Oliver 1999; Changhong and Chi 2002).

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But the author thinks that the existing research results mainly concentrated on the theoretical study, discussions on community commercial degree of satisfaction through empirical study is obviously insufficient.

This paper starts from Community Commerce Satisfaction degree, firstly constructing a research model. According to the survey data, it analyzes community commerce satisfaction evaluation and its influential factors, then puts forward a reasonable of optimization community commerce and, countermeasures to improve the satisfaction of the appropriate, which is good for government departments to develop appropriate policies, to guide the healthy development of community commerce as well as provide a platform for testing theoretical results. To some extent, it may promote the development of theoretical research.

## 86.2 Theories Review

### 86.2.1 *Community Commerce and Consumer Satisfaction*

Community Commerce is a territorial type of commerce, which is built in the community as a carrier, serving the residents within the community, with convenience and benefits for residents by, meeting and promoting residents composite for the target, and providing everyday material and spiritual needs of goods and services for community residents (Banai 1998).

According to the traditional psychological theory, the core elements of the satisfaction include expectations, performance, and the need to be met. In the economic area, there is the famous American consumer satisfaction index (ACSB) model, that is, satisfaction emphasizes the relationship between expectations and results.

Consumer satisfaction is the feeling state of consumer performance and expectations to meet their needs with a product comparison (Oliver 1999). The core thesis of the consumer satisfaction concept lies in the assumption of a close dependence between consumer satisfaction and consumer loyalty (Stauss and Neuhaus 1997). Fomell (1992) thought consumer satisfaction was the overall assessment of the consumer experience on all purchases of the products or services. It is not only a process, but also a feeling, the pleasant or unpleasant perception on consumption and the results according to certain criteria (Oliver 1999). Kotler (1996) defined consumer satisfaction as the quality of experience in consumer acceptance of products or services expected to do a comparison of disappointment or unpleasant feelings, such feelings to decide whether they continue to buy your product or service. The key to keeping consumers is consumer satisfaction (Kotler 1996).

As to the understanding of consumer satisfaction based on the current researches, the paper generally summarize consumer satisfaction as two major points of view: (1) consumer satisfaction is the consumer evaluation of a particular

transaction process due to product performance or service; (2) another view argues that consumer satisfaction is the cumulative experience of the consumer buying process, it is an evaluation of multiple transactions, and concerned about overall consumer satisfaction.

### ***86.2.2 Consumer Satisfaction Model***

Based on the understanding of the concept of consumer satisfaction, scholars have launched a wide range of consumer satisfaction model. Sweden is the first to establish their satisfaction index model—Sweden Consumer Satisfaction Barometer (SCSB) (Fornell 1992). There exists the functional relation in model: Consumer Satisfaction =  $f$  (consumer expectations, perceived value), and consumer expectation is what the quality of products or services the consumer is expected to be (Changhong and Chi 2002). Perceived value is the quality of goods or services compared to its price, positioning in the minds of consumers perception. After adjusts repeatedly the expected value can reflect the present quality quite accurately, thus it has the forward function to the sensation value. The American Consumer Satisfaction Index Model is based on the SCSB model add a preceding factors—Perceived quality, separate the quality perception from the value perception, that consumer satisfaction is jointly decided by the consumer expectations of service quality, perception of quality and value perception (Fornell et al. 1996).

The ACSI model is the design of the overall assessment of the customization, reliability and quality of the three observed variables to measure the perceived quality. Customization is the extent of the enterprises to provide products or services to meet the needs of consumers. Reliability refers to that the degree of the company's products or services are reliable and not defective. Perceived quality is focused on the evaluation of the quality factor, while the perceived value emphasis on evaluation to the price factor. Then it is clearer that consumer satisfaction is the cause of the quality winning or cost lead. Chinese Consumer Satisfaction Index (CCSI) is a quality evaluation method in the study model based on ACSI, according to China's national conditions, the necessary transformation of the model structure and the evaluation index system set up with Chinese characteristics (Yu 2003).

Although Czepiel and Rosenberg agreed that consumer satisfaction could be seen as a holistic concept, they believe that consumer satisfaction is an overall subjective recognition of consumers that is based on the understanding of different factors to the products. This actually has already acknowledged satisfaction is multidimensional, and must be measured by multiple items. Barsky and Labagh made a survey on the staff attitude, location, housing, price, equipment, reception services, parking, food and beverage of stores. Cen Chengde measured consumer satisfaction from four aspects: the satisfaction to the consumer experience, the satisfaction to the service, whether the decision is wise or not, whether the decision is right or not.

### 86.2.3 Store Image

Martineau first introduced the concept of the image to store research areas, and defined “store personality or image” as the method that consumers know about it in mind. Part of it is affected by the factor of function, and part is affected by factors of emotion. When store image is as good as possible, the consumer is more likely to choose that store. In other words, the store image is from the consumer perspective, what reflects is the consumers’ perception of store. James defined store image as “Consumers to assess their view that the combination of the attitude of important store attributes”, this view, image and attitudes are linked. If the objective image of the store would turn into the subjective image need such a process in the consumers’ mind: image—cognitive—attitude.

Through existing researches of the theory, the author found that store image contains two kinds of properties including the (objective) functional attributes and emotional (subjective). The former may include store location, size, commodity and price of property, while the latter may include the store decoration, service, employees’ friendly attribute.

## 86.3 Model Assumptions

Chili-Honchang and Chia-Yu Tu split store image into four operational dimensions: Facilities, services and activities in shops, and convenience. And their empirical research conducted in Taiwan has proved the store image is positively related to consumer satisfaction. Based on the understanding of researches above, the author proposes the following assumptions:

- H1 Store image is positively correlated to expected quality
- H2 Store image is positively correlated to perceived quality
- H3 Store image is positively correlated to perceived value
- H4 Store image is positively correlated to consumer satisfaction

Expected quality refers to what quality products or services consumers expect to get. Oliver (1999) believes that the expectations have a positive impact on consumer satisfaction. Now the paper puts forward the following hypotheses:

- H5 Expected quality is positively correlated to perceived quality
- H6 Expected quality is positively correlated to perceived value
- H7 Expected quality is positively correlated to consumer satisfaction

Perceived quality means the experience or feelings of consumption of its consumers by using the product or service. Now the paper puts forward the following hypotheses:

- H8 Perceived quality is positively correlated to perceived value
- H9 Perceived quality is positively correlated to consumer satisfaction

Perceptive value is a perception positioning in the mind of the consumer about the quality of the goods or services compared with overdue price. Li Dongjin points out that consumer satisfaction is not only affected by the expect value of the consumers during shopping, but also affected by the impact of perceived value in the actual use of the consumption process. The degree of perceived value has a direct effect on consumer satisfaction. Therefore the paper puts forward the following hypotheses:

- H10 Perceived value is positively correlated to consumer satisfaction

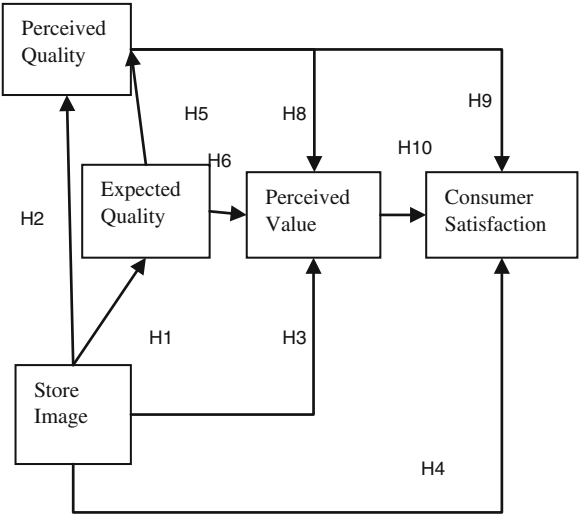
As a result, we get the satisfaction of the community commerce conceptual model shown in Fig. 86.1.

86.4 Research Methods

86.4.1 Indicator Selection and Questionnaire Design

The structure variables, in Fig. 86.1 are called latent variables which cannot be measured directly. They need to select some of the measurable variable (or observed variables) to reflect. Based on the requirements of the connotation of the variable structure model, combining the characteristics of the commerce community, reference relevant literatures and SERVQUAL scale, the text selects 17

Fig. 86.1 Community commerce satisfaction model



variables. According to the SERVQUAL scale, and the characteristics of the commerce community, we will expand the observed variables as questions of the questionnaire, satisfaction measurement questionnaire using Likert’s attitude scale, the indicators “very satisfied, satisfied, in general, satisfied, very dissatisfied” were given “5,4,3,2,1” value.

Using stratified random sampling method, we chose five classes of community in Hangzhou. As to the community residents on the site of the one-to-one questionnaire survey, the questionnaires were taken back on the spot. 250 distributed questionnaires are divided by 5 with 50 in—each class, and 217 questionnaires were returned, with the effective rate as 86.8 %.

86.4.2 Reliability and Validity Analysis

The Cronbach alpha coefficient, as a measurement to test the reliability in this study, the bigger the Cronbach alpha, the higher reliability the questionnaire is. If Cronbach  $\alpha > 0.4$ , the paper thinks the questionnaire is credible. The results from the measurements in Table 86.1, the seven indicators factor consistency reliability alpha coefficients were above 0.5. The high description of the measurement consistency, and good internal structure, achieve the requirements of the study.

We adopt a common degree (Extraction) to test the impact of each evaluation indicators on consumer evaluation results. If common degree is greater than 0.4, the common factor can be a good explanation of the evaluation index. The communality of this study is greater than 0.5, which shows that the extraction of ingredients is a good description of these variables.

We adopt KMO inspection, if KMO values are above 0.9, it is very suitable for factor analysis, a KMO suitable values between 0.8 and 0.9 and appropriate when 0.7–0.8. If Bartlett sphere test  $p < 0.01$ , the validity is acceptable. The KMO value is 0.908, Bartlett inspection of value is 0.000  $p < 0.01$ , suitable for factor analysis.

The author used SPSS for factor analysis, biggest variance orthogonal rotation method used in the analysis, and successfully extracted seven factors. In order to obtain theoretically significant factor structure, in this paper, the following three criteria were filtered as appropriate measure of variables: (1) Load minimum of a variable on a factor is 0.4; (2) The cross-load between variables and other variables is low; (3) A variable to measure the connotation of the same factors must be

Table 86.1 Cronbach a coefficient table

Latent variable	Cronbach’s $\alpha$	Item number
Store image	0.813	4
Expected quality	0.726	2
Perceived quality	0.767	6
Perceived value	0.781	2
Consumer satisfaction	0.873	3

consistent with the connotation of other variables. Variables to meet the above three criteria in one or more can be retained. Exploratory factor analysis results showed that the load coefficient of various factors are greater than 0.7. That is to say Scale structural validity is good. The validity of model represents the overall validity of the scale. The validity is: CMIN/DF = 1.810, GFI = 0.619, AGFI = 0.587, RMSEA = 0.077, PGFI = 0.571, CFI = 0.680, TLI = 0.666. The indicators are in line with the standard which means questionnaire has a good overall construct validity.

86.4.3 Model Analysis and Model Effects Analysis

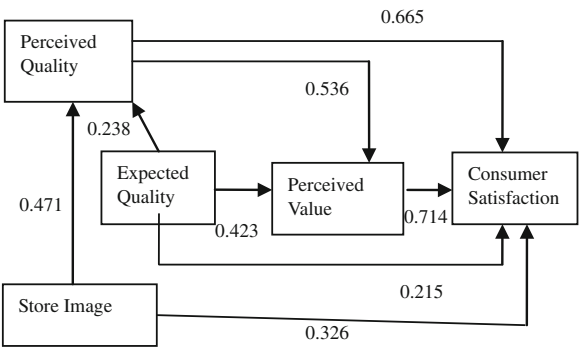
We adopt AMOS7.0 structure model for calculating. The results show that H1 and H3 didn't pass the Significance Testing. If we remove paths H1 and H3, and repeat Iterative calculation, the model-fitting degree didn't change much, however, path coefficient all through the significant test.

In order to study the rationality of parameter estimation value, the appropriateness of measurement model, Chi square test ( $P = 0.208$ ) which means insignificant. The ratio of the Chi square with degrees of freedom is less than 2. Besides, the value of CFI, NFI, IFI are all close to 1, RMSEA < 0.02. Above indexes meet the model test and goodness-of-fit requirements that means model fitting effect is very good. Get structure equation model path coefficient graph, as shown in Fig. 86.2.

The conclusions from Table 86.2 as shows: Firstly, the change of store image has a big impact on consumers' perceived quality, perceived value and consumer satisfaction. Store image enhancement can have direct and positive effect on user perceived quality, while the main indirectly impact on consumer satisfaction;

Secondly, the direct impact of perceived quality on consumer satisfaction is relatively larger than indirect impact of perceived value. Through direct and indirect role in the perceived quality, perceived quality has a significant effect on consumer satisfaction.

Fig. 86.2 SEM path graph



**Table 86.2** Table of different effects on the residents' satisfaction

Path	Direct effects	Indirect effects	Total effects
Store image → Perceived quality	0.471	0	0.471
Store image → Perceived value	0	0.252	0.252
Store image → Consumer satisfaction	0.326	0.493	0.819
Expected quality → Perceived quality	0.238	0	0.318
Expected quality → Perceived value	0.423	0.128	0.551
Expected quality → Consumer satisfaction	0.215	0.551	0.766
Perceived quality → Perceived value	0.536	0	0.536
Perceived quality → Consumer satisfaction	0.665	0.383	1.048
Perceived value → Consumer satisfaction	0.714	0	0.714

At last, perceived value directly influences consumer satisfaction, perceived quality and expected quality have, in some degree, indirect impact on consumer satisfaction.

## 86.5 Suggestions and Study Limitations

In this study, based on the understanding of the relationship between store image, expected quality, perceived quality, perceived value and consumer satisfaction, the authors try to analyze community commerce satisfaction on quantitative research by SEM. Selecting specific measurable indicators, using the residents of community in Hangzhou city as a sample, and taking an empirical analysis on the model provide a theoretical basis for community commerce.

### 86.5.1 Suggestions

There is still a certain gap to meet the needs of community residents.

First of all, scientific and reasonable planning and adjusting community commercial network setting and structure is the premise and foundation to enhance the satisfaction of residents in community. The planning of community commerce should put the convenience for people in the first place. In addition to setting convenience stores and fast-food restaurants for daily life, in the planning of community commerce, we should also to speed up the development of service networks such as community medicine, health care, maintenance, agent service and other services. Truly convenient consumer into the community, convenience services into the home. The construction of community commerce depends on the collaboration of local government, developers, operators, etc (Bloemer and De Ruyter 1998). Government departments and developers should cooperate with each other. Focus on providing daily life facilities such as supermarket, food market, breakfast etc. And there are also recreational entertainment and cultural

center, hospitals and other new features. Make sure that the community commerce meets the basic requirements of preliminary residents.

Secondly, try to introduce domestic and foreign brand stores such as supermarkets, restaurants, intermediaries, community health services and other basic services. What's more, they should cooperate with related departments, strengthen community commerce and services shop management, and enhance the awareness of residents on the community management. Table 86.2 shows that store image have a great impact on consumer satisfaction, therefore improve store image is good for consumer satisfaction. Create a good store image to customers can reduce cost and risk, and improve the interests of psychology. Retailers can reach purchase purpose by providing quality service, good atmosphere, excellent products, reasonable prices and convenient supporting facilities, etc., build the relationship and a sense of belonging (Xiaobo and Guizhi 2009). Hypermarkets should be committed to the establishment of its characteristics, in order to attract the attention of consumers, have a good impression, and thus the formation of the next purchase decision-making reference.

What's more, they should cooperate with related departments, strengthen community commerce and services shop management, and enhance the awareness of residents on the community management. Strengthen the training and education on all kinds of shop owner, improving overall quality of employers and employees.

### ***86.5.2 Study Limitations***

For various conditions of this study, there are still some limitations. First, Empirical study needs to advance from static to dynamic. The demand of consumers is constantly changing and, the definitions of consumer satisfaction, perceived quality etc., are still changing, so researchers need to verify the model in a dynamic way.

What's more, consumer trust and consumer satisfaction are inseparable, but in this paper, the author didn't take it into consideration. Researchers should confirm the role of consumer trust in the model for the further study. In a word, this paper is part of the study on consumer satisfaction model, there are a lot of tasks needed to be further carried out.

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# Chapter 87

## Analysis on Core Antecedents of Customers' Purchasing Attitude of Products with After-Sales Service

Bei Zhao and He-lin Wei

**Abstract** The importance of after-sales service is becoming more and more crucial over time, as the service concept is increasingly catching the attention of consumers. This paper tried to figure out the core antecedents affecting customers when they purchased products with after-sales service. After analyzing customers' opinions of such products, we got four main affecting factors through exploratory factor analysis and confirmatory factor analysis.

**Keywords** After-sales service marketing · After-sales service product · Purchasing attitude · Perceived risk

### 87.1 Introduction

After-sales service (ASS) refers to the service offered after sales of products. It could be considered as a promotion method from the sales point of view. To be more specific, ASS includes product instruction, delivery, installation, tuning, repair, training, and door to door service offered by manufacturers or retailers after products are purchased by customers.

Paul considered that good ASS could bring some advantages, such as: profit, company growth, customer loyalty, and product differentiation (Herbig and Palumbo 1993). In addition, Parsuraman (1998) believed that keeping customers was a more valuable advantage of ASS (Parasuraman 1998). Goffin (1999, 2000 and 2001) thought that competitive advantage, creating customer satisfaction and

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loyalty, as well as developing new products were all ASS advantages and also the reason which keep companies to provide ASS (Goffin 1999, 2000; Goffin and New 2001; Goffin et al. 2001).

Good ASS provides the following functions: obtaining competitive advantages, differing product and service, customer satisfaction, customer retention, building B2P relationship, increasing customer loyalty, be conducive to new product development, and increasing profit.

As the awareness of customer right is increasing and the style of shopping is changing, people are more interested in the ASS than in the product itself when choosing products with similar function and performance under today's intense competition. Therefore, selling good ASS is a new competitive point for today's enterprises.

When marketing and service marketing are increasingly catching attention (Parasuraman et al. 1985), there are a lot of studies regarding service before and within the sales but not after. According to Noel's study (2001), sellers who were offering ASS would gain 44–77 % more gross margin than those did not (Noel 2001). On the other hand, as noted by Keefe (2003) "customers would feel safe and peaceful when they had the right to choose and possess repair guarantee or maintenance guarantee" (Keefe 2003). In addition, customers will be affected by their perception of ASS on the next purchase of the same product. That is why ASS is worthy of attention.

How can sellers predict the outcome of their investment in ASS? To figure that out, the following questions are put forward:

What factors affect customers' attitude of purchasing products with ASS?

How are these affecting factors related to each other?

How do these factors affect customers' purchasing attitude?

## 87.2 Methodology

First, there was no literature specializing in researching ASS factors which would affect customers' purchasing attitude. Therefore, the research used questionnaires to investigate the affecting factors supported by relevant literature review and interview. Then the main affecting factors were summarized by conducting principle component factorial analysis on the outcome of the questionnaire interview with SPSS18.0. Lastly, AMOS19.0 was used to analyze the model and to look into how consumers' purchasing attitude was affected by each factor.

### 87.2.1 Questionnaire Design

Designed questions were mainly coming from literature review; to be more specific, the literature review was meant to identify the main contents of after sales

service. We inferred the main content from the relevant ASS principles and literature of after-sales service. Goffin (1999) believed that there were 7 ASS activities, namely, installation, training, documentation, maintaining, repairing, online support, repair guarantee, and upgrade (Parasuraman 1998). On the other hand, Timothy thought ASS includes 6 activities: upgrade, training, daily maintaining, emergency maintaining, accessory supply, and software service (Wilson et al. 1999). Summing up, ASS from service provider has three aspects: service related to factory, service related to retailer, and product's self value added service. After identifying these service contents, this study researched the causes of customers' purchasing willingness and unwillingness by using the service marketing 7p principle from the customers' point of view.

The questionnaire items which were adopted from LK 5 levels scale were designed on the base of customers approval degree Most agree scores 5, while most disagree scores 1.

### ***87.2.2 Statistical Analysis***

In the statistical analysis, the principal component factor analysis of SPSS18.0 was used for exploratory factor analysis and the structural equation modeling (SEM) of AMOS19.0 was used in a confirmatory factor analysis and model adjustment. The principal component factor analysis was used to extract influence factors, which were then named. SEM was used to test and debug the influence factors model, and also to test the relationship between the factors and the influence of each factor to purchasing attitude.

## **87.3 Results**

### ***87.3.1 Influence Factors of Consumers' Purchasing Attitude Toward After-Sales Service Products***

430 questionnaires were distributed among the population samples randomly in a 1 month period. After several attempts, 404 questionnaires were collected and 366 of them were effective. The effective rate was 91 %.

Through the SPSS analysis, the KMO value was found to be 0.75, which was suitable for factor analysis. After selecting loadings greater than 0.5 of the observed variables principal component factors, Table 87.1 was constructed.

We can see from Table 87.1 that four main factors were extracted from the observed variables of the questionnaires. According to the main factors description of the observable variables, these four factors were named as perceived value, perceived risk, after-sales experience and marketing methods.

**Table 87.1** Rotated component matrix<sup>a</sup>

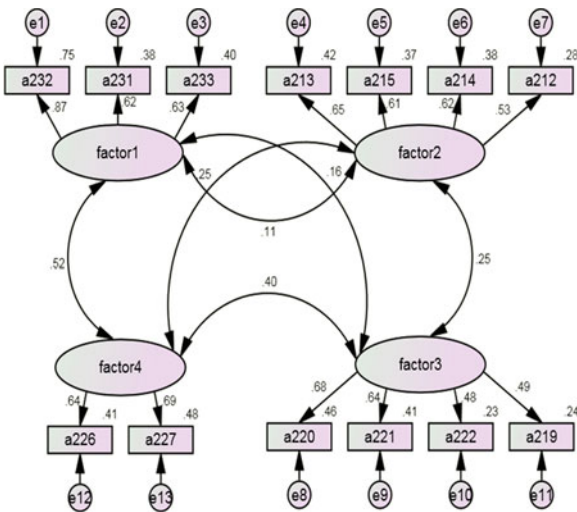
	Component			
	Factor 1	Factor 2	Factor 3	Factor 4
a232: Reflect businesses quality assurance	0.810			
a231: Bring security	0.770			
a233: Reflect businessman credit strength	0.721			
a213: Think after-sales service cost is high		0.737		
a215: Think after-sales service attitude is poor		0.736		
a214: Think after-sales service technology is poor		0.699		
a212: Think that use process trivial		0.692		
a220: Ever used a product warranty or beauty decoration service			0.806	
a221: Ever used a product extra preferential or value-added services			0.739	
a222: Once participated in club activities of the seller			0.619	
a219: Ever used a return or exchange or claim service			0.567	
a226: Ever decided to purchase that is because of the cheap use price				0.834
a227: Ever decided to purchase that is because of the personal selling				0.761

<sup>a</sup> Rotation converged in 5 iterations

87.3.2 Model Verification

According to the results of factor analysis, the four main factors were tested by AMOS19.0 and SEM was used to conduct CFA (Fig. 87.1).

**Fig. 87.1** Confirmatory factor analysis



Some results were indicated in the CFA: Chi square/df was 2.474; GFI, AGFI, IFI, CFI and TLI were 0.942, 0.911, 0.908, 0.906, 0.876 respectively; and RMSEA was 0.064. Although GFI, AGFI, IFI, CF were greater than 0.9, RMSEA was less than 0.08, which showed that the goodness of fit of the entire model was acceptable, but TLI was still slightly less than 0.9 which implied that there was still room for improvement of the model.

From the analysis of the loading factors, the two variables “Once participated in club activities of the seller” and “Ever used a return or exchange or claim service” had lower loading scores than others. Their scores were 0.482 and 0.493, and the rest of the variables were more than 0.5.

Therefore, the lowest loading score variable, “participated in club activities”, was deleted, after that the Chi square/df became 2.189 which was smaller than the previous number 2.475; GFI, AGFI, IFI, CFI and TLI were 0.955, 0.927, 0.933, 0.932 and 0.906 respectively, which were more than 0.9 and RMSEA was 0.057. In addition, the factor loadings of all variables were more than 0.5. Therefore, the results were improved, which implied that the revised model had better adaptability. Eventually, we concluded influence factors in Table 87.2 the factors affecting the purchasing attitude of products with after-sales services.

**87.3.3 Analysis of the Relationship Among Factors  
and Their Relationship with Purchasing Attitude**

Factors’ relationship analysis. By using AMOS19.0, we were able to find out that there were no obvious relationships between perceived value and perceived risk ( $p = 0.099$ ). However, the relations between perceived value and marketing methods ( $p = 0.000$ ), after-sales experience and marketing methods ( $p = 0.000$ ),

**Table 87.2** Influence factors of consumers’ purchasing attitude toward after-sales service products

Level 1 index	Level 2 index
Perceptive value	Reflect businesses quality assurance
	Bring security
	Reflect businessman credit strength
Perceived risk	Think after-sales service cost is high
	Think after-sales service attitude is poor
	Think after-sales service technology is poor
	Think that use process trivial
After-sales experience	Ever used a product warranty or beauty decoration service
	Ever used a product extra preferential or value-added services
	Ever used a return or exchange or claim service
Marketing methods	Ever decided to purchase that is because of the cheap use price
	Ever decided to purchase that is because of the personal selling

perceived risk and marketing methods ( $p = 0.003$ ), perceived risk and after-sales experience ( $p = 0.005$ ) were obvious at the 0.05 level of significance.

Relation analysis between factors and purchasing attitude. After analysis, we could tell that the relations between perceived value and purchasing attitude ( $p = 0.000$ ), marketing methods and purchasing attitude ( $p = 0.036$ ) were obvious. Furthermore, perceived value and purchasing attitude, as well as marketing methods and purchasing attitude were positively related at the 0.001 level of significance. On the contrary, perceived risk and purchasing attitude were negatively related at the 0.05 level of significance; Meanwhile, the relation between after-sales experience and purchasing attitude was not so obvious.

## 87.4 Discussion

### *87.4.1 Influence Factors of Consumers' Purchasing Attitude Toward After-Sales Service Products*

Four factors were found through exploratory factor analysis, and they were: perceived value, perceived risk, after-sales experience, and marketing method. Although customers would be affected by the above factors no matter what products they were purchasing, products with ASS would benefit customers more and leaves them with deeper impression. They would feel safe and protected when they assessed the profit. And they would worry about the quality and ASS of the product when they considered the risk of purchasing. They would also understand the value of the product more after they experienced it and they might develop trust and loyalty on the product because of the after sales experience. Last but not least, they would receive more product information from marketers (Yim et al. 2012). As a complement, the price sensitivity was also a main factor affecting customer purchasing attitude.

### *87.4.2 Model Validation*

In this part, we excluded one factor: participated in seller's club activities for making a better model which was easier for respondents to understand.

And the research suggested that less consumer has the deep impression to club activity which provided by sellers.

### ***87.4.3 Relation Analysis Between Factors and Purchasing Attitude***

After analysis, we found that perceived risk and purchasing attitude ( $p = 0.036$ ) were obviously related at the 0.05 level of significance, but the after-sale experience and purchasing attitude were not ( $p = 0.494$ ).

Countless literature had proved that the higher the perceived risk, the less likely to buy (Maronick 2007; Voss et al. 1998). But it was worth noting that product experiencing would have obvious relations with purchasing willingness; however, for products with ASS that relation was no so notable. One reasonable explanation was that as noted by Agrawal et al. (1996), "If all firms offer the same warranty terms regardless of differences in brand reliability, warranty contracts no longer have high predictive value because accurate discrimination is impossible from the consumers' point of view" (Agrawal et al. 1996). Therefore, consumers thought that after-sales experience was well-deserved things. And some related research also proofed that "the research on warranties as signals of reliability is not very consistent" (Maronick 2007; Jasmand et al. 2011). Another reasonable explanation was that the perception of products at the purchasing moment was more convincing than at the after sales experience (Manstead 1991). Such result could be explained by the psychology stereotype and recency effect as well as the customer implicit cognition theory (Xiao- 2003; Wan-lian et al. 2008). Beales et al. (1981) and Weiner (1985) called the "hidden benefit problem", meaning that consumers were unable to judge by inspection the extent to which a specific brand was, or was not reliable (Beales et al. 1981; Wiener 1985).

## **87.5 Conclusion**

This paper found out 4 main factors affecting the customer purchasing attitude through EFA, including perceived value, perceived risk, after-sales experience, and marketing methods. By validating and perfecting the model with CFA, the constitution of affecting factors was obtained. These factors were found to be pairwise related after analysis. In the research, no obvious relation was found between after-sales experience and purchasing attitude, but notable relation among the rest 3 factors were found. Moreover, there existed negative relation between perceived risk and purchasing attitude.

The first limitation of this paper was that the amount of subjects of investigation was small. Secondly, each factor could be explored deeper. The relation between after-sales experience and purchasing attitude was not significant, so future research could subdivide after-sales experience and purchasing attitude.

This paper could offer some opportunities for further researches, such as: marketing strategy research based on factors affecting purchasing attitude to products with ASS; how to apply customer implicit cognition theory in selling and

servicing marketing; and how various after-sales experience affect purchasing attitude. All these topics could bring a lot of new contributions to the ASS research.

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## Chapter 88

# Analysis of Patient Flow in Emergency Department Based on Markov Chain

Ting Zhu, Xin-li Zhang, Li Luo, Ying-kang Shi and Yu Cao

**Abstract** In this article, we present a study on patient flow conducted in the emergency department of a typical hospital. Based on results of a kind of critical disease predicted by statistical analysis software and the theoretical basis of the Markov chain, a Markov chain model for forecasting patient flow in the emergency department has been developed. The authors focus on expounding the principle of this model and comparing subsequent real-world results with those predicted by the model. This paper is intended to predict the trend of patient flow in ED, find the maximum flow path and the patient proportion on each path, provide a theoretical basis to find the resource consumption of each process on the path to identify peaks and troughs. The Markov chain model showed the law of patients' transfer, it can play a good role for the effective allocation of resources of the hospital.

**Keywords** Emergency service · Markov chain · Patient flow · Statistics and numerical data analysis

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## 88.1 Introduction

Emergency departments (ED) are complex clinical areas. There are great difficulties in measuring the performance of such departments (Jelinek et al. 1999). Virtually, the most urgent problem in the ED we studied now is that the space and bed resources in the ED are too short under the circumstance of so many emergency patients. So the factors that result in the higher use of the ED have been identified. For staff of ED, their greatest goal is to flow up the patients living in the ED, that is to say, transfer the patients out to the inpatient department or other hospitals rather than permanently live in the emergency department. Under these pressures, it is crucial for hospitals to develop methodology for improving patient flow, providing the best possible care in a timely manner, and ensuring maximum utilization of limited resources (Georgievskiy et al. 1998). So we divide the entire emergency process into three modules: patient input, emergency treatment, patient output. Based on statistical analysis of patient flow, the authors find the feasible paths of patients in ED. Furthermore, we find the maximum flow path and the patient proportion on each path. On the basis of the results, we generate a Markov chain model to forecast the law of patient transfer in ED, which can optimize patient flow and forecast the resource allocation on each path.

## 88.2 Methodology

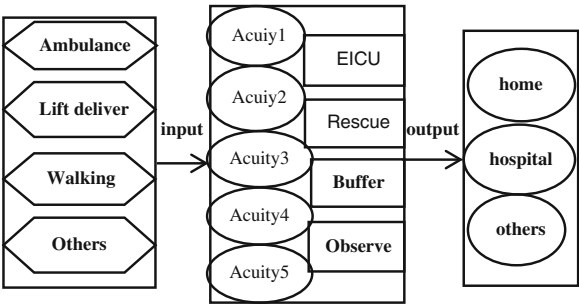
Lloyd G. Connelly and Aaron E. Bair used the Extend DES modeling package (EDSIM) to develop a model of the ED. This validated model was used to compare two alternatives for optimization of patient flow the fast-track triage and the acuity ratio triage (ART) (Georgievskiy et al. 1998). In this article, by use of the collected actual data almost a 1 year period for arrivals, departure times, arrival patterns, and the severity of the patients' conditions, we get a emergency patient flow system based on the fast-track triage and the acuity ratio triage (ART), and we'll verify the system according to a Markov chain model. So our ideas carried out as follows: first of all, we'll describe the patient flow in the ED we studied, followed by expounding the principle of the Markov chain model.

### 88.2.1 Emergency Department Process and Patient Flow

According to the actual investigation of West China Hospital, the process can be described as a system shown in Fig. 88.1, the system includes three modules: patient input, emergency treatment, patient output.

In this system, when patient arrive at the ED, the first patient-personal interaction occurs in the triage area where the patient is diagnosed by triage nurse. The

**Fig. 88 1** Emergency medical flow-chart (Zhu et al. 2010)



nurse assesses patient’s vital signs, determines urgency of patient’s condition and assigns a corresponding ESI which ranges from 1 (most severe) to 5 (least severe), then patients go to different treatment areas to accept diagnosis and treatment.

To make the study more convenient, according to Fig. 88.1, we assume that “others” was “1”, “walking” was “2”, “lift deliver” was “3”, and “ambulance” was “4”, homogeneous, the treatment areas of “observe, buffer, rescue, EICU” were assumed as “4, 3, 2, 1”; By use of statistics and numerical data analysis, some results were obtained as follows:

From Table 88.1, we can see the patient proportion on the process from the input module to the ESI module. Moreover, 37.6 % of all patients are transported to the ED by ambulance and they are corresponded with ESI<sub>2</sub>.

From Table 88.2, we can also see the patient proportion on the process from the ESI module to the treatment module. In addition, 46.4 % of all patients with ESI<sub>2</sub> are sent to the rescuing area, whereas patients with ESI<sub>3</sub>, ESI<sub>4</sub> and ESI<sub>5</sub> are walked

**Table 88.1** Patient proportion transferred from input module to ESI module (the first phase)

Arrival pattern	ESI proportion (%)				
	ESI <sub>1</sub>	ESI <sub>2</sub>	ESI <sub>3</sub>	ESI <sub>4</sub>	ESI <sub>5</sub>
<b>4</b> Ambulance	1.0 %	37.6 %	2.2 %	1.0 %	0.5 %
<b>3</b> Lift deliver	0	6.7 %	7.3 %	19.8 %	0.7 %
<b>2</b> Walking	0.1 %	4.5 %	0.7 %	0.4 %	0
<b>1</b> Others	0.3 %	14.3 %	2.2 %	0.7 %	0.1 %

**TABLE 88.2** Patient proportion transferred from ESI module to treatment module (the second phase)

ESI (%)	Areas proportion			
	<b>1</b> EICU	<b>2</b> Rescue	<b>3</b> Buffer	<b>4</b> Observe
ESI <sub>1</sub>	0.4 %	1.3 %	0	0
ESI <sub>2</sub>	7.9 %	46.4 %	7.8 %	8.8 %
ESI <sub>3</sub>	1.6 %	3.6 %	2.2 %	4.2 %
ESI <sub>4</sub>	0.7 %	3.6 %	1.3 %	10.1 %
ESI <sub>5</sub>	0	0	0	0.2 %

or transported directly to the treatment room and get registered while in the treatment rooms, or the escorting persons register the patients in the admitting area.

Tables 88.1 and 88.2 both have explained one process of the entire emergency process, then we'll present the patient proportion on each path of the entire emergency process in the following Table 88.3.

In Table 88.3, it shows that there are 46 feasible paths in the entire process compared with 80 alternative paths, the patient proportion on each path has also been given. By observing the data, we can see that the largest patient flow path is the 38th one, 26.9 % of all patients with this kind of critical disease are transported to the ED by ambulance, then assigned ESI<sub>2</sub> by triage nurses or directly by doctors accompanied on the ambulance, finally they are sent to the emergency rescue care unit (ERCU).

By summarizing the preliminary statistical analysis on patient flow in the ED, the authors found out something as follows.

In phases, the largest patient flow path in the first phase is “4—2”, the largest patient flow path in the second phase is “2—2”.

In all-over viewing angle, the largest patient flow path is “4—2—2”.

Nevertheless, the article will give a reference when it comes to the derivation of the patient proportion on each feasible path next.

## 88.2.2 The Principle of the Markov Chain Model

### 88.2.2.1 Markov Process

A random process  $\{X_n, n = 1, 2, \dots\}$  is an assemblage of random variables, the different values  $X_n$  can take is called state (Li et al. 2001). The assemblage can be expressed as  $\{I_n, n = 1, 2, \dots\}$ . A stochastic process  $\{X_n, n = 1, 2, \dots\}$  transferring from a state to the next state by a state transition probability is only dependent on the state it is locating in at the right moment, whereas unrelated to what state it is in before this point. That is to say, if throughout the entire process  $\{X_n, n = 1, 2, \dots\}$ , the conditional probability of the state  $X_{n+1}$  merely depends on the value of  $X_n$ , which is not about all the previous values of the process. So the above-mentioned is the so-called Markov process. In this article, there are three processes in the entire emergency process, moreover, the first process ( $X_1$ ) has four states (others, walking, lift deliver, ambulance), the second one ( $X_2$ ) has five states (ESI<sub>1</sub>, ESI<sub>2</sub>, ESI<sub>3</sub>, ESI<sub>4</sub>, ESI<sub>5</sub>) and the third one ( $X_3$ ) has four states (EICU, rescue, buffer, observe). Generally, Markov process is applied in the field of time state transition; however, in the case we studied now it is a state transition in space.

**Table 88.3** Patient proportion of the entire emergency process

Number	Proportion (%)	Path
1	0.4	1—1—2
2	0.4	1—2—1
3	12.5	1—2—2
4	0.9	1—2—3
5	2.2	1—2—4
6	0.2	1—3—1
7	1.1	1—3—2
8	0.2	1—3—3
9	0.7	1—3—4
10	0.2	1—4—2
11	0.7	1—4—4
12	0.2	2—1—2
13	3.6	2—2—2
14	0.4	2—2—3
15	0.9	2—2—4
16	0.4	2—3—1
17	1.8	2—3—2
18	0.7	2—3—3
19	2.7	2—3—4
20	0.4	2—4—1
21	2.9	2—4—2
22	1.3	2—4—3
23	9.2	2—4—4
24	0.2	2—5—4
25	1.8	3—2—1
26	3.4	3—2—2
27	1.6	3—2—3
28	1.3	3—2—4
29	0.2	3—3—1
30	0.5	3—3—3
31	0.2	3—3—4
32	0.2	3—4—1
33	0.2	3—4—2
34	0.2	3—4—4
35	0.4	4—1—1
36	0.7	4—1—2
37	5.8	4—2—1
38	26.9	4—2—2
39	4.9	4—2—3
40	4.5	4—2—4
41	0.9	4—3—1
42	0.7	4—3—2
43	0.7	4—3—3
44	0.5	4—3—4
45	0.2	4—4—1
46	0.4	4—4—2

88.2.2.2 Markov Chain

Markov chain refers to a Markov process that is time discrete and state discrete (Li et al. 2001). Simultaneously, the case we are studied now is a homogeneous Markov chain because that each patient reaching the ED is not only discrete on time but also discrete on state.

88.2.2.3 Transition Probability

If transition probability from state  $i$  to state  $j$  is denoted as  $P_{ij}$ , the  $P_{ij}$  can be conveyed as follows (Yu 2008):

$$P_{ij} = P\{X_{n+1} = j | X_n = i\}; i, j = 1, 2, \dots,$$

The traditional transition probability matrix  $P$  can be represented like this (Li and Gan 2012; Liu 2008):

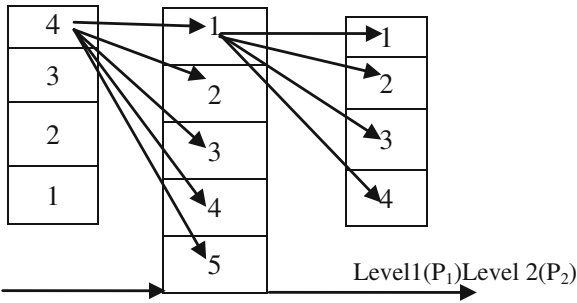
$$P = [P_{11} \ P_{12} \ P_{13}, \dots P_{21} \ P_{22} \ P_{23} \dots P_{31} \ P_{32} \ P_{33} \dots\dots];$$

From queuing theory standpoint, the emergency department can be imagined as a network of nodes and queues and different sorts of servers (Zhao 2010). In terms of patient flow, the ED includes three general subdivisions, it can be described as a network of nodes and levels in Fig. 88.2.

$P_1$  is the transition probability in the level 1 and homogeneously  $P_2$  is the transition probability in the level 2. They can be expressed as the following formulas on account of the results mentioned above.

$$P_1 = \begin{bmatrix} 0.003 & 0.143 & 0.022 & 0.007 & 0.001 \\ 0.001 & 0.045 & 0.007 & 0.004 & 0 \\ 0 & 0.067 & 0.073 & 0.198 & 0.007 \\ 0.010 & 0.376 & 0.022 & 0.010 & 0.005 \end{bmatrix};$$

Fig. 88 2 Emergency patient flow network



$$P_2 = \begin{bmatrix} 0.004 & 0.013 & 0 & 0 \\ 0.079 & 0.464 & 0.078 & 0.088 \\ 0.016 & 0.036 & 0.022 & 0.042 \\ 0.007 & 0.036 & 0.013 & 0.101 \\ 0 & 0 & 0 & 0.002 \end{bmatrix};$$

So the patient proportion on the feasible paths generates like the rule that the probability in the level 1 multiply the probability in the level 2.

$$P_{112} = r[P_{11} \times P_{12}] = r[0.003 \times 0.013] = 0.0039 \%r;$$

$$P_{121} = r[P_{12} \times P_{21}] = r[0.143 \times 0.079] = 1.13 \%r;$$

$$P_{122} = r[P_{12} \times P_{22}] = r[0.143 \times 0.464] = 6.635 \%r;$$

In the formulas, the “r” is an impact factor, which can influence the entire probability patient transfer from level 1 to level 2 but is unrelated to the separate transition probability each step. The “r” can be thought of as the relation between the patient proportion of the entire process with the separate transition probability each step.

#### 88.2.2.4 Markov Chain Model

If  $\{X_n, n = 1, 2, \dots\}$  is a Markov chain, so for any integer  $n \geq 0$ ,  $0 \leq l < n$  and  $i, j \in I$ , the transition probability  $P_{ij}^{(n)}$  has the following properties (Zhang 2007):

$$A. P_{ij} = \sum P_{ik}^{(l)} * P_{kj}^{(n-l)}, \quad k \in I;$$

$$B. P^{(n)} = P * P^{(n-1)};$$

$$C. P(k+1) = P(k) * P;$$

P is the transition probability matrix in the state of K.

Hence, the innovation of the model is that we set up a space state transition model to predict the patient flow. Concurrently, the idea provides a new research direction for the Markov chain model and the patient flow in the emergency department (Samaha et al. 2003).

### 88.3 Results

In this article, we present a study on patient flow conducted in the emergency department of a typical hospital. We have expounded the principle of the Markov chain and the paper focus on explaining the law of the patient flow in the ED by this new model. The result is that the entire patient proportion obtained by the statistical analysis software is different from the transition probability generated by the model. Therefore, the authors introduce an “impact factor” to the model. The

“r” can be thought of as the relation between the patient proportion of the entire process with the separate transition probability each step. Simultaneously, the “r” is the most significant essential in the model, and it needs a deep-seated exploration to get.

**Acknowledgments** The authors are grateful to the anonymous researchers for helpful literature resources. And thank for the national natural science foundation of china.

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# Chapter 89

## Analysis of Risk Assessment and Risk Management for Power Generation Enterprise

Lu-ming Yan

**Abstract** Market reformation is an inevitable trend, the diversification and complexity of risks faced by power generation enterprises in our country is increased. This thesis describes the risk management for power generation enterprises in detail according to the risk-management processes on the basis of introduction to the theoretical framework of risk management. At the section of risk identification, this thesis discusses the external and internal risks of power generation enterprise, and analyzes the impact of current domestic and foreign energy situation to power generation enterprises. This thesis focuses on risk assessment and discusses the risk assessment model. Combining economic evaluation and characteristics of Chinese electricity market, this thesis applies VaR method in the risk assessment of power industry and creatively brings up a risk assessment model. This model is applicable not only to the power industry research but also to the specific risk assessment model for power generation enterprises.

**Keywords** Power generation enterprises • Risk assessment • System risk

### 89.1 Introduction

As energy prices increased continuously, power companies in terms of power generation companies or power grid enterprises, the meaning and status of risk management is rising. Risk management involves four steps: risk identification, risk assessment, risk control and risk management. Above all, The risk identification is the basis, risk assessment and risk control is the core, risk management is

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the effects of implementation. Most of the technical difficulty is the risk identification and risk assessment. Part of the core of risk management, risk assessment is an important aspect of the electricity risk management. With the continuous development of the electricity market, the limitations of the traditional risk management techniques have become increasingly apparent (Boqiang and Chuanwen 2009). Based on the characteristics of China's power market, firstly, this article identify the various risks faced by the power generation companies, then the VaR methodology is applied to the risk measure of the power industry and power generation businesses, and do objective measure of its short-term risk, this will play a useful reference on risk investment decision-making for power generation companies (Gouveia and Matos 2009).

## **89.2 Overview of Risk Management Theory**

The process of risk management is the main content and the center link for achieving risk management; it reflects the basic rules and basic steps of risk management. The risk management program consists of four main steps: risk identification, risk assessment, risk control and assessment of risk management effectiveness.

### ***89.2.1 Risk Identification***

Risk identification is the basic premise of risk control, which is the process used to judge and make a systematic classification analysis for a variety of potential uncertainty which will be come in order to identify potential risks and the nature.

### ***89.2.2 Risk Assessment***

Accurate assessment of risk is a prerequisite to the core areas of risk management. The risk assessment analyzed collected datas on the basis of risk identification.

### ***89.2.3 Risk Control***

The risk decision control is after risk assessment, the approach which is used to cope with risk factors is a critical stage of risk management process.

### ***89.2.4 Evaluation of Risk Management Effectiveness***

Risk management effectiveness evaluation is to analyze and compare the implementation of risk management methods, results and targets fit in order to judge the scientific, adaptability, and profitability of management program.

## **89.3 Existing Problems in Power Risk Assessment**

Although the risks on the electricity market at home and abroad has been done a lot of research and discussion, but there are four insufficient point as follows:

### ***89.3.1 Discussion of Economic Risks is Insufficient***

Domestic literature demonstrates the security of power grid and power system in terms of technical point, which concern mainly in network planning risk, electricity demand and supply program. With the development of the electricity market, economic risks of power generation industry also need to do some research and argumentation. But the issue of how to measure the economic risk is relying solely on traditional net present value method for project appraisal. In the study of risk management for power generation industry (Menniti et al. 2010), it more concentrated in the single auction or credit aspects risk, rather than the overall economic risk.

### ***89.3.2 Quantitative Research on Risk of Power Generation Companies is Less***

Domestic literatures are more emphasis on the qualitative study of the risk of investment for power enterprises. The qualitative research of risks usually do subjective estimation to the size of the possibility of risk and the size of loss in order to gain the value of loss roughly, but they have never done objective and quantitative research on the value of risk loss. Among them, they emphasis on the grid companies, but the quantitative model of measuring risk for generating companies is almost empty.

### ***89.3.3 Lack of Systematic Risk Assessment***

Discussion of the risks on the electricity market at home and abroad are both for the power grid and power generation companies, the risk management are discussed qualitatively from processes or business, and there is no practical systematic risk assessment models and methods.

### ***89.3.4 Does Not Help to Find the Source of Risk***

It is difficult to determine exactly what has bought risk of power companies on the basis of qualitative analysis. Though we can refine risk in accordance with the processes and business and analyze individual differences compared to industry average level, such an analysis is difficult to analyze the impact of a variety of sources of risk in systemic risk, the risk of a single source of risk is not clearly quantified indicators.

Therefore, through the study and analysis of domestic and international risk research literature, and inspired by the portfolio risk of financial markets, if starting from the source of risk to quantify the risk, then analyze comprehensive systemic risk (Yun and Kim 2003). It has become a core issue of this paper that whether we can establish risk assessment model as a new risk assessment model, and thus contribute to do some help to take appropriate risk control measures for power generation companies or power generation industry (Gross et al. 2010; Zhang et al. 2007).

## **89.4 Integrated Risk Calculations of Power Generation Enterprise**

### ***89.4.1 Calculating Method of Integrated Risk***

The method of risk calculating in this article is VaR method, stands for “Value at Risk”, and its meaning is “value at risk”, the most original meaning refers to the maximum possible loss of a financial asset or portfolio under normal fluctuations of the market. The essence of VaR is the method which measure comprehensive risk of market based on standard statistical techniques (Liao et al. 2007). There are three types to estimate the value of VaR: historical simulation method, delta normal method and Monte Carlo simulation method.

89.4.2 An Empirical Study of the Integrated Risk Calculation

Power system risk model is analyzing from risk factors, and calculated the probability of occurrence of each risk and then conduct a comprehensive analysis of the system analysis. So we can gain integrated risk after sub-risk portfolio. Before the calculation, we still need to forecast the valuation which influenced risk variables of non-decision-making in future periods. In this case, we predict that the tariff is 0.3977 yuan/kwh in 2010, the amount of domestic coal is 1.551 billion tons, the amount of imported coal is 54.51 million tons and per ton of coal CIF price is about 126 dollars. If we using a uniform degree of confidence for all sub-risks (Orme and Venturini 2011), and taking predictive value of risk and variable which influenced risk into the calculation, then you can get the results in Table 89.1.

We can judge the probability of occurrence of Sub- risk according to specific economic situation, then combine with the sub- risks to calculate the integrated risk for power industry. For example as Table 89.2.

89.5 Integrated Risk Analysis for Power Generation Enterprise

89.5.1 The Simple Application of VaR Method in Risk Assessment for Power Generation Enterprise

The aim of our study is to conduct a risk assessment of coal-fired power generation industry in a certain region in 2010, and in terms of industry, it is impossible to find time series of industry’s profit and loss. Therefore, we can only collect the benefits and costs of the historical data, then calculated the time series of gains and losses of the power industry (Zhao 2009). For this case compared to the power system risk model, we also need to collect the tariff in the region from 1990 to 2010, the amount of the coal from the domestic, consumption of import electric coal and the historical sequence of CIF of per ton electric coal. When these basic

Table 89.1 Comprehensive risk calculation

Sub-risk	Units	Confidence degree of sub-risk		
Power sub-risk	%	95 %	90 %	85 %
Coal price sub-risk	%	95 %	90 %	85 %
Exchange rate sub-risk	%	95 %	90 %	85 %
Total profit of risk before tax (historical simulation method)	Billion yuan	−1,250.30	−955.38	52.27
Total profit of risk before tax (delta normal method)	Billion yuan	−1,687.73	−858.59	−282.79

**Table 89.2** Comprehensive risk calculation

Sub-risk	Units	Confidence degree of sub-risk		
Power sub-risk	%	90 %	90 %	95 %
Coal price sub-risk	%	95 %	95 %	90 %
Exchange rate sub-risk	%	95 %	90 %	90 %
Total profit of risk before tax (historical simulation method)	Billion yuan	−1,059	−1,061	−1,147
Total profit of risk before tax (delta normal method)	Billion yuan	−1,305	−1,310	−1,241

data collection is complete, we can calculate the time series of profit and loss of all power generation companies in one region from 1990 to 2010, the calculation results are shown in Table 89.3.

Because we calculate the value of VaR in the method of time series of profit and loss based on the concept of VaR, so the basis of time series is loss rather than profit. And the loss can be considered as opposite number of the profits, so the basic data sequences we have calculated should be the opposite number of Table 89.3, as shown in Table 89.4.

According to Table 89.4, we can calculate the VaR value under different confidence level, that is the assessment results of integrated risk for power industry in the region, calculated results are shown in Table 89.5.

**89.5.2 VaR Method in Analysis of Risk Assessment of Power Generation**

Whether power system risk assessment model or the calculation of the simple application of the VaR method, the value of results which calculated by Delta normal method is much larger than the value of the historical simulation method. However, due to the Delta Normal Method is less easy to communicate, so we adopt the results of the historical simulation method for analysis.

Compared computing process in these two methods, we can see that they have the following characteristics:

- 1. The form of expression of system investment risk assessment model is more intuitive, but the VaR simple application method is easier to understand.

**Table 89.3** Calculation results of generating profits for the calendar year in one region (unit: million yuan)

Years	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Profits	−981	−856	−714	−592	−866	−582	−712	−246	58	634
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Profits	1,254	1,577	1,921	2,374	1,535	178	228	1,877	1,542	3,766

**Table 89.4** Calculation results of generating loss for the calendar year in one region (unit: million yuan)

Years	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Profits	981	856	714	592	866	582	712	246	−58	−634
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Profits	−1,254	−1,577	−1,921	−2,374	−1,535	−178	−228	−1,877	−1,542	−3,766

**Table 89.5** Assessment results

Calculation results of integrated risk (unit: million yuan) confidence degree	95 %	90 %	85 %
Results of historical simulation method	866.38	856.12	714.47
Delta normal method	2,778.15	2,296.30	1,961.67

2. The depth analysis of System investment risk assessment model can not only do quantitative assessment for power investment risk, also analyze the probability of occurrence of a variety of risk factors for systemic risk, and the degree of this effect.
3. Investment risk assessment model is more flexible, a variety of sub-risk can be estimated alone and also can be estimated combined.
4. System investment risk assessment model required basic datas which are relatively small, and are more conducive to the actual operation.

**Acknowledgments** In this paper, on the basis of making an overview of the theoretical framework of risk management of power generation companies, we discussed risk management in detail for power generating company according to the process of risk management. Not only expounded the theory of risk management, but also analyzed the issue existing in electric risk management, and calculated and analyzed the risk of power generation enterprises by using VaR method. It has some practical significance which illustrated for the improvement of VaR for risk assessment for the power generation industry or power generation companies.

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# Chapter 90

## Application of ISM in Influence Factors of Human Resource Training Effects of Transportation Enterprises

Tian-bo Li and Shu-dong Li

**Abstract** By using the methods of interpretive structural modeling (ISM), the article builds influence factors system of human resource training effects and analyzes the hierarchical relationship among the factors in transportation enterprises. It draws the conclusions: The direct factors which impact human resource training effects are composed of training pattern, instructional program, and trainee' learning motivation. The indirect ones comprise corporate culture, enterprise economic strength, development plans, as well as other relevant personnel and systems. Furthermore, human resource training effects of transportation enterprises are subject to some external factors such as state laws, social credibility, etc.

**Keywords** Transportation enterprises • Human resource • Training effects • ISM

### 90.1 Introduction

Nowadays human resource has turned into the most important resource in economic society. People who have received traditional one-off education cannot meet the requirements to human resource in the age of knowledge-based economy, "learning how to learn and continuous learning have become core career competencies" (Maurer et al. 2003). It is significant for individual employee and entire enterprise to accomplish training: By means of training, employees can enrich

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their knowledge, improve their abilities and raise the efficiency in their work, and then, both organization and individuals will achieve success on the basis of economic benefits growth.

In many developed western countries, enterprise training and education planning are carried out widely and thoroughly. They represent another kind of training system with the exception of university education. Compared with human resource training in China, training systems in developed countries are more integrated. Culture awareness and training effect are extraordinarily considered by the managers of enterprises in these countries (Zhu 2009). Nevertheless, Chinese transportation enterprises only focus on temporary training. They lack for the training planning so that the learning results are not satisfactory in most case. A transportation enterprise who attempts to heighten its training effect should primarily find out what have influenced the training effect, then it could formulate the targeted principles in the light of itself characteristics to improve the training system in depth (Zhou 2009). According to the research achievement of the experts and scholars home and abroad (Pantzalis and Park 2009; Parhi and Mishra 2009; Yamamura 2009; Mastromarco and Ghosh 2009; Papagapitos and Riley 2009; Grochulski and Piskorski 2010; Zarutskie 2010; Gimmon and Levie 2010; Birasnav et al. 2010; Eide and Showalter 2010), we found that there were a good many literatures recorded influence factors of human resource training effect of transportation enterprise. But the number of literature which got involved in interaction among various factors is few; especially the one made a study of mathematical model is fewer.

Interpretative structural modeling (ISM)—a method exploited by American Prof. J. Warfield—is used to resolve the problem on the complicated socioeconomic system. ISM decomposes the complex system into several sub-system elements and constructs a multi-level hierarchical structure model. It converts the vague perception into the model with distinct and palpable structure. By the way of observing the correlations among these elements, we can search out the crucial factors in the system (Yue 2006). ISM has been extensively applied in the fields of system engineering, management science, social economy and so on. Therefore, this paper attempts to adopt the method of ISM to enumerate the items which have influenced human resource training effect in Chinese transportation enterprise, and analyzes the hierarchical relationships among all kinds of the factors. The purpose of the article is to offer a new research idea for majority scholars.

## **90.2 Analysis on Influence Factors of Human Resource Training Effect**

Before setting up the influence factors system of human resource training effect of transportation enterprises, we must select the scientific influence ingredients which have impacted the training effect in truth. Basing on the research achievement of

**Table 90.1** Influence factors system of human resource training effect

	Index	Influence factors	Contents
Human resource training effect (X <sub>14</sub> )	X <sub>1</sub>	Law and regulations	Legal rules of human resource training system
	X <sub>2</sub>	Market economy system	The influence of human resource disposition under the circumstance of market economy system
	X <sub>3</sub>	Social credibility	The influence of brain drain in enterprise
	X <sub>4</sub>	Industrial technical level	The requirements to training planning in the current industrial technical level
	X <sub>5</sub>	Training manager	Attention degree of leadership on training, operating capability of training manager, etc
	X <sub>6</sub>	Trainer	Trainer's professional knowledge, teaching skill, etc
	X <sub>7</sub>	Training pattern	Training method, time and place arrangement, number of trainees, data for preparation, etc
	X <sub>8</sub>	Teaching program	Academic course, instructional details, assessment criteria, etc
	X <sub>9</sub>	Trainee	Trainee's self-efficacy, learning motivation, training needs, etc
	X <sub>10</sub>	Enterprise training planning	Short-term, medium-term and long-term training planning which depends on industry type, technical requirement and employees' character
	X <sub>11</sub>	Enterprise economic strength	Proportions of training funds input in enterprise funds allocation
	X <sub>12</sub>	Salary system	Wage and award system which could encourage employee to take part in training
	X <sub>13</sub>	Corporation culture	Different culture among the enterprises such as values, belief, etiquette, etc

(X<sub>13</sub>) and human resource training effect (X<sub>14</sub>) for the elements of ISM

both domestic and overseas experts, combining with practical situations of Chinese transportation enterprises the article builds a comprehensive influence factors system of human resource training effect (see Table 90.1) in the light of practical situation in China.

### 90.3 Construction of ISM in Influence Factors of Human Resource Training Effect of Transportation Enterprises

From the point of view above, we choose 13 major influence factors—law and regulations (X<sub>1</sub>), market economy system (X<sub>2</sub>), social credibility (X<sub>3</sub>), industrial technical level (X<sub>4</sub>), training manager (X<sub>5</sub>), trainer (X<sub>6</sub>), training pattern (X<sub>7</sub>),

teaching program ( $X_8$ ), trainee ( $X_9$ ), enterprise training planning ( $X_{10}$ ), enterprise economic strength ( $X_{11}$ ), salary system ( $X_{12}$ ), corporation culture.

### 90.3.1 Mark out the Interrelation of Influence Factors

There is mutual function among influence factors of human resource training effect in transportation enterprises. For instance, from the environment of low social credibility, training managers merely hire the technical talents from the same trade while ignoring their own staff training. For another example, trainer's teaching methods and lecture style can stimulate trainees' learning motivation (Byars and Rue 2004). After making certain of the relationship among 14 factors, we formulate the relational matrix  $R$  of all elements. As diagram 1 shows, matrix  $R$  is square matrix of order 14. "1" means that direct impact exists among the elements; "0" means that direct impact does not exist among the elements (the indirect impact may exist, but no reference is made in this article). The elements in matrix are defined as:

$$r_{ij} = \begin{cases} 1, & x_i \text{ directly impact } x_j \\ 0, & x_i \text{ does not directly impact } x_j \end{cases} \quad (i, j = 1, 2, \dots, 14) \quad (90.1)$$

### 90.3.2 Divide the Hierarchical Relationship Among the Factors

Interpretive structural modeling method need to change relational matrix into reachability matrix. Reachability matrix illustrates whether connected channels exist from one element to another. As relational matrix  $R$  in Fig. 90.1, we figure out the sum of  $R$  and identity matrix  $I$ , and then make the  $n$ -th power operation for matrix  $(R + I)$  until the formula as follow holds:

$$M = (R + I)^{n+1} = (R + I)^n \neq (R + I)^{n-1} \quad n = 1, 2, 3, 4, \dots \quad (90.2)$$

The matrix  $M = (R + I)^n$  is named as reachability matrix. The element  $M_{ij}$  in reachability matrix  $M$  means that the connected channels exist from  $x_i$  to  $x_j$ . Thereby, the reachability matrix expresses direct or indirect relationship among the elements. After computing by Matlab software, we have educed the reachability matrix of influence factors system  $M = (R + I)^2$ . The next, according to the number of "1" from less to more, we reorder the elements to educe the hierarchical matrix (see Fig. 90.2).

**Fig. 90.1** Relational matrix

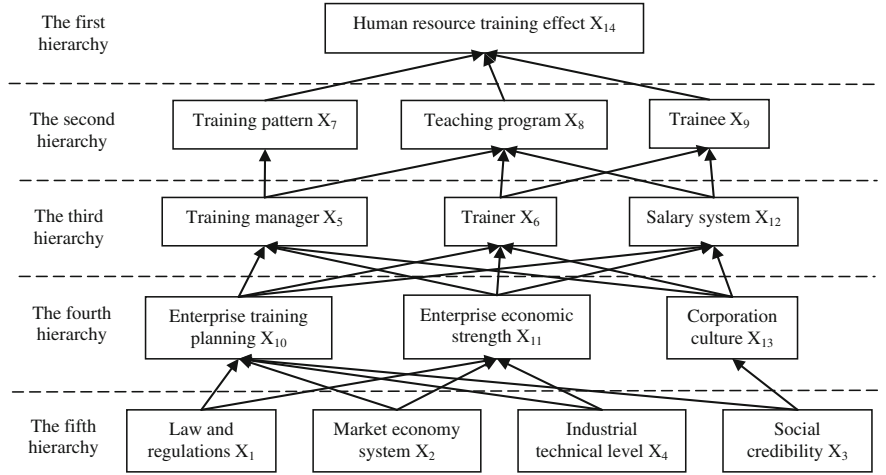
$$R = \begin{matrix} & \begin{matrix} x_1 & x_2 & x_3 & x_4 & x_5 & x_6 & x_7 & x_8 & x_9 & x_{10} & x_{11} & x_{12} & x_{13} & x_{14} \end{matrix} \\ \begin{matrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \\ x_7 \\ x_8 \\ x_9 \\ x_{10} \\ x_{11} \\ x_{12} \\ x_{13} \\ x_{14} \end{matrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \end{matrix}$$

**Fig. 90.2** Sorted reach ability matrix

$$M = \begin{matrix} & \begin{matrix} x_{14} & x_7 & x_8 & x_9 & x_5 & x_6 & x_{12} & x_{10} & x_{11} & x_{13} & x_1 & x_2 & x_4 & x_3 \end{matrix} \\ \begin{matrix} x_{14} \\ x_7 \\ x_8 \\ x_9 \\ x_5 \\ x_6 \\ x_{12} \\ x_{10} \\ x_{11} \\ x_{13} \\ x_1 \\ x_2 \\ x_4 \\ x_3 \end{matrix} & \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 \end{bmatrix} \end{matrix}$$

### 90.3.3 Create the Diagram of Interpretive Structural Modeling

On the basis of sorted reachability matrix, we create the diagram of interpretive structural modeling (see Fig. 90.3). This diagram indicates the major influence factors which react upon each other step by step.



**Fig. 90.3** ISM diagram of influence factors system of human resource training effect of transportation enterprises

**90.4 Hierarchy Analysis on Influence Factors of Human Resource Training Effect of Transportation Enterprises**

There are five hierarchies in influence factors system of human resource training effect of transportation enterprises. From the fifth hierarchy to the first, ISM diagram indicates the pointed level relationship of all factors.

**90.4.1 Relationship Analysis Between the First and Second Hierarchy**

Direct influence factors of human resource training effect of transportation enterprises are composed of training pattern ( $X_7$ ), teaching program ( $X_8$ ) and trainee ( $X_9$ ). The species of training pattern are too many, such as on-the-job training (OJT), apprenticeship training. Different approaches will have different effect on training outcome. Whether training time is suitable, whether place is bright and quiet, directly impact the training effect. Whether training course design associated with company daily work, whether it is accepted by the trainees, whether it is in line with company development in the future, directly impact the training effect too. Trainee’s opportunity (volunteered for training or is assigned to participate in training), requirement and self-confidence determine their learning motivation. So trainee is one of the principal influence factors.

### ***90.4.2 Relationship Analysis Among the Second, Third and Fourth Hierarchy***

Salary system ( $X_{12}$ ) is quite important to employee's working enthusiasm. Through the training, the employees can grasp new knowledge and skills. The higher efficiency in working, the more wage obtained. A fair salary system will provide a firm material foundation for employee's learning motivation. Training manager ( $X_5$ ) is in charge of design the training project and teaching program. Their management level, conscientiousness and communication with trainees cause the final training results. Trainer's ( $X_6$ ) teaching methods and lecture style can impact trainee's learning interest evidently. Corporation culture ( $X_{13}$ ) has influenced the knowledge conceptual of the staff in company. In the atmosphere of respecting knowledge and talent, enterprise can cultivate the technical talent who possessed big ideas and inflexible will (Parhi and Mishra 2009). Enterprise training planning ( $X_{10}$ ) is a major ingredient of training effect system. Little benefit has been obtained by training once or twice. If enterprise wants to attain the ideal training effect, it ought to make the long-term plan which measures up to enterprise development strategy. Undoubtedly enterprise economic strength ( $X_{11}$ ) also is a dominant part which controls the input power of every company. The company of large scope has invested more funds to human resource training than the small one. To sum up, the indirect factors in the third and fourth hierarchy have affected the human resource training effect of transportation enterprises by the second hierarchy.

### ***90.4.3 Relationship Analysis Between the Fourth and Fifth Hierarchy***

Transportation Enterprise must abide by law and regulations and perform the training under the guidance of government. The content of training needs to be in accord with the requirements to current industrial technical level ( $X_4$ ). Meanwhile, human resource training not only adapts to the operating mechanism of market economy system ( $X_2$ ) but also conforms to the social credibility ( $X_3$ ). The factors in the fifth hierarchy are external factors; they affect the human resource training effect from the fourth hierarchy to the first.

## **90.5 Conclusion**

This article has analyzed the hierarchy structure of influence factors system of human resource training effect of transportation enterprises. By the observation for directional impact relationship among the factors, it divides the influence factors

into different sorts: direct, indirect and external factors. “Training pattern”, “teaching program” and “trainee” are subsumed in the class of direct factors. Promotions of these three factors will help improve the training quality in a short time. If a transportation enterprise sets out to create the stable and sound training system during the prolonged development, it needs to start with the items such as “corporation culture”, “enterprise training planning”, “salary system” and so forth. Companies should focus on the employee training in multi-angles and exploit the diversified management methods combined with internal actual situation. Simultaneously, human resource training system of transportation enterprises is affected by some external factors, for instance, law and regulations, market economy system, social credibility, industrial technical level, etc. They have to strictly obey the state’s laws and carry out the program rationally for the purpose of raising human resource training efficiency.

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# Chapter 91

## Application of LibQUAL<sup>+TM</sup> and FAHP on Public Library Service Quality Evaluation

Xiao-qing Li and Jing-zhong Yang

**Abstract** The paper is targeted to constitute for Chinese public libraries a service quality evaluation index system with main reference to LibQUAL<sup>+TM</sup>, so far the most renowned evaluation system of its kind in the realm of library studies. Fuzzy Analytic Hierarchy Process (FAHP) which encompasses both qualitative and quantitative analysis is deployed to evaluate the public library service quality in a comprehensive manner. The system and its evaluation models are incorporated to be conducive in understanding and improving the service quality of Chinese public libraries.

**Keywords** Fuzzy analytic hierarchy process · LibQUAL<sup>+TM</sup> · Public library · Service quality evaluation

### 91.1 Introduction

With the coming of knowledge economy era, the digitization of document information, and the rapid growth of network, the status and role of public library as “social knowledge server” and “important information hub” has been attracting more and more worldwide attention (Wang and Bi 2010). public library service philosophy, library resources, service ability have undergone a fundamental change, which causes people put great concerns on public library service quality. Nowadays, how to improve service quality has become the core issue of public

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libraries concerns. Public library service quality evaluation can be great help for us to understand the job problem, clear improvement direction, and ultimately promote the development of the public library.

## 91.2 Public Library Service Quality Evaluation Overview

Traditional library service quality evaluation is mostly based on library collection resources, building size, and funds input. Since the 1990s, along with the service marketing theory development, the notion of library as an information service institution increasingly win support among the people, The International Federation of Library Associations and Institutions (IFLA) president Alex Byrne mentioned in the 73rd World Library and information Congress that the whole library is around to provide the highest quality information service (Shi and Wang 2009). Service quality belongs to subjective categories, and is closely related to the user's experience. Service quality isn't only determined by the service provider. Or, "only the user can evaluate the quality, while all other evaluation basically is be of no great importance" (Zeithaml et al. 1990).

Western library service quality evaluation is at the forefront in this field. In 1982, the United States Public Library Association (PLA) published the "Public Library Service Performance Evaluation Handbook"; In 1992, Library 2000 Review Committee was set up by Singapore Ministry of Information and Arts to study how to improve public library service quality and finally formed the public library performance evaluation system named as "The seven paradigms"; In 1999, the United States Association of Research Libraries (ARL) in cooperation with A&M university library at Texas of the United State began the LibQUAL<sup>+</sup>™ research programs, which eventually evolved to be the most influential and most popular library service quality evaluation system in international library circle after many large-scale validation and revision. However, though this system is applicable to the academic and research libraries, it also has very strong draw lessons from a meaning for public libraries.

Domestic library service quality evaluation research started in the 1990s. Some scholars introduced SERVQUAL and LibQUAL into China and actively carry out theoretical research and evaluation practice (Wang and Bi 2010). Wang and Bi (2010) evaluate the service of the three provinces and cities public libraries in Northeast China with reference to LibQUAL+ research ideas. This article puts forward that public library service evaluation practice can combine the LibQUAL+ system with other assessment methods to understand the public library service from different perspectives, which may avoid that the evaluation work takes a part from the whole. In the literature research, the majority of domestic library service quality evaluation research is mainly for academic and research libraries. The public library service quality evaluation is absence of the research. Public library service is not only the interaction process between the library and users, but also it is the combination of the hardware and software. The service process and effect is

highly complex, dynamic and fuzzy. Evaluation process includes both subjective and objective factors. Therefore, it is suitable to take a combination of qualitative and quantitative evaluation method, both to prevent evaluation to be too subjective, but also to avoid excessive quantitative evaluation. After careful comparison of several evaluation models, the study has the final choice of fuzzy analytic hierarchy process (FAHP), which is a combination of qualitative and quantitative analysis, to evaluate public library service quality. We take a public library in Quanzhou city of Southeast China as a case study on evaluation model.

### 91.3 Public Library Service Quality Evaluation Index System

LibQUAL<sup>+TM</sup> are the most widely used and most influential library service quality evaluation index system in foreign libraries. LibQUAL<sup>+TM</sup> consist of twenty-two standard questions covering three categories, or dimensions: Affect of Service (AS), Information Control (IC) and Library as Place (LP), which have been refined through four years' large-scale experiments in 2000–2003. It has been proved that LibQUAL<sup>+TM</sup> had strong reliability, credibility, consistency, adaptability and applicability. However, LibQUAL<sup>+TM</sup> provide the unified index system to every library. It can't reflect some local issues and meet some local service demands. Though LibQUAL<sup>+TM</sup> evaluation index maintains stability relatively, it advises users to increase local questions to reflect library actual situation (Zeng 2009). Since LibQUAL<sup>+TM</sup> were introduced in our country library research and practice, it has gained much affirmation. Domestic empirical study also shows that LibQUAL<sup>+TM</sup> ideas and models can be applied to university library in China. However, it can not be completely copied. We should draw lessons from and transform it to form some library service quality evaluation index systems, which are suitable for China's various types of libraries (Shi and Wang 2009).

The study constructs public library service quality evaluation index system mainly with reference to LibQUAL<sup>+TM</sup>. Statements and questions to measure the public service quality are selected through literature study and interview with readers. And those questions are audited by 3 invited experts which all have worked for more than 10 years in public libraries as senior managers. The construction of evaluation index system follows the principles as "scientific and comprehensive", "reasonable and applicable", "logically structured" and "user-oriented." Firstly, the index can reflect the present situation of the public library service objectively and accurately. Secondly, the contents of the index can be applied to interpret the public library service characteristic. Thirdly, the index system should be logically designed. Finally, the system is expected to reflect the trend of user orientation. The public library evaluation index system established by the study is as shown in the Table 91.1 (Nitecki 1996).

**Table 91.1** Public library service quality evaluation index system

Evaluation index	Evaluation content	Result (each level's percentage)			
		Excellent	Good	Medium	Bad
B1: Library as place	C1: Readers can study and think quietly in this public library	0.5060	0.3810	0.1071	0.0060
	C2: Library overall environment is neat, comfortable and attractive	0.4048	0.4762	0.1012	0.0179
	C3: Library installation arrangement is reasonable	0.2798	0.4702	0.2202	0.0298
	C4: Library literature resources distribution is reasonable	0.2679	0.3988	0.2857	0.0476
	C5: library rules and regulations are reasonable (opening hours, overdue books regulations, the number of borrowed books and the time limit to borrow books)	0.2143	0.4643	0.2262	0.0952
B2: Affect of service	C6: Library guidance and marks are clear and beautiful	0.5595	0.3393	0.0893	0.0119
	C7: Library is equipped with enough software and hard devices available	0.1369	0.4881	0.2857	0.0893
	C8: Librarians treat readers politely and friendly	0.3214	0.3333	0.2857	0.0595
	C9: Librarians dress neatly and behave politely	0.1071	0.4583	0.3452	0.0893
	C10: Librarians enhance readers' confidence of using the library	0.0536	0.3750	0.4405	0.1310
	C11: Librarians response to the requirement of readers quickly	0.1548	0.4405	0.3452	0.0595
	C12: Librarians have enough knowledge and skills to deal with readers' problems	0.3095	0.3929	0.2024	0.0952
	C13: Librarians pay attention to and understand the personalized requirements of the readers, and provide satisfactory help	0.0714	0.2024	0.5536	0.1726
	C14: Librarians solve the readers' problems sincerely and reassuringly	0.2798	0.4048	0.2798	0.0357
	C15: Library usually opens the training courses and knowledge lectures which is helpful to readers	0.4286	0.3095	0.2321	0.0298
B3: Information control	C16: Library responses to the readers' criticisms and advices and improves them in time	0.1726	0.3393	0.3869	0.1012
	C17: Journals, newspapers and magazines are kept in the library perfectly and easy to be found	0.2679	0.3452	0.2679	0.1190
	C18: Library collections keep novel and timely	0.2500	0.4940	0.1964	0.0595
	C19: It is easy and convenient for readers to get information they want from library web	0.1964	0.4464	0.3095	0.0476
	C20: Readers can obtain the library electronic resources at home or in office	0.3393	0.3333	0.2202	0.1071
	C21: Readers can obtain the information they want without help from others in the library	0.1429	0.1964	0.4702	0.1905
	C22: Interlibrary loan and document delivery service is timely and efficient	0.0893	0.2798	0.4048	0.2262
	C23: Library provides readers services of printing, copying and duplicating	0.1607	0.2262	0.4524	0.1607

## 91.4 Fuzzy Analytic Hierarchy Process

Analytic hierarchy process (AHP) was proposed by the famous operation researcher T. L. Satty in the 1970s of 20th century. It is a multi-objective decision making method and a combination of quantitative and qualitative analysis. The basic idea of the method is to establish an orderly hierarchical system, by analyzing the elements of complex systems and their mutual relations. Then by comparing the relative importance of factors, give the ratio of the corresponding scale, and construct judge matrix of the upper structure and lower one. In order to meet the principle of consistency, evaluate the weight value to provide the basis for decision-making and evaluation. Based the method of AHP, Van Laarhoven and Pedryczw (1983) proposed a extension model of AHP, which used fuzzy set to replace the numbers of the judge matrix, and then got the fuzzy weights of each element. The extension model formed the basis for fuzzy analytic hierarchy process (FAHP). With the help of the ideas of classification in AHP, FAHP established fuzzy consistent relation and the fuzzy consistent matrix based on fuzzy set theory, which made that the decision-making model agree with the people's habits of mind and that it be more easily to test the consistency of judge matrix. Fuzzy analytic hierarchy process organically integrated the quantification and objectivity of AHP with the compatibility of fuzzy comprehensive evaluation to be a decision-making method with great applicability, which is mainly based on the following definitions, theorems and conclusions:

**Definition** If the matrix  $A = (a_{ij})_{n \times n}$  satisfies  $0 \leq a_{ij} \leq 1$  ( $i, j = 1, 2, \dots, n$ ), then  $A$  is called fuzzy matrix; If the fuzzy matrix  $A = (a_{ij})_{n \times n}$  satisfies:  $a_{ij} + a_{ji} = 1$  ( $i, j = 1, 2, \dots, n$ ), then fuzzy matrix  $A$  is called fuzzy complementary matrix; If the fuzzy matrix  $A = (a_{ij})_{n \times n}$  satisfies that  $\forall i, j, k$  make  $a_{ij} = a_{ik} - a_{jk} + 0.5$  ( $i, j = 1, 2, \dots, n$ ), then fuzzy matrix  $A$  is called fuzzy consistent matrix.

**Theorem 1** Fuzzy complementary matrix has the following properties:

$$\textcircled{1} a_{ij} = 0.5 (i = j); \textcircled{2} a_{ij} + a_{ji} = 1; \textcircled{3} \left[ \sum_{k=1}^n a_{ik} \right] + \left[ \sum_{k=1}^n a_{ki} \right] = n; \textcircled{4} \frac{1}{2} \leq \sum_{k=1}^n a_{ik} \leq n - \frac{1}{2}; \textcircled{5} \sum_{i=1}^n \sum_{j=1}^n a_{ij} = \frac{n^2}{2}.$$

**Theorem 2** The necessary and sufficient conditions of that fuzzy complementary matrix  $R = (r_{ij})_{n \times n}$  is fuzzy consistent matrix are: the difference of any specified row (column) elements and the remaining rows (columns) corresponding elements is a constant, or there is a vector  $W = (w_1, w_2, \dots, w_n)^T$ , which is  $n$ -order, non negative and normalized, and a positive number  $a$  to make  $a_{ij} = a(w_i - w_j) + 0.5$ , ( $i, j = 1, 2, \dots, n$ ).

**Theorem 3** If the elements and weights of fuzzy judge matrix  $A$  satisfies:  $a_{ij} = a(w_i - w_j) + 0.5$ , Then,

$w_i = \frac{1}{n} - \frac{1}{2a} + \frac{1}{na} \sum_{k=1}^n a_{ik}$ . Where,  $a$  is a parameter satisfying  $a \geq \frac{n-1}{2}$ ; and  $\forall i, j \in \Omega$  make  $|w_i - w_j| \leq \frac{1}{n-1}$ ,  $0 \leq w_i \leq \frac{2}{n}$ .

In Theorem 3, usually let  $a = \frac{n-1}{2}$ , then  $w_i = \frac{1}{n(n-1)} \left[ 2 \left( \sum_{k=1}^n a_{ik} \right) - 1 \right]$  ( $i, j = 1, 2, \dots, n$ ).

**Theorem 4** Construct a fuzzy complementary matrix  $A = (a_{ij})_{n \times n}$ , where  $a_{ij}$  represents the relative important degree of  $a_i$  comparing with  $a_j$ .

Let  $d_i = \sum_{k=1}^n a_{ik}$ ,  $b_{ij} = \frac{(d_i - d_j)}{e} + 0.5$ , then matrix  $B = (b_{ij})_{n \times n}$  is fuzzy consistent matrix.

About the value of  $e$  in theorem 4, Xu Zeshui mentioned: according to the property ④ of the theorem 1, then  $\frac{1}{2} \leq d_i \leq n - \frac{1}{2}$ , therefore,  $1 - n \leq d_i - d_j \leq n - 1$ ; and according to  $0 \leq b_{ij} \leq 1$  and theorem 2, then  $e \geq 2(n - 1)$ . Considering that the value range of  $b_{ij}$  is smaller if  $e$  is bigger, it had better to let  $e$  values minimum to make the matrix  $B$  retain the information of matrix  $A$  as much as possible (Xu 1997).

## 91.5 Public Library Service Quality Evaluation Model Based On FAHP

### (A) Establishing the Hierarchical Structure System

Based on literature review and expert interviews this study has established the public library service quality evaluation index system with reference to LibQUAL<sup>TM</sup>. The index system includes 3 levels (library as place, affect of service and information control) and 23 indicators as shown in Table 91.1 (Coleman et al. 1997).

### (B) Weighting Coefficient

In order to determine the relative importance of elements, 0.1 ~ 0.9 fuzzy judgment scales are established as shown in Table 91.2 (Zhang 2000).

Two public library senior managers and two readers who have accumulated rich experience in library were invited to take part in questionnaire survey and interview consulting the index weight (Thompson et al. 2003). First of all, the first expert compared the importance of one first level indicator with another according to the public library service quality standards, and the fuzzy judgment scale values were obtained to work out the fuzzy complementary judgment matrix of relative importance degree:

**Table 91.2** Fuzzy judgment scales

Scale	Definition	Description
0.5	Equally important	Two elements are equally important
0.6	Slightly more important	One element is slightly more important than another
0.7	Obviously more important	One element is obviously more important than another
0.8	Much more important	One element is much more important than another
0.9	Extremely more important	One element is extremely more important than another
0.1, 0.2, 0.3, 0.4	Conversely comparison	$r_{ij}$ is the judgment value obtained to compare the element $a_i$ with the element $a_j$ , $r_{ji} = 1 - r_{ij}$ is the judgment value obtained to compare $a_j$ with $a_i$

$$A = \begin{pmatrix} 0.50 & 0.25 & 0.35 \\ 0.75 & 0.50 & 0.60 \\ 0.65 & 0.40 & 0.50 \end{pmatrix}$$

According to the theorem 2, A is not fuzzy consistent matrix and is converted to B according to theorem 4 :

$$B = \begin{pmatrix} 0.5000 & 0.3125 & 0.3875 \\ 0.6875 & 0.5000 & 0.5750 \\ 0.6125 & 0.4250 & 0.5000 \end{pmatrix}$$

B is fuzzy consistent matrix.

According to the theorem 3, the weight vector of the first level indicators is calculated as follows:

$$W_{A1} = (0.2333 \quad 0.4208 \quad 0.3458)^T$$

Similarly, the weight vectors of the first level indicators according to the three other experts' judgment can be obtained.

$$W_{A2} = (0.1833 \quad 0.4083 \quad 0.4083)^T$$

$$W_{A3} = (0.2583 \quad 0.3583 \quad 0.3833)^T$$

$$W_{A4} = (0.3083 \quad 0.3333 \quad 0.3583)^T$$

Suppose all the authorities of experts close to be equal, the first level index weight vector derived from judgment of experts group is finally obtained as follows:

$$W_A = (0.2458 \quad 0.3802 \quad 0.3739)^T$$

Next, calculate the second level index weight vectors similarly:

$$\begin{aligned} W_{B1} &= (0.1587 \quad 0.1298 \quad 0.1412 \quad 0.1390 \quad 0.1581 \quad 0.1129 \quad 0.1606)^T \\ W_{B2} &= (0.1329 \quad 0.1432 \quad 0.0377 \quad 0.1188 \quad 0.1773 \quad 0.0803 \quad 0.1113 \quad 0.0736 \quad 0.1249)^T \\ W_{B3} &= (0.1923 \quad 0.2101 \quad 0.1436 \quad 0.1347 \quad 0.1148 \quad 0.0712 \quad 0.1333)^T \end{aligned}$$

### (C) Evaluation Matrix

Evaluation language level includes four grades  $v_1 = \text{Excellent}$ ,  $v_2 = \text{good}$ ,  $v_3 = \text{medium}$ ,  $v_4 = \text{bad}$ . Comments set is  $V = \{v_1 \quad v_2 \quad v_3 \quad v_4\}$ . For purposes of comparison, quantify the qualitative evaluation as a further move, and make “95 points, 80 points, 70 points and 55 points” correspond “excellent, good, medium and bad” respectively. Therefore, comments weight Set is obtained as  $V = \{95 \quad 80 \quad 70 \quad 55\}$ .

The paper version of questionnaire is designed according to the public library service evaluation system as shown in Table 91.1. With the permission of the public library in Quanzhou City, 200 copies of questionnaire are delivered to readers in its reading rooms. 179 copies are recovered. The recovery rate is 89.50 %. After screening, 168 copies are valid. Valid rate is 93.85 %. Four grades (excellent, good, medium and bad) of each item or sentence are provided for reader to select. For example, in the item “Readers can study and think quietly in this public library (B1)”, 50.6 % of readers rate “excellent”, 38.1 % rate “good”, 10.71 % rate “medium”, 0.6 % rate “bad”. Then, the evaluation vector for B1 is generated as (0.5060 0.3810 0.1071 0.0060).

Similarly, we can calculate the evaluation matrix as shown below (Only the index evaluation matrix of first level “library as place” is listed here for space limitation):

$$R_{B1} = \begin{pmatrix} 0.5060 & 0.3810 & 0.1071 & 0.0060 \\ 0.4048 & 0.4762 & 0.1012 & 0.0179 \\ 0.2798 & 0.4702 & 0.2202 & 0.0298 \\ 0.2679 & 0.3988 & 0.2857 & 0.0476 \\ 0.2143 & 0.4643 & 0.2262 & 0.0952 \\ 0.5595 & 0.3393 & 0.0893 & 0.0119 \\ 0.1369 & 0.4881 & 0.2857 & 0.0893 \end{pmatrix}$$

Combine the second level index evaluation matrix with weight vector, make the fuzzy conversion of synthetic operation, and then evaluation value matrix are as following:

$$\begin{aligned} B_1 &= W_{B1}^T \circ R_{B1} = (0.3285 \quad 0.4340 \quad 0.1926 \quad 0.0448) \\ B_2 &= W_{B2}^T \circ R_{B2} = (0.2233 \quad 0.3726 \quad 0.3219 \quad 0.0823) \\ B_3 &= W_{B3}^T \circ R_{B3} = (0.2221 \quad 0.3518 \quad 0.3100 \quad 0.1161) \end{aligned}$$

**(D) Comprehensive Evaluation**

$B_1$ ,  $B_2$  and  $B_3$  constitute the first level index evaluation matrix  $R_A = (B_1, B_2, B_3)^T$ . When calculated with weight vector, the first level index evaluation result is obtained as following:

$$\begin{aligned} B = W_A^T \circ R_A &= (0.2458 \ 0.3802 \ 0.3739) \circ \begin{pmatrix} 0.3285 & 0.4340 & 0.1926 & 0.0448 \\ 0.2233 & 0.3726 & 0.3219 & 0.0823 \\ 0.2221 & 0.3518 & 0.3100 & 0.1161 \end{pmatrix} \\ &= (0.2487 \ 0.3799 \ 0.2856 \ 0.0857) \end{aligned}$$

Quantify the result as a further step:

$$Q = B \circ V^T = (0.2487 \ 0.3799 \ 0.2856 \ 0.0857) \circ (95 \ 80 \ 70 \ 55)^T = 78.72$$

The evaluation result shows that :in this investigation, 24.87 % of readers think library service is excellent, 37.99 % think it's good, 28.56 % think it's medium, 8.57 % think it's bad. Generally the public library service quality is good, but there are still many areas in need of improvement. For example, we can see from Table 91.1 that this library don't do well in paying attention to readers' personalized demands and strengthening readers confidence to use the library. In addition, Inter-library loan and document delivery service need to be improved.

**91.6 Conclusion**

The study constructs public library service quality evaluation index system mainly with reference to LibQUAL<sup>+TM</sup> and comprehensively evaluates the public library service quality based on FAHP, which is a method combining qualitative analysis with quantitative analysis. The significance of the research is reflected in the following aspects:

Firstly, the index system referring to the most influential evaluation system in international library area makes the public library service quality evaluation work partially converge with international trend. The LibQUAL<sup>+TM</sup> evaluation system has been widely used in foreign library service quality evaluation. After many times' validation and revision, the index system has become more and more mature and stable, and of a pretty strong reference value for our public library service quality evaluation. Furthermore, comparing with LibQUAL<sup>+TM</sup>, the method in this study is simpler and cheaper. It is suitable for many domestic public libraries service quality routine evaluation.

Secondly, the index system is user-oriented. In essence, library is a kind of service agency. Along with the library's competition changing from collections competition to management and service competition, public library service quality evaluation work must focus on service and users.

Finally, the study takes the fuzziness and complexity in the public library service quality evaluation process into Consideration. Many concepts of the library service quality evaluation are of much uncertainty. The study comprehensively considers the various service quality factors and introduces fuzzy mathematics into the method, which improves the accuracy and scientific in the evaluation.

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# Chapter 92

## Conceptualizing the Chinese Consumer's Self-Concept

Wei-hong Zhao and Hai-qing Zhu

**Abstract** This study empirically develops a model for consumers' self-concept from the Chinese perspective. The evidence from in-depth interviews and random samples shows that the Chinese consumer's self-concept contains a six-dimension construct. They are instinct self-concept, real self-concept, ideal self-concept, actual self-concept, social self-concept, and ideal social self-concept.

**Keywords** Actual • Self-concept • Ideal self-concept • Ideal social self-concept • Instinct self-concept • Real self-concept • Social self-concept

### 92.1 Introduction

In a competitive market, understanding of consumer self-concept is the key to find the intrinsic motivation of consumer behavior, and gain a competitive advantage. The effects of self-concept on attitudes, preference, and purchase intentions have been confirmed empirically in various studies involving products/brands (e.g., Wu and Chan 2011; Chang 2010; Yim et al. 2007). The previous studies mostly quote the conceptual model proposed by Sirgy (1982) or the conceptual model proposed by Brewer and Chen (2007). In spite of that, it is necessary for marketers to understand Chinese consumers' self-concept because of the differences between east culture and west culture. The purpose of this study is to develop a model for Chinese consumers' self-concept, and empirically investigate its validity based on literature review and in-depth interviews.

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## 92.2 Theoretical Background

### 92.2.1 *Definition and Dimensions of Consumers' Self-Concept*

Despite the fact that there is no precise definition of self-concept in the consumer behavior literature, a basic definition of this term is: “totality of the individual’s thoughts and feelings having reference to himself/herself as an object” (Rosenberg 1979). Considering the importance of consumers’ self-concept in consumer behavior literature, a number of investigators have discussed its dimensions.

As shown in Table 92.1, these researches of consumer self-concept construction have varied from one-dimensional perspective to multidimensional one. Despite the lacking of agreement of consumers’ self-concept, its multidimensionality is the trend.

## 92.3 Research Model

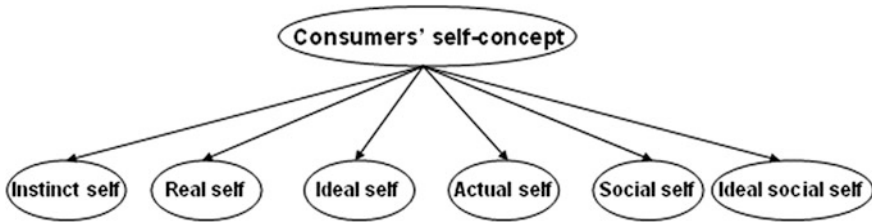
### 92.3.1 *Proposed Self-Concept Model*

To explore Chinese consumers’ self-concept, this study makes an in-depth interviews to 68 Chinese consumers based on the literature. This study divides the dimension “actual self-concept” proposed by Sirgy (1982) into two dimensions: “real self-concept” with natural attributes and “actual self-concept” with social attributes. During in-deep interviews, the study found that some consumers’ behavior should be caused by hunger, cold, sex, and so on. So, “instinct self-concept” is proposed. Based on the above, this study proposes a six-dimension self-concept model (Fig. 92.1).

1. *Instinct self*: According to Freud, the personality is composed of three parts: Id, ego, and superego. Among them, the Id refers to the original I, including basic desires, impulses and vitality. To be a consumer, there are many needs caused by instinctive physiological conditions at any time. For example, starvation, thirst, discomfort, curious and so on. Instinct self-concept is dominated by consumers’ instinct behavior. Faced with special stimulus, consumers will act with a fixed mode.
2. *Real self and actual self*: Sirgy (1982) defined actual self as how individuals think about themselves, and though it can be seen as one of the self-concept’ dimensions. However, he did not distinguish this term from the perceptive of human nature. In this paper, we define real self-concept as how individual considers himself/herself from the natural attribute, including his own personality, values, and the pursuit of ability. Meanwhile, we define actual self-concept as how individual considers himself/herself from the social attribute,

Table 92.1 The dimensions of consumers' self-concept

Scholar(s)	Instrument	Conceptual model	
		First-order	Second-order
Belch and Landon (1977)		Actual self-concept, ideal self-concept	
Schenk and Holman (1980)		Individual repertoire of self-image, perception of others in a specific situation	Situational self-image
Sirgy (1982)	Theory review	Actual self-image, social self-image, ideal self-image and ideal social self-image	
Onkvisit and Shaw (1987)	Theory review	Real self (actual or objective self), self-image (subjective self), ideal self (self-actualization) and looking-glass self (social self)	
Adam and Scott (1998)	Motor vehicle market	Ideal self, apparent self, social self, perceived self, and actual self	
Waugh (2001)	University students	Capability, perception of achievement, and confidence; same-sex peer, opposite-sex peer, and family; physical, personal confidence, and honesty/trustworthy	Academic self-concept social self-concept presentation of self
Fu (2001)	Chinese common consumer	Actual self-concept, ideal self-concept, social self-concept, ideal social self-concept, desired self-concept	
Yang (2002)	Chinese female consumer	Family self, feeling self, freedom self, fashion self, fervor self	
Carlos (2006)	Public	One's own traits, attitudes, preferences; social norms, group memberships, others' opinion	Independent self-concept interdependent self-concept
Lv and Zou (2006)	Chinese male consumer	Social self, enterprising self, loving self, familial self	
Brewer and Chen (2007)	Theory review	Individual self-concept, relational self-concept, and collective self-concept	
Cooper and Sherry (2010)	Consumer self-concept	Individualist self-concept orientation, relationist self-concept orientation, collectivist self-concept orientation	



**Fig. 92.1** Conceptual model for consumer's self-concept

including his/her social role, social responsibility awareness and so on. Actual self-concept refers to people linked with others.

3. *Ideal self*: According to George and Jae, an individual is cognizant of not only what she/he is, but also what she/he wishes to be (George and Jae 1991). In general, ideal self-concept is the reference point with which actual self is compared. If there is a gap between them, an individual strives to achieve the ideal state. In this respect, ideal self is a motive force driving an individual upward. Ideal self-concept refers to how a person would like to perceive himself/herself.
4. *Social self*: From the sociological perspective, social risk is defined as the extent to which consumers think that other people judge them on the basis of the product or a brand they use (Jacoby and Kaplan 1972). Consumers live in a society associated with others, and other people's opinions would influence their judgments more or less. Lee (1990) suggests that social risk is one of the multiple dimensions of perceived risk which consumers subjectively have in product purchase and/or consumption situation. Social self-concept refers to how a person thinks about others' opinions on him/her.
5. *Ideal social self*: Ideal social self-concept is the ideal state of social self-concept. If there is a gap between them, an individual would strive to achieve the social self's ideal state. Sirgy (1982) regards Ideal social self-concept as one of the self-concept' dimensions and defines it as how a person would like others to consider him/her.

## 92.4 Research Method

### 92.4.1 Measures

To ensure the content validity of the scales, all items selected for each construct in this study were adapted from the extant literature. Each construct was measured using multiple items, fully anchored on the basis of a seven-point Likert scale ranging from "strongly disagree" to "strongly agree".

### ***92.4.2 Data Collection and Sample Characteristics***

This study surveyed customers by street survey manner, E-mail, and QQ online questionnaires in a random sample. Total of 650 questionnaires were sent out, and 45 invalid questionnaires were removed, 503 questionnaires eventually were used in the empirical analysis, which gives an effective response rate of 84.3 %.

## **92.5 Results**

### ***92.5.1 Measurement Assessment***

For verifying the validity of the questionnaire items, principal component analysis with varimax rotation was used to draw out 6 factors. The results show, Kaiser-Meyer-Olkin test value ( $0.905 > 0.5$ ) indicates that a sample is sufficient, Bartlett's sphericity validation value ( $p = 0.00; < 0.05$ ) indicates correlation matrix of all variables were statistically significant. So factor analysis model is appropriate. As shown in Table 92.2, one item of Instinct self-concept (x15) appeared cross loading and it was removed for verifying the single dimension of the items. The remaining items are loading to a single factor, and loading benchmark is over 0.5, indicating good discriminant validity and convergent validity. Moreover, the internal consistency of the rest of the variables was verified with Cranach's alpha values by this study. The results are indicated that the measurement of the concept of the study asked the items have higher internal consistency. A confirmatory factor analysis is shown in Table 92.3, 3 items(x25, x45, and x54) were removed because modified index is not fit for setting strict benchmarks in 10. The other items show significant convergent validity, discriminant validity, and superior model fit degree. Finally, this study use AMOS 7.0 to test the overall measurement model of Self-concept, whose modified index set strict benchmarks in 10 (shown in Table 92.4).

### ***92.5.2 Test of the Structural Model***

As shown in Fig. 92.2, the conceptual model in statistics is reasonable.

**Table 92.2** Analysis results: principal component and reliability

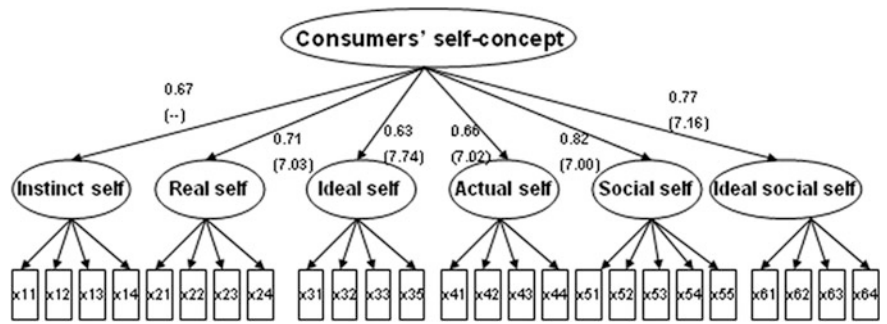
Constructs	Items	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Cranach's alpha
Instinct self	x11	0.54						0.67
	x12	0.77						
	x13	0.56						
	x14	0.61						
Real self	x21		0.70					0.76
	x22		0.65					
	x23		0.71					
	x24		0.73					
	x25		0.64					
Ideal self	x31			0.73				0.80
	x32			0.72				
	x33			0.70				
	x34			0.65				
	x35			0.68				
Actual self	x41				0.58			0.76
	x42				0.66			
	x43				0.73			
	x44				0.78			
	x45				0.62			
Social self	x51					0.56		0.73
	x52					0.54		
	x53					0.67		
	x54					0.62		
	x55					0.66		
Ideal social self	x61						0.62	0.77
	x62						0.67	
	x63						0.66	
	x64						0.70	

**Table 92.3** Results of CFA

Constructs	Items before CFA	Items after CFA	X <sup>2</sup>	(d.f.)	p	GFI	AGFI	RMR	NFI	CFI	RMSEA
Instinct self	4	4	2.2	2	0.33	–	0.99	0.02	0.99	–	0.02
Real self	5	4	2.1	2	0.35	–	0.99	0.02	–	–	0.01
Ideal self	5	5	7.9	5	0.16	0.99	0.98	0.03	0.99	–	0.03
Actual self	5	4	3.5	2	0.18	–	0.98	0.03	0.99	–	0.04
Social self	5	4	3.8	2	0.15	–	0.98	0.03	0.99	–	0.04
Ideal social self	4	4	4.4	2	0.11	–	0.98	0.03	0.99	–	0.05

**Table 92.4** Evaluation results: overall measure model

Constructs	Correlation matrix					
	1	2	3	4	5	6
Instinct self	1					
Real self	0.27	1				
Ideal self	0.56	0.29	1			
Actual self	0.33	0.44	0.39	1		
Social self	0.27	0.44	0.31	0.36	1	
Ideal social self	0.30	0.39	0.30	0.36	0.58	1
Mean	4.75	4.62	4.81	4.60	4.67	4.84
Standard deviation	1.14	1.32	1.20	1.29	1.24	1.26
Concept reliability	0.82	0.80	0.87	0.78	0.86	0.82
AVE	0.53	0.51	0.57	0.47	0.61	0.54
Model fit	$X^2(264 \text{ d.f.}) = 448.228, p = 0.000, GFI = 0.93, AGFI = 0.92,$ $NFI = 0.89, TLI = 0.94, CFI = 0.95, RMSEA = 0.04$					



**Fig. 92.2** Result of SEM

## 92.6 Conclusions and Discussion

Firstly, consumers’ self-concept includes natural attribute and social attribute, and contains six dimensions: instinct self-concept, real self-concept, ideal self-concept, actual self-concept, social self-concept, and ideal social self-concept. Secondly, from the perspective of relative contribution of each dimension, social self-concept and ideal-social self-concept are the largest. Sirgy (1982) pointed out that actual self consistency and ideal self consistency received the most support in the previous study. It shows that Chinese consumers are more likely to be affected by the group, and they pay more attention to others’ view and social effect than the western consumers do.

The model of Chinese consumers' self-concept proposed in this study is an improvement of the one proposed by Sirgy (1982). It is important for marketers to pay attention to consumers' demand of social attribute to make effective marketing strategies in Chinese market.

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# Chapter 93

## Confirmatory Factor Analysis of Structure Dimensions About Service Employees' Innovation Behavior

Xia Li

**Abstract** According to service employees' working characteristics, their innovation behavior can be divided into four-dimensional structure, namely innovation orientation, innovation ideas generation, innovation ideas implementation, innovation ideas practice. Based on home and abroad study, the paper designs the questionnaire about service employee innovation behavior, collects many questionnaires for exploratory factor analysis and confirmatory factor analysis, tests service employee innovation behavior's four structure dimensions.

**Keywords** CFA • Innovation behavior • Service employee • Structure dimensions

### 93.1 Introduction

Scholars analyze the concept of individual innovative behavior based on more views, on the one hand highlight individual innovative behavior's "new", new methods, new ideas, the other highlight the process from the idea production to conduct implementation. In order to improve the service quality and customer satisfaction, service employees exert personal knowledge and ability in virtue of organization resources, put forward valuable concepts, new service technologies and methods, new service products and processes, and customer communication methods, and carry out these ideas in work, which mean employees innovation behavior (Lin and Wu 2003).

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## 93.2 Literature Review

Kanter (1988) thought individuals have cognition and attitude toward problems in the initial stages of individual creative, in succession creative individuals have to seek supporters and try to get them to accept, finally creative individuals make the idea or originality to practice and make a prototype or model to produce commercial products or services (Kanter 1988). Scott and Bruce (1994) divided individual innovation behavior into three stages: (1) the establishment of the issue and the generation of ideas or solutions; (2) seek the support of its vision; (3) making innovative ideas “product”, which means the idea into a viable product and widely used, the final completion of its innovative ideas (Scott and Bruce 1994). Kleysen and Street (2001) summarized 289 innovation activities which mentioned in 28 literatures and concluded that individual innovation behavior should include five dimensions, including looking for opportunities, generating ideas, evaluating ideas, seeking support, and application (Kleysen and Street 2001). However, West considered employee innovation behavior consists of two stages, namely the production of ideas which means creativity and the implementation which means the new or improved products and services are implemented in work (West 1987). King and Anderson (1995) also thought that innovation behavior is divided into two stages, namely the idea generation and implementation. In addition the idea generation is a divergent phase, including identification problems, ideas improvements and other activities, the results of this phase is to produce recommendations on innovation (King and Anderson 1995). The implementation phase is a convergence process, the results of this phase are to get the benefits of developing innovation, the demarcation point of two-stage is to make creative decisions.

## 93.3 Analysis on Employee Innovation Behavior of Service Enterprises

There are large differences in methods and processes of production, transmission and consumption between service production and manufacturing production, products in manufacturing sector is relatively closed system, and production in service sector is relatively completely open system (Barras 1986). Service production and consumption are simultaneous, service delivery processes are directly affected by the process of customer needs, which makes service employees innovative behavior is different from the manufacturing employees (Hurt et al. 1977). Combination with service employees work characteristics, employee innovation behavior can be divided into four dimensions.

### ***93.3.1 Innovation Orientation***

Knowing change is as important as obeying habit, this is a tendency. Orientation refers to a person's will intension when he engaging in an act. Innovation orientation means the intention or desire when he attempts make innovation behavior. In the field of psychology, there are "intention model" to predict or explain individual behavior models, advocates that individual intention has a strong positive correlation with actual behavior. Therefore, employees' innovation orientation is a necessary precondition for innovation behavior during work. Innovation orientation is mental performance for the staffs who dare to doubt their knowledge and challenge the work inertia (Lu and Zhang 2007).

### ***93.3.2 Innovation Ideas Generation***

Service employees can receive much information in the ordinary course, which include the system information by organizations supplied, the various proposals by customers supplied and outside relevant information. The convergence of information and knowledge together, it will lead to some innovation ideas for work staff. Innovative thinking is a manifestation of new knowledge, is not a special event, but people's behavior, a way of existence.

### ***93.3.3 Innovation Ideas Implementation***

Ford (1996) pointed out that innovation and custom actions were on behalf of the options of competitive behavior, those who offer fresh ideas for innovation change actually challenge and breach the established theories and preferences of action habits, which will bring a lot of pressure, so employees do not need to use their influence to implement innovative action (Ford 1996). Thus, employees with innovation ideas don't necessarily implement them. To this end, in order to prevent innovation rejected by members of the organization, employees need to get friends, supporters and sponsors' support to ensure the successful implementation of innovation behavior (Woodman et al. 1993).

### ***93.3.4 Innovation Ideas Practice***

Services business is different from the manufacturing industry, employees may make mass production manufacturing in accordance with the technical means or methods (Lin and Wu 2004). But service employees need to face different

customers, different scenes. Therefore, the innovation ideas need to constantly assess and amendment.

93.4 Empirical Analysis

93.4.1 Service Employee Innovation Behavior Scale Design

At present, the most widely used Innovation Behavior Scale is compiled by Scott and Bruce (1994), which scale has six items. These topics are compiled to complete based on Kanter’s innovation stage theory (1988) by Scott and Bruce, and refer to the company CEO and vice presidents’ interviews, however the individual innovation behavior scale was treated as a single dimension, which doesn’t accord with the assumption of the study. In this study Kleysen and Street’s multiple dimensions (2001) are recognized. Meanwhile, these scales are not well in the domestic revised version, considering industry backgrounds, cultural backgrounds, behavior habit and so on, it’s necessary to establish localization innovation behavior scale. Based on domestic and foreign literature, the study scale is designed as follows (Table 93.1).

Table 93.1 Service employees’ innovation behavior scale

Subject	Origin	Coding
1. I will the motivation of changing existing service skills to improve work efficiency	Kleysen and Street (2001)	IB1
2. I like to serve customer with unusual demand	Janssen (2010)	IB2
3. I like to take risks to support new ideas	Zhou and George (2001)	IB3
4. I will identify those opportunities which have positive impact on work, departments, organizations and customers	Kleysen and Street (2001)	IB4
5. At work, I like to find a new service skills, content or technical methods	Scott and Bruce (1994)	IB5
6. For a better idea in heart, I will seek knowledge to support	Janssen (2010)	IB6
7. At work, I will have some innovative ideas or new solutions to problems	Scott and Bruce (1994)	IB7
8. I will actively make new ideas in mental into action	Scott and Bruce (1994)	IB8
9. In the process of implementing new ideas, encounter any obstacles, I would like to continue the new practice	By myself	IB9
10. I like to communicate with customers for my new ideas	By myself	IB10
11. I like to share my new idea with colleagues	Scott and Bruce (1994)	IB11
12. I like to assess the advantages and disadvantages of new ideas, choose the best option	Kleysen and Street (2001)	IB12
13. I like repeating practice on my new ideas	By myself	IB13

### ***93.4.2 Questionnaire Granting and Reclaiming***

These scale questionnaires were granted in service enterprises in Shanghai. 160 samples were collected from services employees, and checked about the questionnaires' validity, and 128 samples were obtained excluding invalid questionnaires at this study. The questionnaire used Likert five component systems, asked respondents to use "1", "2", "3", "4", "5" to represent their point (Lu 2002).

### ***93.4.3 Reliability Analysis***

The scale's terms maybe truly reflect measurement purposes, but some might be "junk term", if you do not delete these junk terms, which may lead to variable result in multiple dimensions, and it's difficult to explain the meaning of each factor. Therefore, it's necessary to discriminate analysis on subjects.

The Corrected-Item Total Correlation (CITC) is a good identification indicator (Ma 2002). CITC between  $-1$  and  $1$ , it's positive closer to  $1$ , which means the higher correlation. Generally considering, if the term's CITC is less than  $0.3$ , and the term is deleted, Cronbach  $\alpha$  increases, then delete the term (Lu 2002). Meanwhile, if Cronbach  $\alpha > 0.9$ , indicating best scale reliability. If Cronbach  $\alpha > 0.8$ , indicating better scale reliability. If Cronbach  $\alpha > 0.7$ , indicating scale reliability to meet the requirements. Therefore, this study carried out SPSS17.0 to analyze scale reliability, concrete analysis as follows.

As can be seen from the result, 13 measured terms' CITC are more than  $0.3$ , but the value of IB3 is relatively low, it is considered to remove with  $\alpha$  coefficient's change. The other items'  $\alpha$  coefficient upgrade when the IB3 is deleted, and at the same time the scale'  $\alpha$  is  $0.918$ , indicating that the questionnaire is stable and reliable when IB3 is deleted.

### ***93.4.4 Exploratory Factor Analysis***

As a special method of factor analysis, exploratory factor analysis (EFA) is an important pre-statistical method for observed variable indicators to measure the latent variable factor. Particularly when the relationship between observed variables and latent variable indexes is not clear with the lack of adequate theoretical basis, it's necessary to make use of exploratory factor analysis.

In this paper, the principal component analysis was adopted with greatest variance rotation to extract common factor. The following principles: (1) as the number of selected factors, select the factor whose eigenvalue is more than  $1$ . (2) Projects' loading rate in their respective factor must be greater than  $0.5$ , which means convergent validity. (3) Each item in its factor load must be close to  $1$

**Table 93.2** Employees’ innovation behavior scale KMO and Bartlett test

KMO		0.743
Bartlett test of sphericity	Approximate Chi square	259.070
	df	66
	Sig	0.000

(the bigger the better), but the load on other factors must be close to 0 (the smaller the better), so it has discriminant validity.

1. *KMO and Bartlett Test*

It’s necessary to determine the suitability of factor analysis of scale after all terms amendment. KMO (Kaiser-Meyer-Olykin Measure of Sampling Adequacy) and Bartlett spherical test (Bartlett Test of Sphericity) are commonly used. Generally considering, KMO above 0.9 is ideal, 0.8–0.9 is very suitable, 0.7–0.8 is fit, 0.6–0.7 is unsuitable, 0.5–0.6 is reluctant, below 0.5 is not suitable. Bartlett spherical test statistics significance probability is less than or equal to the significance level, factor analysis can be used (Ma 2002).

From Table 93.2, KMO of employee innovation behavior scale is more than 0.7, Bartlett test statistical significance is 0.00, that is suitable for factor analysis.

2. *Result analysis*

Through Table 93.3 analysis, employee innovation behavior scale can extract four factors, and 68.06 % of the variance in total is explained. If the total variance explained is more than 60 %, which means a better construct validity (Wangli 2004). So the innovation behavior scale has good construct validity.

**Table 93.3** Employees’ innovation behavior scale EFA result

Component matrix				
Item	Component			
	1	2	3	4
IB1	0.678	−0.234	−0.304	0.314
IB2	0.635	0.296	−0.396	−0.372
IB4	0.538	−0.239	0.244	0.270
IB5	0.598	−0.170	−0.550	0.074
IB6	0.489	−0.252	0.577	−0.348
IB7	0.602	0.031	0.523	0.268
IB8	0.230	0.818	0.173	0.214
IB9	0.626	0.506	0.020	−0.041
IB10	0.206	0.684	0.034	−0.288
IB11	−0.02	−0.142	−0.227	0.721
IB12	−0.430	−0.266	0.173	0.664
IB13	0.498	−0.096	0.049	0.645

*Extraction method* Principal component analysis

93.4.5 Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) is based on specific theory or concept theoretical framework, evaluates the theoretical point’s reasonable problem by the mathematical procedure. It’s a sub model of structural equation model (SEM) and a particular application.

1. Model building

As shown in Fig. 93.1, 12 items of innovation behavior scale belong to the four latent variables who are relevant, they are innovation orientation (using Orientation to express), innovation ideas generation (Ideas), innovation ideas implementation(Implementation), innovation ideas practice(Practice), and each of which latent variable contains three measure index.

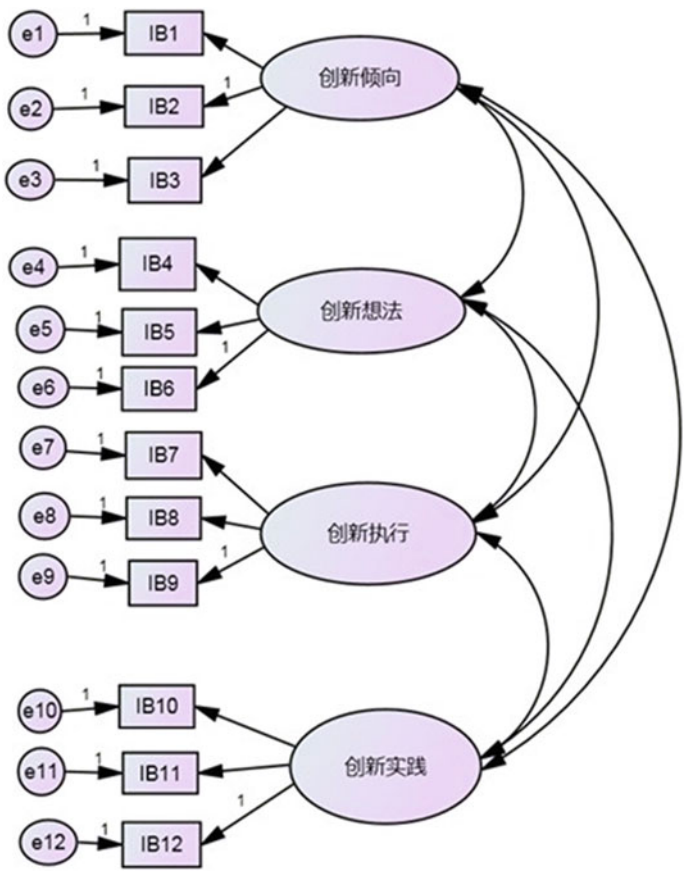


Fig. 93.1 Assumption model for CFA of service employees’ innovation behavior scale

2. Model Identification

According to the t rules, the model has 12 measure items, so  $q(q + 1)/2 = 78$ , the model needs to estimate 12 factor loadings, 12 error variances and 4 correlation coefficients, A total of 30 parameters will be estimated,  $t = 30 < 78$ , which meets the necessary conditions for model identification.

3. Model Parameter Estimation and Modify

After running AMOS18.0, the model fit is not ideal. Among modification indices, the maximum modification indice exists  $e7 \leftrightarrow$  innovative ideas with 13.586, and  $e2 \leftrightarrow$  innovation implemented with 13.533, and  $e6 \leftrightarrow e7$  with 14.482. So the model needs modifying according to modification indices (Fig. 93.2).

4. Model Estimation after modification (Fig. 93.3)

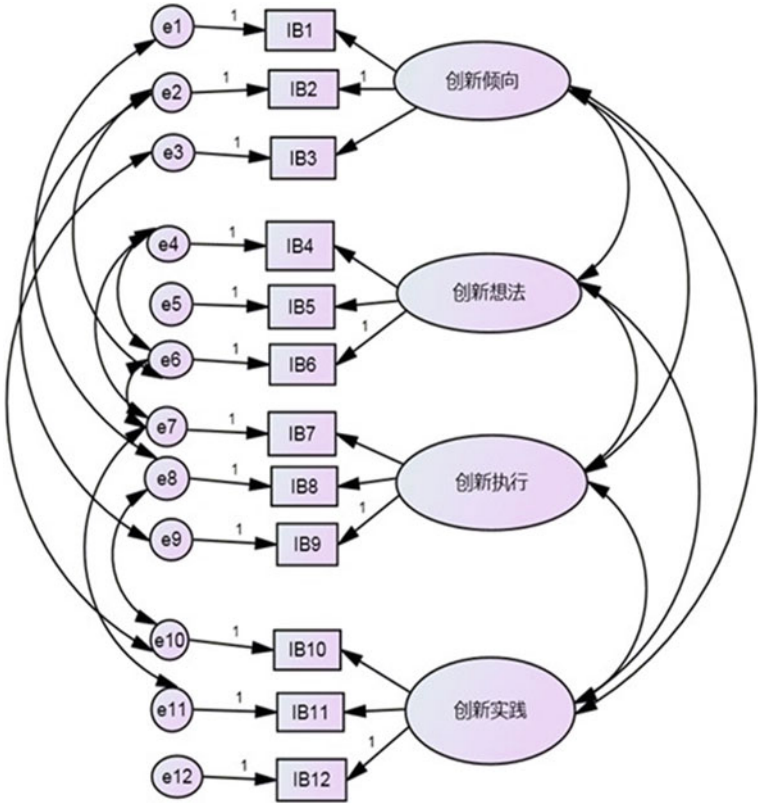


Fig. 93.2 Modification model for CFA of service employees' innovation behavior scale

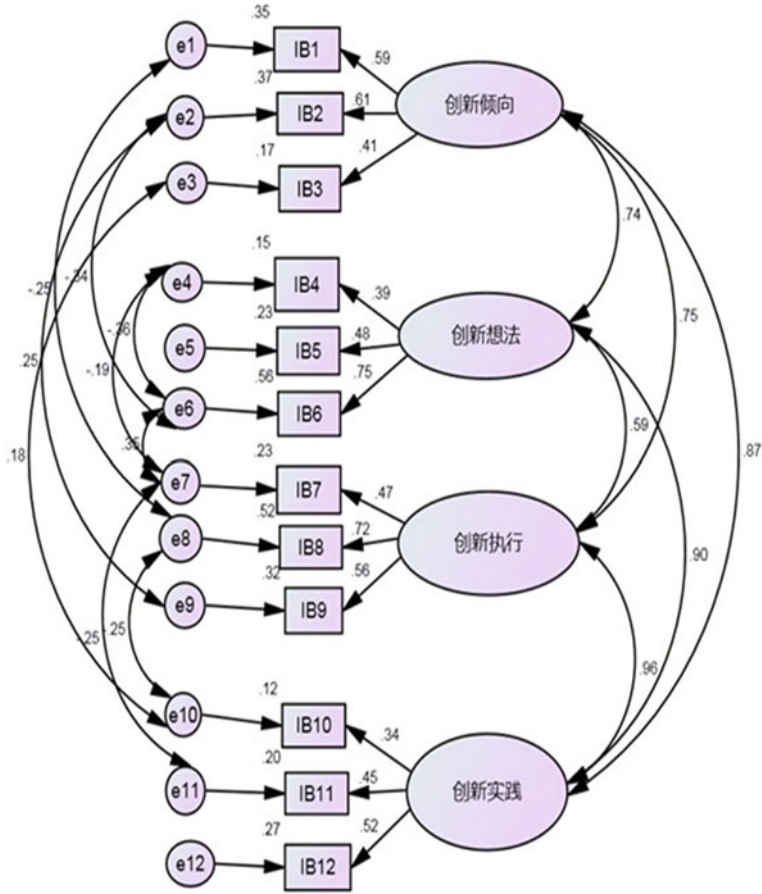


Fig. 93.3 CFA of service employees' innovation behavior scale

### 5. Result Analysis

Through SEM coefficient estimates and model fit indices, the model's CMIN/DF is 1.49, less than 2. In general, the Chi square degrees of freedom ratio is less than 2, which means the better goodness of fit of the assumptions model (Carmines and McIver 1981). Meanwhile, except PGFI, NFI, RFI close to the standards, other indicators have been fitted to standard, so the model has better goodness of fit.

While the path coefficient results have good reliability, in addition to the correlation coefficient between innovation ideas implementation and innovation ideas is 0.59, the correlation coefficient between the other dimensions are above 0.7, indicating that these dimensions have correlation with each other.

Through the issuance and collection of questionnaires and SPSS software analysis, on the one hand the scale is verified to have good reliability and validity,

on the other hand the scale is tested to have four-dimensional structure, namely innovation orientation, innovation ideas generation, innovation ideas implementation, innovation ideas practice.

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# Chapter 94

## Evaluation and Analysis of Competitiveness in Market Industry

Yong Cui, Yuan-sheng Huang and Xin-bo Dai

**Abstract** With China's accession to WTO and the development of Market economy, supermarket industry in China achieved rapid development. In this paper, we studied large supermarkets in Big Cities, through frequency analysis, correlation analysis, cross-table analysis, principal component analysis and other methods, using SPSS17.0 software. Then the current various problems of market industry and propose improvement measures and views were put forward.

**Keywords** Market industry · Market competitiveness · Market analysis · Marketing strategy

### 94.1 Introduction

Using modern goods solve the traditional retail store locations by the way of bulk purchases and retail sales, lower commodity price was restricted by a fixed form of small and scattered (Kogut and Kulatilaka 1994; Kim 2003; Kara et al. 2004; Eriksson and Lofmarck 2000; Andersen 2001). Now, most of the studies at home and abroad focused on the commercial street of the city center building, shopping center development and design, while the supermarket business management, strategy and practice analysis, and supermarkets' structure of geographical space

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in the city mode were much more concentrated in exploring the supermarket (Andersen 2001; Harris and Goode 2004; Alessandri et al. 2004; Isik et al. 2003; Lambrecht and Perraudin 2003).

Previous studies more focused on marketing strategy, management theory research (Lambrecht and Perraudin 2003; Mruto and Keppo 2004; Leimeister et al. 2009). In this paper, the major supermarkets of Big Cities were set as the research object, through site visits, surveys, and access to relevant literature and other means, the cause of the problems in the marketing strategies of Big Cities supermarket were more fully explained by using SPSS software to analyze the collected data.

94.2 Analysis of Market Industry in Big Cities

In this paper, the existing supermarkets in big cities were used for the study, which were RT-Mart, Huiyou, Hualian, Zhonglou, the North, SPAR, Baobai. First, consumers choose the order in the supermarket frequency analysis.

Table 94.1 shows that 70 % of people will choose to RT-Mart, 50 % of people will choose to Hualian, followed by Huiyou, Baobai, SPAR, Zhonglou and the North.

94.2.1 Inappropriate Siting

Some supermarkets located in Big Cities were not very reasonable. In the following, we take Baobai as an example to illustrate this problem.

There are three branches: Big Cities Department Store which is located on Yuhua road, Baobai Shopping Plaza which is in High open area and Baobai Shopping home which is in Mature business district in the southwest side of Big Cities. They are all located in the economically more developed regions, but only the Baobai Shopping

Table 94.1 Frequency analysis of supermarket choice

		RT-Mart		Huiyou		Hualian		Zhonglou	
		Fre	Per	Fre	Per	Fre	Per	Fre	Per
Effective	0	6	30	13	65	10	50	17	85
	1	14	70	7	35	10	50	3	15
	Total	20	100	20	100	20	100	20	100
		Zhonglou		Beiguo		SPAR		Baobai	
		Fre	Per	Fre	Per	Fre	Per	Fre	Per
Effective	0	17	85	18	90	16	80	14	70
	1	3	15	2	10	4	20	6	30
	Total	20	100	20	100	20	100	20	100

Plaza approved by the people. For example, although the Big Cities Department Store, which is located on Yuhua road, is located in Big Cities City Centre, and the Yuhua Road is also the most prosperous commercial pedestrian street, where is full of popular and rich commercial atmosphere, what's more, there is only 200 meters around from the places of interest Zhilizongdushu and Lianhuachi. We didn't note that various of brand stores were opened on this street, so as to the road was very crowded, then there were not enough space for consumers of the building to park their car. On the positioning in the high-level consumer protection hundred buildings, there is no wide parking lot will be fatal to its development.

### ***94.2.2 Lack of Unique Market Position***

From the perspective of marketing strategy, the main problem of Big Cities supermarkets is that lack of a unique market position. Today, individual consumer demand is more and more obvious and differences in consumer demand has become increasingly evident, in this condition, stereotyped supermarket not only can not attract consumers to their supermarkets to buy goods, but will result in excessive competition between the major supermarkets, and eventually the result is a waste of resources and the consequences of falling profits.

### ***94.2.3 Lack of Unique and Appropriate Mix Marketing***

As people's living standards improve more and more, people began to attach importance to meet the spiritual and psychological needs. That is to say, there is a growing consumer focus on emotional. With the enhancement of value-oriented and the accumulation of experience, as opposed to product brand loyalty, customers become less and less loyalty to the supermarket. These phenomena suggest that the traditional marketing model has become increasingly difficult to attract consumers. But now marketing strategies adopted by major supermarkets in Big Cities are almost the same, no special.

### ***94.2.4 Shopping Environment to be Beautified***

As people's living standards and consumer's demand has become increasingly prominent emotional today, the major supermarket product categories, product prices comparable circumstances, the supermarket pleasant shopping environment will be an important factor to attract customers. The survey shows the improvements have been proposed in the "optimized shopping environment", which accounts for about 80 %.

94.2.5 *Level of Service to be Improved*

Consumers go to the department store for shopping mainly. In addition to shopping, others want to get more psychological and spiritual satisfaction. The survey shows the improvements have been proposed in the “higher standards”, which accounts for about 70 %.

94.3 **Strategies and Improvement**

94.3.1 *Reasonable Location*

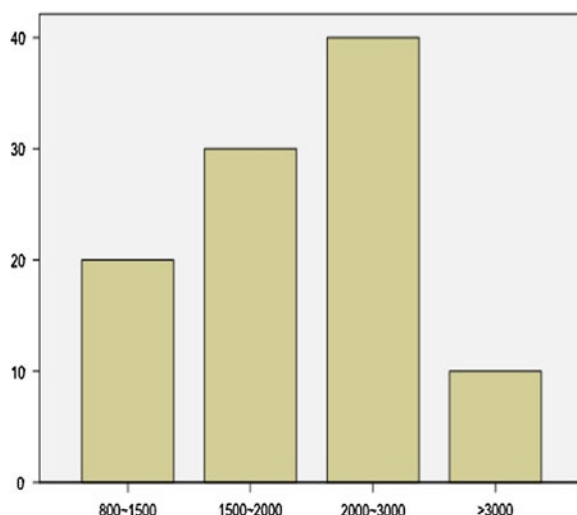
When choosing the supermarkets’ site, the following factors should be considered: Residents around the population, living standards and purchasing power around the locations of traffic conditions, their management ability, the strength of competitors, competition intensity, etc.

Table 94.2 shows that the higher the per capita household income, the higher the frequency of the supermarket; about 60 % of people will go to the supermarket twice a week on average. This shows that going to the supermarket has become essential to people’s daily lives in Big Cities, it also means that, supermarkets has become more and more important in people’s lives.

**Table 94.2** Per capita disposable income and frequency of going to supermarket

			The frequency of entering the supermarket				Total supermarket
			2/7	1/7 week	1/14 two weeks	>1/14	
<i>Per capita disposable income</i>	800–1,500	Count	1	1	1	1	4
		Per capita disposable income in %	25.0	25.0	25.0	25.0	100.0
	1,500–2,000	Count	4	0	0	2	6
		Per capita disposable income in %	66.7	0	0	33.3	100.0
	2,000–3,000	Count	5	1	1	1	8
		Per capita disposable income in %	62.5	12.5	12.5	12.5	100.0
	>3,000	Count	2	0	0	0	2
		Per capita disposable income in %	100.0	0	0	0	100.0
<i>Total</i>	Count		12	2	2	4	20
	Per (%)		60.0	10.0	10.0	20.0	100.0

**Fig. 94.1** Month per capita disposable income of consumers



### 94.3.2 Target Market Differentiation

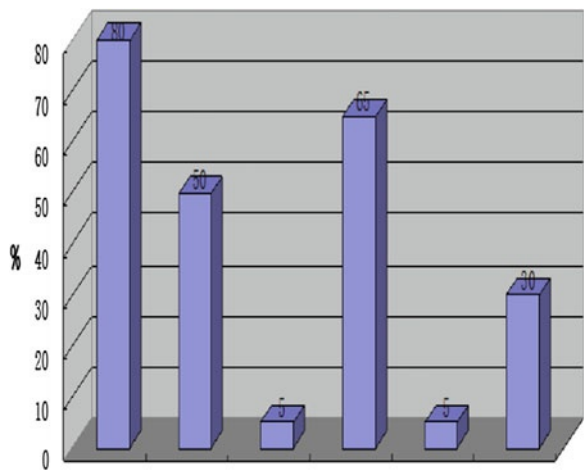
Different income levels and living standards on the same kinds of consumer goods prices, the functional requirements are different (Windrum and Goni 2008; Teece 2006). Supermarkets make reasonable market segmentation. Selecting the different needs from different consumer groups or consumer groups in the same target market can not only avoiding excessive competition, but also obtaining a higher operating profit.

We can know from Fig. 94.1, middle-level consumers now: 40 % of the average consumer's disposable income of 3,000 yuan up to 2,000, 30 % of per capita disposable income of consumers up to 1,500–2,000; and 10 % of consumers to high-level consumers, and its per capita disposable income reached 3,000 yuan. And 10 % of consumers to high-level consumers, and its per capita disposable income reached 3,000 yuan.

### 94.3.3 Innovation of Marketing Mix

The choice of marketing mix and target market selection should adapt to market positioning, supermarket product, price, promotion, distribution channels and also the choice of strategies to strengthen collaboration. For example, Big Cities supermarkets can enhance their own characteristics as the following listed: Increased marketing public relations, bulk commodities installment, increase in the supermarket's own promotional staff, change the concept of consumer spending, cooperate with enterprises to issue Gold Card together with other new promotions.

**Fig. 94.2** Select product category



The above Fig. 94.2 shows that people go to supermarkets to buy products or commodities, fruits and vegetables, snacks, fresh food and other daily necessities mainly.

**94.3.4 Beautify Shopping Environment**

As people’s living standards and consumer’s demand has become increasingly prominent emotional today, the major supermarket product categories, product prices comparable circumstances, the supermarket pleasant shopping environment will be an important factor to attract customers (Chesbrough 2010). If you walk into the supermarket and have a warm feeling, naturally would it lead to active consuming. Now it’s available to make improvement better from both internal and external environment.

Internal environment: Soft music along with the customer the whole process of shopping, eye-catching special label to attract customers’ shopping pace, clean and healthy environment to make customers always have the feeling of comfortable, escalators placed, benches, drinking fountains can be placed to help consumers abolish fatigue. External environment: Parking lot, places to put ex-gratia of goods, district of every single page of goods are essential.

94.3.5 Strengthen Service Concept and Providing Perfect Service

Service not only refers to the key moment in shopping process, but also including shopping before and after shopping after-sales service, it is throughout the whole process of consumer spending (West and Gallagher 2006; Ailawadi and Keller 2004; Cronin et al. 2000). Consumers go to stores, not only to go shopping, but to acquire more psychological and spiritual satisfaction, and hope to show their position in society, economic status, life, personal accomplishment and other personal characteristics and quality through the process of purchasing commodities.

As to the supermarkets, they require understanding consumers’ psychology demand change constantly, perfect and innovate service contents.

We can see from the Table 94.3 that the higher income levels they obtain, the higher amount of consumption t to the supermarket they have.

From Table 94.4 we can know that the per capita disposable income and expenditure is in significant correlation. Tables 94.3 and 94.4 shows that the higher the disposable income of consumers, the bigger its consumer quota is. Combining the foregoing tables and pictures, we know it requires high levels of environment and services.

Table 94.3 Cross reference table of disposable income per capita and expense specified amount each time

			Expense specified amount each time			Total
			10–50 Yuan	50–100 Yuan	Above 100 Yuan	
Disposable income per capita	800–1,500	Quantity	0	4	0	4
		Percentage (%)	0.00	100.00	0.00	100.00
	1,500–2,000	Quantity	3	3	0	6
		Percentage (%)	50.00	50.00	0.00	100.00
	2,000–3,000	Quantity	0	5	3	8
		Percentage (%)	0.00	62.50	37.50	100.00
	>3,000	Quantity	0	1	1	2
		Percentage (%)	0.00	50.00	50.00	100.00
	Total	Quantity	3	13	4	20
		Percentage (%)	15.00	65.00	20.00	100.00

**Table 94.4** Correlation of disposable income per capita and expense specified amount each time

		Expense specified amount each time	Disposable income per capita
Expense specified amount each time	Pearson	1	0.421*
	correlation		
	Significance(Two- sided)		0.018
Disposable income per capita	N	31	31
	Pearson	0.421*	1
	correlation		
	Significance(Two- sided)	0.018	
	N	31	31
Remarkable related in 0.05 fiduciary level			

*Note* \* Remarkable related in 0.05 fiduciary level

## 94.4 Discussion

Facing fierce competition in the market, most supermarkets can only pay constant attention to customers, customer services, and to cultivate customers. In order to further development and expansion, and keep the invincible position, supermarkets in big cities should combine local pattern, carry out the corresponding marketing activities to attract customers. Supermarket managers should also get out of the office to make real time surveys. Advanced analysis software for statistical data analysis is used in this paper, which not only makes the survey results more accurate, but also save unnecessary energy expenditure for managers.

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# Chapter 95

## Farmer Cooperatives as the Mainstay on Safety of Agricultural Products in China

Guo-Ming Han and He Wang

**Abstract** The safety of agricultural products is a source of food security, and safety of agricultural products is directly related with the use of pesticides. This article first briefly review our current research situation on food security and put forward the importance of farm management; then, from the Micro-economics of information to explain the reasons of market failure and government failure; and then from the perspective of farmer cooperatives to put forward ideas; finally, we propose that the co-operatives as the main part with governments and other social organizations to participate in the management of multi-center safety of agricultural products to solve the problem.

**Keywords** Farmer cooperative • Government failure • Market failure • Pesticide misuse • Safety of agricultural products

### 95.1 Introduction

The recent “poisonous bean”, “poisonous bean sprouts” and “poisonous leek”, “poisonous rice” and other similar problems of China’s food safety incidents caused great concerns about food safety by consumers, and the government in the field of food safety control effectiveness has been highly questioned. Therefore, how to prevent a similar occurrence of food safety and pesticide abuse, and re-establish our citizens’ confidence about food security which become the topic of social concern.

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In recent years, our scholars with the success of international experience and from our own specific national conditions to make a lot of specific researches and beneficial explores for this issue, for example, Chun-Guang Fan think that China should learn from foreign experience to build the whole process of information disclosure system and achieve the regulatory objectives of food security (Fan 2008); Scholar Ping-Ya from the perspective of the relationship between government and market to research and think if we want to break the dilemma of China's food safety regulation, not only the problem of withdrawing or merging regulatory authorities, but also reconstruction of the government and market relations and reflect the current regulatory model of the problem (Liu 2011); Hong Shen through the market meta-analysis of the results of a random sample in recent years drawn that we should from the food safety standards, food safety management system, food safety risk assessment system, food safety information monitoring network system (Hong 2011) of this four -pronged approaches to address food safety issues. Xiao-xin Xu, a scholar believed that it should give full play to the role of intermediary organizations, to promote consumer participation (Xiao-xin 2002); Liu Jun pointed out that because of externalities, human limited rationality and there is a serious information asymmetry between producers and consumers, the market itself cannot solve the current existence of various food safety issues, which must be resolved through government regulation (Jun et al. 2007).

Above researches and practices have shown that full control of food is an effective method to achieve food security for government. Since agricultural products are the main source of food and basic, if quality and safety of agricultural products cannot be guaranteed, food quality and safety cannot truly be protected from (Wang 2004). Therefore, the agricultural food safety management should be the first important issue of food regulatory process, however, academic research on this issue is less. According to the 2008s national agricultural census data, China had more than 200 million farming households and 395 000 agricultural management units to the end of 2006 (National Bureau of Statistics of China 2008) and China have about 121,716 billion m<sup>2</sup> arable land (Ministry of Land and Resources of the People's Republic of China 2009), only about 6,000 m<sup>2</sup> in the average farming household, small-scale farmers in various agricultural management units occupy a very large proportion. Excessive retail operations contribute to many problems in safety of agricultural products management. Obviously, if there is no good agricultural safety management, the subsequent regulatory process of food safety regulatory process will be nonsense. Therefore, issues are associated with agricultural safety management to make in-depth study is great significance, and the agricultural safety management is the most important aspect.

## 95.2 Analyze the Market Failure and Government Failure of the Agricultural Products Safety

### 95.2.1 *Source of Danger on Agricultural Products Safety*

In China, only after the founding of our country, the use of pesticides is promote, while the history of the use of pesticides in abroad is very early, so foreign countries have more profound understanding to the negative impact of pesticides. Australian scholars Clevo Wilson and Clem Tisdell through data analysis to confirm the use of pesticides will not only cause some damage to the human body, but also would cause lasting environmental pollution, so the cost is greater than the benefits of its use, and ultimately there will be detrimental to the sustainable development of agriculture (Wilson and Tisdell 2001); American scholar Johns. Wilson and Tsunehiro Otsuki from a public health perspective view believe that food production must find proper balance between security and economic and should fully remove abuse of pesticides and develop more stringent standards for pesticide use (Wilson and Otsuki 2004); Canada vigorously promote organic farming decades ago as far as possible avoid the use of pesticides (Nazarko et al. 2004). Thus, the negative impact of pesticides is beyond doubt and the development of ecological agriculture is the future trend.

According to relevant experts, usually after the use of pesticides due to the loss of crops caused by pests and diseases will remain at about 35 %, however, if we do not use pesticides, the crop losses may reach 70 % (People.com.cn). Therefore, the use of pesticides in food crops to ensure that our supply is very important. According to the present circumstances, large-scale use of pesticides is unavoidable; if we reduce or do not use pesticides will lead to a large decline in agricultural production so that farmers' income decreased; In addition, rural hollowing trend also contribute to the use of pesticides by farmers to improve farming efficiency. As developing countries, farmers' income is still very low in the case that we can not be allowed to consciously control the use of pesticides, but also it became the largest risks in agricultural product safety. Xiao-xin Xu even pointed out that because the quality of farmers is relatively low and profit-driven, farmers prefer to buy and use highly toxic pesticides, which is the initial source of agricultural products safety (Xiao-xin 2002).

On the condition of our country is concerned, we can not resist the use of pesticides is a fact. But the important thing is how to ensure the use of pesticides within a safe scope and how to encourage farmers to produce more and more green and organic products in order to gradually get rid of the constraints of pesticides on farmers' income, and ensure the farmers' interest can still be protected or compensation under the agricultural products safety, which is worthy of our consideration and study.

### ***95.2.2 Cause of Market Failure—Cannot Distinguish Between Good and Bad Quality of Agricultural Products***

As far as China's agricultural market concerned, a serious shortage of information on production causes information asymmetry in the buyers and sellers, so that it can not fix the price of agricultural products according their quality. Specific analysis from the following two aspects:

On the agricultural products themselves, they have of dual properties which are the experience qualities and credence qualities. On the one hand, from pesticide residues in agricultural products (adverse reactions after eating), taste, freshness and other aspects of quality characteristics, they are experience qualities, since they can obviously be perceived only after consumers consume them; on the other hand, in terms of the status of pesticide residues (no significant reaction after eating, but it does harm to the human body), the situation of hormones contain, the internal nutrition elements, it is the credence qualities, since they are generally not can be perceived even after consumers consume them. Agricultural products with these two properties, in particular, credence qualities, which can create the conditions for concealing some of the negative information for producers so that buyers can not get advance with important information related to commodities that result in the emergence of asymmetric information and phenomenon of market failure on the one hand, Market failure causes consumers hard to distinguish good and bad quality of agricultural products that results in confusing quality and poor quality of agricultural products; On the other hand, that promote farmers to use a variety of pesticides to improve agricultural production and change in agricultural products' taste and appearance, etc., but less people ignore their true intrinsic quality, such as high-nutrition, pollution-free, etc., which result in farmers who produce the production which are safe agricultural products can not obtain the price compensation, and it ultimately leads to this phenomenon of "bad money drives out good money".

As for consumers, the evaluation of other goods is same, the evaluation of the quality of agricultural products and food safety mainly according to the price (Young Sook Eom 1994), that is to say, consumers tend to "price priority", but green consumption consciousness is not strong (Sun 2006). For some agricultural products, consumer can not from its appearance or quality to distinguish their merits, and take them to the same grade, so it is appeared that the price advantage as the standard of choice behavior, blindly pursue the so-called "cost-effective" and make the market failure's phenomenon more serious. In short, the consumer because of the lack of necessary information of agricultural products, eventually trend to make the wrong choice.

### ***95.2.3 Cause of Government Regulation Failure—Not Effective Supervision***

The frequent problems of agricultural products safety reflects that the government regulation did not achieve expectant goal, its reason basically has the following two points:

#### **95.2.3.1 First, Control Cost is High**

In theory, only the food in “from field to table” to implement comprehensive monitoring for each link can completely ensure food safety, but the cost is so high that the government cannot afford (Zhou and Yang 2002). Because, if the government carry out monitoring during the entire process that it must first arrive the entirely supervision of productions of the agricultural products, it required for agricultural products to make strict testing and quarantine requirement farmer timely disclose information of agricultural products. But as mentioned above, smallholder economic decentralization of China makes the local government can not achieve every household in the supervision, various regulatory decisions by government cannot be effectively implemented, pesticide abuse are common. But the western developed countries have already completed agricultural industrialization, large-scale standardized production, which is the one of characteristics and together with various types of third departments widely exists, which make the government regulatory focus, regulatory pressure smaller, low regulation cost, easy to implement the decision, so that government is also more successful.

#### **95.2.3.2 Second, Penalty Execution Cost is High**

For some violation of food safety law, every government has corresponding legal penalties. However, China’s agricultural product marketing channel is very flexible. According to our survey, no matter how devious village, it will have the peddlers drive into the villages to collect agricultural products and then they sell them to other brokers. Therefore, the whole process of acquisition of agricultural products mostly not achieves safety testing. Even agricultural products are detected, but it just after them collected, so it is difficult to be clear responsibility even back to individual farmers, which prompt farmers often have a luck and to do some thing with violations of the food safety law. It is also the main reason that the safety of agricultural products traceability system and HACCP system which are very popular abroad but it is difficult to popularize in China. In addition, the use of tightening pesticide will reduce the income of the farmer, the consequences may be to generate greater friction between the farmer and local government supervision departments, even make the friction evolved into a confrontation, that more cannot guarantee the safety of agricultural products.

We can assume that, if the government invested a large amount of manpower, material resources, financial capacity to produce whole supervision and publish each of violations of discipline, the result is likely to transfer the high regulatory costs to the cost of agricultural products, which will make the farmer try various methods to increase production of agricultural products to achieve their expected income, the main method of the increase production is to use a variety of unsafe pesticides.

### **95.3 Farmer Cooperatives—an Effective Organization to Solve the Market Failure and Government Failure**

To ensure the agricultural products safety, we need to build intermediary organization. The organization can not only make the dispersive smallholder together, unified management, business cooperation, common for the market, but also is able to represent the interest of farmers, which make farmers' interest and safety of agricultural products unified, the organization form is the farmer cooperatives (Zhang and Guo 2011).

#### ***95.3.1 Farmer Cooperatives is Conducive to Solve Market Failure***

First of all, cooperative can be distinguished from other organizations through the registered trademark.

The agricultural product market is a kin to a fully competitive market, the market has a large number of buyers and sellers, each producer substantially homogenous. If individual farmers directly to propagate the superiority of their commodities provided. Not only the propaganda effect is poor, but a cost of publicity is high. But, cooperative can play its large scale, standardization of production, safety and high efficiency and other advantages. Through the trademark registration, cooperative can improve their visibility, which let they pay more attention to brand reputation and improve produce quality; on the other hand, it can give consumers more purchasing decision-making information to reduce information asymmetry which brings the risk of decision-making, to reduce the losses of consumers and farmers because of market failure in a certain extent and realise that high quality of agricultural product is high price.

### ***95.3.2 Cooperative Can Achieve the Farmers' Benefit Compensation and Promote Production of the Green Agricultural Product***

To ensure the agricultural products safety and reduce use of pesticide is the responsibility of the whole society. But in some rural areas of China, to promote economic development, improve people's living level remains is the most urgent task, that lead to economic dominant behaviors. Economic dominant behavior is to obtain the maximum profit for the purpose. If green agricultural products can create additional profits, then the farmer will have an incentive to produce safety, pollution-free agricultural products. Otherwise, they are not willing to improve the agricultural products safety for giving up this can obtain benefits. Only when a part of farmers in the process of development of green agriculture get larger earnings, there will be more farmers to develop green agriculture under the interests of the market, so as to promote the healthy and sustainable development of agriculture and ensure the agricultural products safety. Cooperatives can compensate farmers who due to reduced the use of pesticide that causes loss of benefits and improve the income of the farmers when achieve production of green agricultural products at the same time. Cooperatives through for farmers to provide agricultural products purchasing, agricultural technology and product sales service to reduce the cost of agricultural products, increase product yield, increase the revenue of agricultural product sales, eventually make up the farmer for the production of green agricultural products caused by the loss of interest; it also can make farmers combined to develop logo of regional products and make the agricultural product brand, it can improve the income of the farmer through high quality or to obtain from brands' gain.

### ***95.3.3 Farmer Cooperatives in Favor of the Government to the Agricultural Product Control***

First of all, cooperatives can make dispersive farmer focus on contact and reduce the cost of government's supervision and execution.

The farmer can rapidly together through the cooperative and related agricultural service easily supervises farmers through it, that can save the related cost of government agencies and dispersive farmer. Unified procurement of agricultural materials, unified technical specification, unified use of fertilizer, and unified pest detection of agricultural products and sales through cooperative to achieve supervision of the whole production process of the members of the cooperative. To a large extent to ensure that the product is green, pollution-free and make the government a variety of difficult to flexible implementations of supervision measures internalization, greatly reduce the cost of government supervision, while avoiding quarrel between the government and farmers due to communication

barriers. Therefore, cooperatives can help the government to solve the management of agricultural product safety which will be confronted with many difficulties.

Secondly, stakeholders' consistent pressure greatly curbs member pesticide abuse.

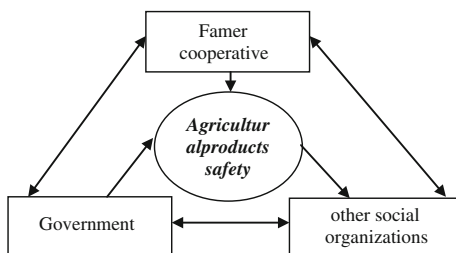
Local government is unable to grasp the situation of the dispersive farmer use pesticide, but relationship in a relatively narrow range of farmers is an "acquaintance society", everyone has a more detailed understanding him or her neighbours. If a member of cooperatives conceal the case using potent pesticide, which extremely likely problems of agricultural product safety makes the whole society's reputation suffered by damage and income loss. Then, the farmer should not only suffer from cooperatives' punishment, but also bear the moral condemnation from crowd around. The farmer cooperatives have so extremely wide range of contact bases that can promptly correct the problems of pesticide abuse problems and contribute to the success of government regulation.

## 95.4 Polycentric Governance—Government, Cooperatives, Other Social Organizations Three Indispensable

By Ostrom and a number of other scholars to develop the Polycentric Governance Theory: on public things good governance not only rely on the government, but also need to attract more social organization (third department) involved, and emphasize the importance of independent management, which is the only way to improve the management efficiency and solve practical problems (Fig. 95.1).

Government for the safe production of agricultural products to create a good system environment. First of all, government should perfect relevant laws and regulations, formulate standards which corresponding to the safe production of agricultural products and punitive measures of violations of the standard, to make safe production becomes a farmer self-discipline; secondly, to support and promote the development of farmer cooperatives, which can realize the safe production of agricultural products and the dispersive farmer united as one of the advantages and make members of cooperatives form more closely the interests of the community, thus more conducive to government regulation; again, regularly

**Fig. 95.1** The relationship between the three agricultural product



publish food safety detection notice, award good and punish bad; finally, vigorously support the development of other social organizations.

Cooperatives as an effective social organizations which should develop its advantage that close to the management object to become the main body of agricultural product safety; ensure agricultural production source security through advantages of the production supply and marketing; put government which can not well in the management of agricultural product safety into internalization; to expand its influence and drive more farmers to the pursuit of a higher quality of agricultural products; in line with the government's supervision, cooperative should take the lead to comply with "food safety law"; strengthen relationship between cooperatives and other social organizations, such as the Federation of cooperatives, consumer associations and other organizations, which common to the management of agricultural product safety to give advice and strive to become the main force of safe production of agricultural products.

Other social organizations, such as the Consumers Association, the association that raise a pig, vegetables Association, financial and insurance institutions, shall also to be a force for the safety production of agricultural products. Consumers Association should play its the advantage of contacting consumers and producers to explore the solutions of the contradictions between the two, which as a bridge; all kinds of associations should actively explore the standards and promotion of agricultural product safety to make up for supervision insufficiency of government in agricultural product and share the government's working pressure. And a variety of training have been regularly or irregularly organized to improve the production technology of the cooperative's members, introduction of high quality, high efficiency, no pesticide is dependent on the quality of agricultural product; in addition, it should make full use of insurance risk protection mechanisms, to give a part of green agricultural products which are the short shelf life, easy to deteriorate, the risks are great to insurance, which ensures farmers' interests do not suffer lose.

## 95.5 Conclusion

On the "from farm to table" the entire production chain supervision, we know that the farm management is the first line of defense for agricultural products safety, if we does not carry on the effective management, it will be of no avail behind the various efforts, and abuse and residue of pesticide is the most important problem of agricultural production management. But, the phenomenon of existence of "market failure" and "government failure" make the agricultural product safety's issue more outstanding, that agricultural products can not access to social recognition and revenue equivalence because of its quality. Therefore, this paper argues that we must make clear corresponding responsibilities between government, cooperatives, other social organizations in the problem of agricultural product safety, especially cooperatives should play the unique advantages in solving the problem; The government focuses on the guides of policies and regulations, to

regulate market behavior and award good and punish bad; various other social organizations should play their advantages in the promotion of good product, safety standards, maintenance of the legitimate rights and interests of consumers and so on, to further enhance the effective management of agricultural product safety. Only those three cooperate with each other, each doing his own job, which can solve the problem of food safety—Government supervision and Farmers' Benefit Compensation.

### **Note:**

According to the relationship between information acquisition and consumer behavior, scholar Nelson in 1970 to put the goods should be divided into search qualities and experience qualities, in which the search qualities refers to the consumers in the purchase of goods before they have sufficient information; experience qualities, as the name suggests, is that consumers know product information (quality) only after purchase them. Subsequently, scholars Darby and Karni in 1973 pointed out some commodity is not only before the purchase but also after purchase are still not know some of the information about them, thus them put forward concept of credence qualities.

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# Chapter 96

## Genetic Algorithms for Vehicle Routing Problem with Recourse Cost Model

Jun-qi Chen and Tomohiro Murata

**Abstract** This paper deals with the vehicle routing problem involved with System fuzzy vehicle travel times. A two-stage possibility programming model is formulated and the influence of the fuzziness of travel times and service times is treated as recourse cost. By introducing the generalized mean value to define the Fuzzy Mean, the recourse possibility programming model can be transformed into an ordinary programming problem (Slowinski and Hapke in Scheduling under fuzziness. Physics, Heidelberg, 2000) and then a solution method based on Genetic Algorithms is proposed to give the optimal solution of the problem. Finally, some examples are given to illustrate the two-stage model and the solution algorithm.

**Keywords** Genetic algorithms · Possibility programming · Recourse cost · Vehicle routing

### 96.1 Introduction

Efficient fleet and vehicle planning, scheduling and delivered are essential for transportation service providers who want to improve service and increase reactions, particularly when cost is a primary factor. In the field of operations research, the problems of fleet and vehicle planning, scheduling and dispatching are recognized as Vehicle Routing Problems (VRP) (Dong 2004, 2006). A typical vehicle routing problem requires to design a least cost route from one depot to a set of

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geographically scattered points (cities, stores, warehouses, schools, customers etc.).The research has been actively done up to now for the vehicle routing problem, and a lot of optimization technique or approximate solution methods are proposed (Ball et al. 1995).

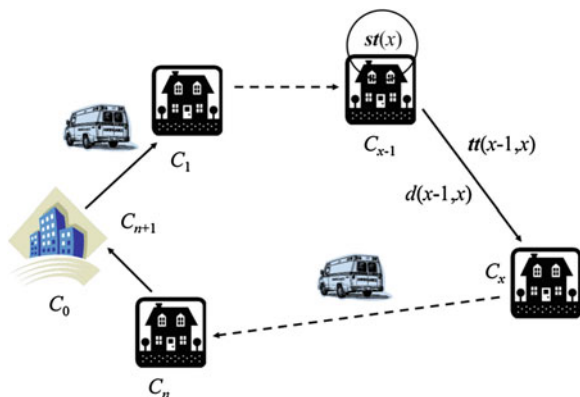
Although a great number of models and solutions methods for solving Vehicle Routing Problems are formulated before, most of them arise from definite mathematical models and all the factors considered in the models must be known exactly. Unfortunately, real world situations are not so often determined. There are cases that the uncertainty, concerning level of demand, location, timing, length of travel times, etc. must be taken into consideration (Klein 1991). However, in the technique that has been proposed so far [9], the travel time and the amount of the transportation demand are the most important information that needs to be fully understood beforehand (Cheng and Gen 1996). It is often when the influence of uncertain, various factors cannot be disregarded when a current vehicle routing problem is solved, and the technique for taking an uncertain factor into consideration is necessary.

The paper deals with the vehicle routing problem involved with system fuzzy vehicle travel times, these fuzzy times are represented as fuzzy numbers and interpreted as possibility distributions (Okada and Soper 2000). First of all, recourse cost possibility programming model (Yao and Lin 2003) is formulated that and influence of the fuzziness of travel times and service times is treated as recourse cost. Next, the recourse possibility programming model can be transformed into an ordinary programming problem and then a solution method based on Genetic Algorithms (GA) is proposed to give the optimal solution of the problem. Finally, some examples are given to illustrate the two-stage model and the solution algorithm.

## 96.2 Problem Definition

Figure 96.1 illustrates the vehicle routing problem considered in this paper with the following variables:

Fig. 96.1 Route diagram



$at(x)$ : The arriving time of customer  $x_k$ .

$E(x)$ : The earliness of customer  $x$ .

$T(x)$ : The tardiness of customer  $x$ .

$bt(x)$ : The service beginning time.

$st(x)$ : Customer  $c_x$ 's service time (discharge time and responding to customer time and so on) is also shown by a triangular fuzzy number.

$tt(x-1, x)$ : The travel time from customer  $c_{x-1}$  to  $c_x$ , that is shown by a triangular fuzzy number.

$d(x-1, x)$ : The distance from customer  $c_{x-1}$  to customer  $c_x$ .

### 96.2.1 Delivery Routes

The delivery order of the round in the customer of  $x$  company, it shows by the  $x + 2$  dimension vector  $0, 1, 2, 3 \dots x, x + 1$ . However,  $C_0 = C_{x+1}$ .

$$E(x) = \max(0, bt(x) - at(x)) \quad (96.1)$$

$$T(x) = \max(0, at(x) - bt(x)) \quad (96.2)$$

### 96.2.2 Delivery Scheduling Cost

Earliness  $E(x)$  and Tardiness  $T(x)$  when only mode value  $at(x)$  at time of arrival  $at(x)$  is considered are defined as

$$E(x) = \max(0, bt(x) - at(x)) \quad (96.3)$$

$$T(x) = \max(0, at(x) - bt(x)) \quad (96.4)$$

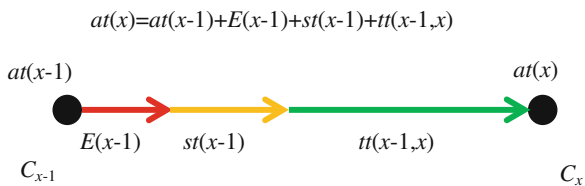
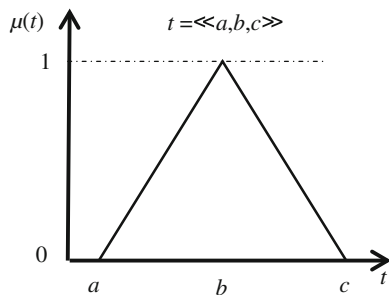
Another,  $at(x)$  is calculated by next expression.

$$at(x) = at(x - 1) + E(x - 1) + st(x - 1) + tt(x - 1, x) \quad (96.5)$$

$$at(0) = 0, E(0) = 0, st(0) = 0 \quad (96.6)$$

When only the mode value at the traffic time and service time are considered, the delivery scheduling cost can be shown by the following expression (Fig. 96.2)

$$y_1 = \sum_{k=0}^n wd(x, x + 1) + \sum_{k=1}^n [pE(x) + qT(x)] \quad (96.7)$$

**Fig. 96.2** Arrival time calculation cases**Fig. 96.3** Triangular fuzzy number

### 96.2.3 Fuzzy Recourse Cost

Because actual traffic time and the service time are fuzzy numbers, the gap is caused from the mode value  $at(x)$  at arrival time  $at_a(x)$ , if this gap is assumed to be  $at_f(x)$ , it becomes (Fig. 96.3)

$$at_f(x) = at_f(x-1) + st_f(x-1) + tt_f(x-1, x) \quad (96.8)$$

$$st_f(0) = 0, at_f(0) = 0 \quad (96.9)$$

For gap  $at_f(x)$  at the arrival time  $at(x)$  the gap is caused from those mode value  $E_f(x)$  and  $T_f(x)$  at actual waiting time and the delay time. If the gap of waiting time and the delay time is recorded respectively as  $E_f(x)$  and  $T_f(x)$ , it becomes

$$E_f(x) = \max(0, -at_f(x))$$

$$T_f(x) = \max(0, at_f(x))$$

If you assume the cost each unit time to bury  $E_f(x)$  and  $T_f(x)$  to be  $u$  and  $v$  respectively, recourse cost is calculated by next expression.

$$y_2 = \sum_{k=1}^n [uE_f(x) + vT_f(x)] \quad (96.10)$$

## 96.3 Optomization Model Formulation

### 96.3.1 Fuzzy Optimization Model

The object problem including recourse cost is formulated as the following possibility plan problem.

Minimize

$$\begin{aligned}
 f &= y_1 + y_2 \\
 &= \sum_{k=0}^n wd(x, x+1) + \sum_{k=1}^n [pE(x) + qT(x)] \\
 &\quad + \text{Fuzzy mean} \sum_{k=1}^n [uE_f(x) + vT_f(x)]
 \end{aligned} \tag{96.11}$$

Subject to

$$E(x) = \max(0, bt(x) - at(x)) \tag{96.12}$$

$$T(x) = \max(0, at(x) - bt(x)) \tag{96.13}$$

$$at(x) = at(x-1) + E(x-1) + st(x-1) + tt(x-1, x) \tag{96.14}$$

$$at(0) = 0, E(0) = 0, st(0) = 0 \tag{96.15}$$

$$at_f(x) = at_f(x-1) + st_f(x-1) + tt_f(x-1, x) \tag{96.16}$$

$$st_f(0) = 0, at_f(0) = 0 \tag{96.17}$$

$$E_f(x) = \max(0, -at_f(x)) \tag{96.18}$$

$$T_f(x) = \max(0, at_f(x)) \tag{96.19}$$

“Fuzzy Mean” of expression shows the operator that the mean values of a fuzzy number are requested. By assuming the mode value of  $tt(x-1, x)$ ,  $st(x)$  and  $at(x)$  to be  $tt_a(x-1, x)$ ,  $st_a(x)$  and  $at_a(x)$ , respectively,  $tt(x-1, x)$ ,  $st(x)$  and  $at(x)$  can be shown as showed in next expression (Fig. 96.4).

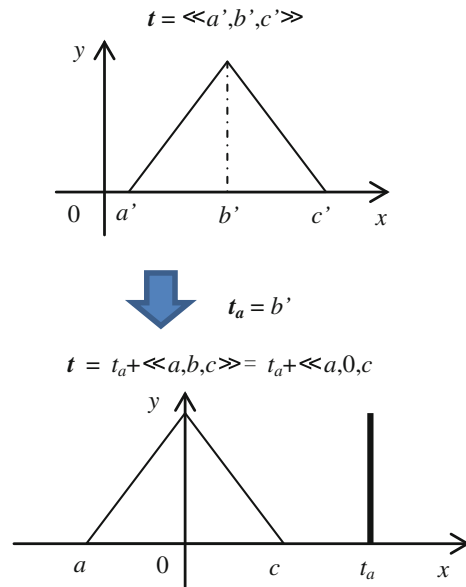
$$tt(x-1, x) = tt_a(x-1, x) + tt_f(x-1, x) \tag{96.20}$$

$$st(x) = st_a(x) + st_f(x) \tag{96.21}$$

$$at(x) = at_a(x) + at_f(x) \tag{96.22}$$

Here,  $tt_f(x-1, x)$ ,  $st_f(x)$  and  $at_f(x)$  is a triangle fuzzy number of mode value is 0.

**Fig. 96.4** Equivalent transformation of fuzzy number



### 96.3.2 Equivalent Deterministic Optimization Model

To obtain the solution of the minimization problem of expression, here is, expected value Generalized Mean Value (GMV) of generalization introduced, mean values “Fuzzy Mean” of a fuzzy number are defined.

The Generalized Mean Value (GMV) of a fuzzy number is introduced. Concretely, if the membership function of a fuzzy number  $N$  is set to  $\mu(t)$ , the Generalized Mean Value  $\text{GMV}(t)$  of  $t$  will be calculated by the following formula

$$\text{GMV}(t) = \frac{\int t\mu(t)dt}{\int \mu(t)dt} \quad (96.23)$$

when  $t$  is fuzzy triangular number  $t = \ll a, b, c \gg$  GMV of  $t$  is calculated by next expression

$$\text{GMV}(t) = (a + b + c)/3 \quad (96.24)$$

Because  $tt_f(x-1, x)$  and  $st_f(x-1)$  are a triangle fuzzy numbers of mode values  $= 0$ , it can be shown by

$$tt_f(x-1, x) = \ll tt_f^L(x-1, x), 0, tt_f^R(x-1, x) \gg \quad (96.25)$$

$$st_f(x) = \ll st_f^L(x), 0, st_f^R(x) \gg \quad (96.26)$$

$$\begin{aligned}
at_f(x) &= at_f(x-1) + st_f(x-1) + tt_f(x-1, x) \\
&= \ll at_f^L(x-1) + st_f^L(x-1) + tt_f^L(x-1, x), \\
&\quad at_f^R(x-1) + st_f^R(x-1) + tt_f^R(x-1, x) \gg \\
&= \ll at_f^L(x), 0, at_f^R(x) \gg
\end{aligned} \tag{96.27}$$

Because of  $at_f^L(x) \leq 0$ ,  $at_f^R(x) \geq 0$ ,

$$E_f(x) = \max(0, -at_f(x)) = 0, 0, -at_f^L(x) \gg \tag{96.28}$$

$$T_f(x) = \max(0, at_f(x)) = 0, 0, at_f^R(x) \gg \tag{96.29}$$

$$GMV(E_f(x)) = -at_f^L(x)/3 \tag{96.30}$$

$$GMV(T_f(x)) = at_f^R(x)/3 \tag{96.31}$$

Therefore, the fuzzy optimization problem of expression returns to the following equivalent deterministic optimization problem

Minimize

$$\begin{aligned}
f &= \sum_{k=0}^n wd(x, x+1) + \sum_{k=1}^n [pE(x) + qT(x)] \\
&\quad + \sum_{k=1}^n \left[ -uat_f^L(x) + vat_f^R(x) \right] / 3
\end{aligned} \tag{96.32}$$

Subject to

$$E_a(x) = \max(0, bt(x) - at_a(x)) \tag{96.33}$$

$$T_a(x) = \max(0, at_a(x) - bt(x)) \tag{96.34}$$

$$at_a(x) = at_a(x-1) + E_a(x-1) + st_a(x-1) + tt_a(x-1, x) \tag{96.35}$$

$$at_a(0) = 0, E_a(0) = 0, st_a(0) = 0 \tag{96.36}$$

$$at_f^L(x) = at_f^L(x-1) + st_f^L(x-1) + tt_f^L(x-1, x) \tag{96.37}$$

$$at_f^R(x) = at_f^R(x-1) + st_f^R(x-1) + tt_f^R(x-1, x) \tag{96.38}$$

$$at_f^L(0) = 0, st_f^L(0) = 0 \tag{96.39}$$

$$at_f^R(0) = 0, st_f^R(0) = 0 \tag{96.40}$$

$$x = 1, 2, \dots, n \tag{96.41}$$

## 96.4 Optimization Algorithm Using GA

This paper has aimed to examine the adaptive possibility of the genetic algorithm to the minimum cost problem. The solution of this problem used the order expression. The intersected operator used the Nearest Insertion (NI) method. 2-opt type mutation operator was used for the mutation.

The order expression here is a device to prevent the point number from appearing that overlaps when intersecting. For example, if the expression type is “5-4-6-1-3-8-2-7”, the order expression becomes “5-4-4-1-2-3-1-1”. That is, the figure of the expression type reaches the value of the small order in the point number that remained when the point is sequentially removed from the left.

**Step 1:** Parents individual  $u$  is generated at random

**Step 2:** Parents individual  $v$  is generated at random

**Step 3:** Intersected operator

To inherit two parent's good characters to the child by intersection and to achieve settling a prompt solution with GA, the intersected operator that used the Nearest Insertion (NI) method is proposed. This is called NI type intersection, and consists of the following procedures

1.  $u = \{u_0, u_1, u_2, \dots, u_n, u_{n+1}\}$  is parents individual,  $v = \{v_0, v_1, v_2, \dots, v_n, v_{n+1}\}$  is parents individual,  $u'$  is child individual,  $v'$  is child individual.
2. Intersection  $i$  of parents individual  $u$  and parents individual  $v$  is decided.
3. The partial tour  $\{u_i, u_{i+1}, \dots, u_n\}$  composed of the part since intersection  $u_i$  of parents individual  $u$  is copied onto the child individual  $u'$ . The partial tour  $\{v_i, v_{i+1}, \dots, v_n\}$  composed of the part since intersection  $v_i$  of parents individual  $v$  is copied onto the child individual  $v'$  (Fig. 96.5).
4. A partial tour  $\{u_0, u_1, \dots, u_{i-1}\}$  of the remainder of parents individual  $u$  and a partial tour  $\{v_0, v_1, \dots, v_{i-1}\}$  of the remainder of parents individual  $v$  are replaced.
5. An intersecting partial tour from the head to child individual  $u'$  and child  $v'$  sequentially, arbitrary  $x_m (m < n)$  is inserted in the last gene, it ends in all genes of parents individual  $u$  and parents individual  $v$  are inserted in child individual  $u'$  and child  $v'$ .

**Step 4:** 2-opt type mutation operator

This operator enables settling a prompt solution by using 2-opt method that is simple limited part search heuristics. This consists of the following procedures.

1.  $u = \{u_0, u_1, u_2, \dots, u_n, u_{n+1}\}$  is parents individual,  $u'$  is child individual.
2. Gene  $u_i$  and  $u_j$  are selected from  $u$  at random.
3.  $\{u_i, u_{i+1}\}$  and  $\{u_j, u_{j+1}\}$  are selected from  $u$ .
4. In partial tour  $\{u_{i+1}, u_{i+2}, \dots, u_j\}$  of  $u = \{u_0, u_1, u_2, \dots, u_i, u_{i+1}, \dots, u_j, u_{j+1}, \dots, u_n, u_{n+1}\}$  its gene mutates by one arbitrarily. For example,  $u_p$  is chosen, and it mutates from  $u_p$  and  $u_q$  (Fig. 96.6).

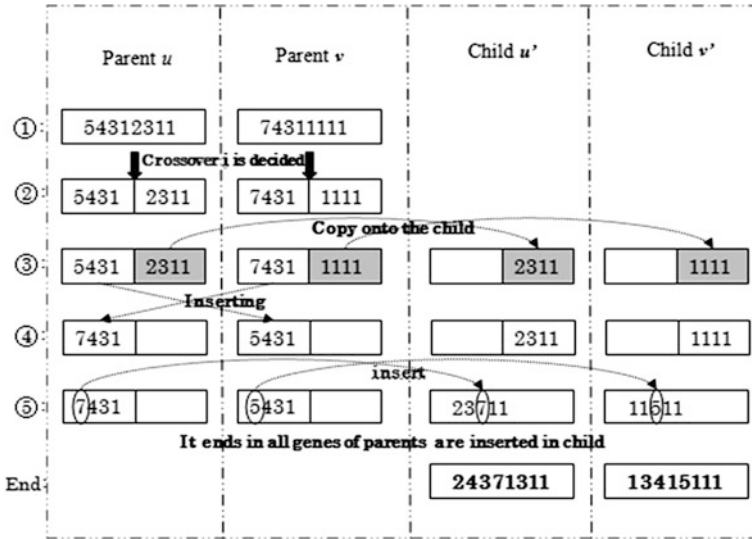


Fig. 96.5 Nearest insertion (NI)

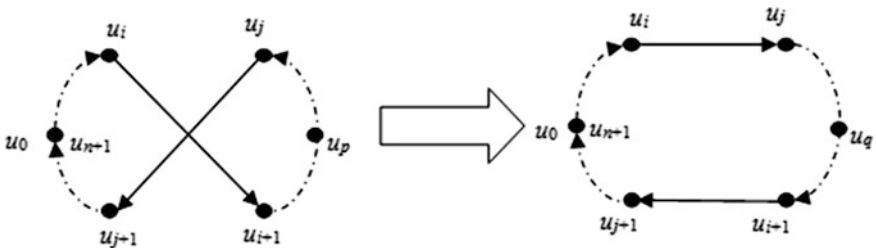


Fig. 96.6 2-opt method

5. It is in former encounter tour after it reverses the order of new partial tour  $u' = \{u_0, u_1, u_2, \dots, u_i, u_j, u_{j-1}, \dots, u_q, \dots, u_{i+1}, u_{j+1}, \dots, u_n, u_{n+1}\}$  is generated.

**Step 5:** Fitness calculation

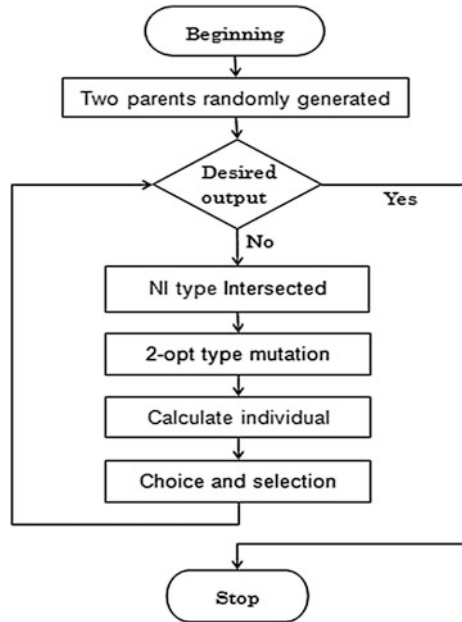
The fitness is set for the value to rise in a better solution. It is a solution in the fuzzy delivery scheduling problem that the cheaper cost is better, it is  $f$  calculated by  $f$  and fitness  $g$  is assumed to be

$$g = 1/f \tag{96.42}$$

in the present study.

If this fitness is high, in a word, it is superior individual by small cost value  $f$ , conversely, it is inferior individual when  $f$  is large.

**Fig. 96.7** Algorithm flowchart



**Step 6:** Choice and selection

If the best individual (individual with a high fitness) is a parents individual among parents individual  $u$ ,  $v$  and child individual  $u'$ ,  $v'$ . Only the parents' individual is left (The number of individuals from 2 to 1). If the best individual is a child individual, the child individual and the second best individual are left. This is an operation to achieve the following two.

- a. It exists near the spot where a good solution is found, and it looks for a good solution as much as possible.
- b. It flies to the area that has not been deeply searched in order to find a better solution.

It means that it is a manner of operation to achieve both a global search and a local search.

**Step 7:** Proliferation

If the number of individuals is 1, it returns to Step 4 and repeats; the number of individuals of groups is assumed to be 2. If the number of individuals is 2, a new individual is not added; it returns to Step 5 and repeats.

**Step 8:** End condition

If the maximum search frequency of the research fills it, end (Fig. 96.7).

**Table 96.1** Experimental result

The proposed algorithm					
Problem no.	Sum( <i>wd</i> )	Sum( <i>pE<sub>a</sub></i> + <i>qT<sub>a</sub></i> )	Sum(− <i>uat<sub>L</sub></i> + <i>Vat<sub>R</sub></i> )	Best Va.	Most suitable Va.
1	91.4	582.6	39.8333	713.833	713.83329
2	95.6	299.9	60.8333	456.333	456.33333
3	85.3	492.1	45.1333	562.533	562.53333
4	88.4	561.4	67.9667	717.767	717.76666
5	147.5	572.7	90.6	810.8	810.80001
6	94.1	590.1	79.9333	764.133	764.1333
7	176.8	665.3	85.0333	927.133	927.13333
8	109.8	519.6	89.6	719	719.00001
9	213.5	513.2	98.333	825.033	825.03333
10	89.9	474.3	59.8667	624.067	624.06665
11	91.6	489.3	69	649.9	649.9
12	241	555.3	125.067	321.367	921.3667
13	145	388.9	85.1	619	618.99999
14	118.1	551.6	59.5	729.2	729.2
15	198.3	624	73.8333	896.133	896.13344
16	125.5	130.1	66.3667	321.967	321.96667
17	96.8	502.1	60.4667	659.367	659.36667
18	148.8	675.8	115.4	940	940
19	267.7	523.7	139.8	931.2	931.2
20	169.7	699.9	102.667	972.2667	972.2667

*Note*

*Best Va.* Best Value

*Most suitable Va.* Most suitable Value

## 96.5 Numerical Study

### 96.5.1 Case Description

The example of calculating number  $n = 6$  of customers was made by using the benchmark problem through 20 questions. However, the fuzzy traffic time and the fuzzy service time were generated by the same part random number. Moreover, each wit about target function are  $w = 1.0$ ,  $p = 1.0$ ,  $q = 1.0$ ,  $u = 1.0$ ,  $v = 2.0$ .

### 96.5.2 Results and Evaluation

Result of comparison obtaining the best solution and optimum solution for example of calculating 20 questions respectively by using proposed technique and enumeration method, the proposed method was able to acquire all the optimum solutions. In a word, the proposed method can acquire the optimum solution efficiently (Table 96.1).

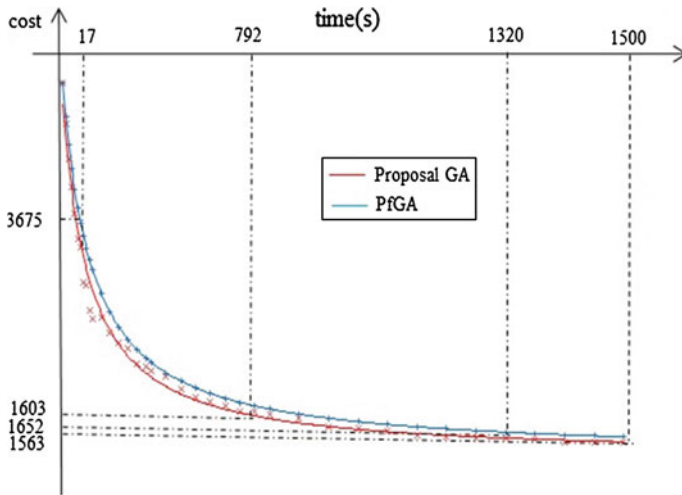


Fig. 96.8 Efficiency and time

It creates five examples of the computations with customers  $n = 100$  using a benchmark problem. However, fuzzy passing time and service period are generated by using a uniform distribution random number; they are considered as each wit  $w = 1.0$ ,  $p = 1.0$ ,  $q = 1.0$ ,  $u = 1.0$ ,  $v = 2.0$  in objective function.

Various results of calculation were obtained; take the average value, then contrast PfGA and the proposed algorithm, the result as Fig. 96.8 shows.

In the figure, the abscissa shows the spending time calculated by the program, the ordinate shows the costs of all paths. Two algorithms running between 0 and 18 s at the same time, the costs of the optimal path calculated by the two algorithms are the same on the whole. After 18 s, in the two algorithms, the cost calculated by the proposed algorithm is less than that calculated by the PfGA algorithm. When the program running to the 792 s, the decline rate of proposed algorithm tends to be slow, the difference between two algorithms get small. When staying at the 1,320 s, two algorithms tend to be similar, until after the 1,500 s, the costs of the optimal path calculated by the two algorithms are almost the same, staying in about the 1,563 s.

The above results indicate that, under the same condition the proposed algorithm computing faster than the PfGA algorithm, seek the optimal solution. Validity of the proposed algorithm is clarified.

### 96.5.3 Discussion

The improved algorithm has the large enhancement compared to the original algorithm in computing time. This reason of enhancement mainly manifests in the following two spots:

1. Sakurai proposed in NI overlapping method, what used is the expression manifests two male parents' genes, when overlapping, because the matched question, can only produce a sub-individual, if in my procedure, produce 2 sub-individuals at least. The procedure must move two times to be able to carry on the next link at least. But in this improved algorithm, after a pair of male parent gene overlapping, directly produces two sub-individuals. This may effectively reduce the burden of procedure, and may save the computing time.
2. Sawai proposed the choice, in elimination and multiplication method, if the individual with a high fitness of 2 parents' individuals and 2 children individuals is a parent individual, only the parent's individual is left. If a good individual is a child individual, the child individual and the second good individual are left. If the number of individuals is 1, a new individual is generated at random. But in this paper proposed the algorithm, only needs to retain 2 adaptation highest individuals. One may not need the process of multiply; the other may maintain the male parent two individual adaptations, and keeps in the high standard. This enhanced the possibility of extracting the most suitable solution, and reduced the procedure running time. Nearest Insertion (NI) method process is relatively complicated, but can get the satisfied solution; 2-opt method can combine the sort organically; deal with the contradiction between the local search of the global sampling effectively. Experiment results show that, the two methods can significantly reduce the total travel and vehicles

## 96.6 Conclusion

In this paper, when the traffic time and the service time are expressed as a triangular fuzzy number, customers' specified waiting time to the collection delivery service beginning time and penalty according to the delay are included, the delivery scheduling problem of total cost minimization is formulated as a possibility plan problem. After it had proposed the method based on Parameter-free Genetic Algorithms, the effectiveness was shown according to the calculation example. It was clarified to the proposed method that takes measures to escape from the localized solution which were necessary at that time to obtaining the optimal solution of the problem at a short computing time.

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# Chapter 97

## Optimal Reliability, Warranty Length, Price and Service Quality for Repeat Purchase Products

Xuan Wang and Liwen Liu

**Abstract** The product warranty is becoming more and more important for the companies providing long life cycle products. In this paper, a decision model is developed to determine the optimal reliability, price, warranty length and warranty service quality. The demand function of the model characterizes the repeat purchase process which is related with the customer satisfaction for warranty service quality. We also develop a warranty delivery cost function to model the cost of service quality. We look at both stable and dynamic scenarios which are based on whether the price, warranty length and service quality are constant over the product life cycle. The maximum principle method is used to obtain optimal solutions for dynamic situations. Finally, the management implication get from the model solutions is discussed.

**Keywords** Diffusion effect • Learning effect • Maximum principle • Repeat purchase • Service quality • Warranty policy

### 97.1 Introduction

Warranty is viewed as a signal that conveys information about product reliability and as such it serves as an important marketing tool. Longer warranty implies better reliability. However, today, customers desire not only better product reliability, but also better warranty service which means quick response for failed

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product. Especially in the cases of long life cycle products, good warranty service will lead to repeat purchases. Thus warranty has two new roles: relationship role and profiting role. Relationship role is that warranty is the best way to keep in touch with the customers and to improve customer satisfaction and loyalty. Profiting role means that warranty service gains more profit than product sale in many situations. Some research has found both warranty length and service quality can impact the demand, but there is no research considering both warranty length and service quality in their models. In this paper, we try to explore in this direction. We construct a decision model to determine simultaneously the optimal reliability, price, warranty length and service quality. The demand function of the model incorporates the factor of repeat purchase which results from the customer satisfaction for warranty service.

Regarding the economic role of warranties, four rationales have been proposed in the literature: signaling role (provision of product quality information to customers), insurance role (protection against product failures), sorting role (mechanism to discriminate customer risk preferences if customer heterogeneity is not fully observable by the seller) and incentive role (incentivize the seller to improve product quality) (Emons 1989). Warranty is an important element of marketing new products as better warranty signals higher product quality and provides greater assurance to customers. Many researchers studied warranty policy because of its importance. Murthy and Djameludin (2002) performed a review of the new product warranty literatures published between 1980 and 2000. Wu (2012) performed a review of warranty data analysis literatures published between 1990 and 2010. Many researchers concerned how to determine the optimal warranty length. Huang et al. (2007) developed a model to determine optimal reliability, warranty length and price for new products. Wu et al. (2009) developed a model to determine optimal price, warranty length and production rate for producers. Lin et al. (2009) concerned of the dynamic optimization of price, warranty length and production rate. Ladany and Shore (2007) studied the determination of optimal warranty length with a Cobb-Douglas demand function. Lin and Shue (2005) investigated optimal price and warranty length applying optimal control theory. Wu et al. (2007) studied the optimal burn-in time and warranty length under free replacement and pro-rata warranty. In most studies, researchers concerned of the warranty length. However, service quality of warranty is lack of attention. Cohen et al. did an empirical study about the service quality of warranty in the U.S. automobile industry (Guajardo et al. 2012). They found both warranty length and service quality can impact the demand. This conforms to what we believe. So far as we know, there is no demand function considering both warranty length and service quality.

The outline of this paper is as follows. In Sect. 97.2, we give the mathematical details of the model formulation. Section 97.3 examines the optimal policies for the proposed model. Finally, in Sects. 97.4 and 97.5 we make some discussion and draw some conclusions.

## 97.2 Development of the Decision Model

The decision model for determining the optimal reliability, warranty length, price and service quality includes two key components: the demand function and the cost function. Both functions are briefly reviewed and discussed in this section.

### 97.2.1 Nomenclature and Notation

$s(t)$	service quality of warranty claim at time $t$ ;
$D(t)$	warranty delivery cost at time $t$ , which include warranty reserve inventory cost and warranty logistic cost—to indicate that this is a function of $s(t)$ i.e., high level of $s(t)$ needs more warranty inventory and logistic cost;
$\theta$	reliability parameter (failure rate), with a smaller value of $\theta$ implying better product quality;
$p(t)$	unit sale price at time $t$ ;
$w(t)$	duration of warranty period for products sold at time $t$ ;
$\delta$	discount rate;
$L$	product life cycle;
$t_p$	average useful life time of the product;
$q(t)$	sales rate of first purchase process at time $t$ , $0 \leq t \leq L$ ;
$q'(t)$	sales rate of repeat purchase process at time $t$ , $t_p \leq t \leq L$ ;
$Q(t)$	accumulated sales in $[0, t]$ , $0 \leq t \leq L$ ;
$Q_0$	parameter characterizing past sales or production experience;
$Q_M$	maximum sales potential;
$\psi$	parameter to reflect the relative influence of innovators in the sales model;
$\omega(w, \theta)$	expected warranty cost per unit sold;
$c(Q(t), \theta)$	total manufacturing cost of unit product, which includes unit development cost and production cost—to indicate that this is a function of $Q(t)$ and $\theta$ because of learning effect;
$\pi$	expected discounted integral profit during the interval $[0, L]$ .

### 97.2.2 The Demand Function

All products have finite lifetime  $t_p$  and life cycle  $L$ . Usually  $t_p$  is less than  $L$ . Due to the finite lifetime, customers are forced to replace the good, unless it is not substituted by a complete new innovation. We define these products as repeat purchase products. There are mainly three streams of repeat purchase: (1) products are up to the useful lifetime and scrap and customers repurchase; (2) the new

generation products have little innovations and customers repurchase; (3) customers break products because of misuse and have to buy a new one, since the warranty will not cover. The demand function of first purchase products (new products) is well researched by Huang et al. In the present paper, we construct a demand model to characterize both the first purchase process and the repeat purchase process.

The first purchase process is also known as the diffusion process. Huang's new product demand model is based on the well known bass model (Bass 1969) and Glickman and Berger's model (Glickman and Berger 1976). These two models are consistent with the behavior of actual product demand and are easy to use. Many applications of these models could be found in the literatures (Mitra and Jayprakash, Blischke and Murthy) (Mitra and Patankar 1990; Murthy and Blischke 1992). We also construct our model based them. What's more, we believe high quality products bring high level of consumer satisfaction and more repeat purchase demand. High quality products are products with low failure rate (reliability  $\theta$ ) and high level of service quality ( $s(t)$ ). Thus we have following 4 assumptions in our model:

1. The life cycle of the product is twice of the average lifetime, i.e.,  $L = 2t_p$ . This means every customer has to replace the good after time  $t_p$  since the purchase.
2. A customer has a probability to buy the product again when the purchased item reaches the end of its useful life ( $t_p$ ). Evidence of this assumption can be found in the literatures of Blischke et al. (2011) and Joachim (2011).
3. There is a monotonic relationship between customer satisfaction and repurchase intentions that is linear for small changes in satisfaction. This is supported by Anderson's remarkable empirical work (Anderson et al. 1994).
4. Customer satisfaction is quality-driven, i.e., the probability of customers' repurchase is proportion to the products' quality level. Here quality contains two parts: the reliability of the product and the service quality of the warranty. We multiply them to indicate the quality level of the product since both of them will affect the quality level of the products.

In Huang's model for new product, demand is represented by a displaced log-linear function multiplies the diffusion effect. It is modeled as follows:  $q(t) = k_1(w(t) + k_2)^{\alpha} p(t)^{-\beta} \left[1 - \frac{Q(t)}{Q_M}\right] \left[\psi + \frac{Q(t)}{Q_M}\right]$  where  $k_1 > 0$ ,  $k_2 > 0$ ,  $\alpha > 1$ ,  $0 < \beta < 1$  and  $Q(0) = Q_0$ .  $Q(t)$  is accumulated sales volume,  $Q_M$  is the maximum sales potential and  $\psi$  reflect the relative influence of innovators. Demand increases with warranty length ( $w(t)$ ) and decreases with price ( $p(t)$ ) and has diffusion effect indicate by the square brackets.

Let  $v$  denote the probability that a customer who has bought the product buys the product again when the purchased item reaches the end of its useful life. In our model, we define the repeat purchase demand in  $[L/2, L]$  as  $q'(t)$ . i.e.,  $q'(t) = vq(t - L/2)$ ,  $t \in [L/2, L]$ . The parameter  $v$  is proportional to quality level.

i.e.,  $v = k_3 \theta^{-r} \bar{S}(t)$ , where  $0 < k_3 < 1$ ,  $0 < r < 1$  and  $\bar{S}(t) = \frac{2}{L} \int_{t-L/2}^t s(t) dt$ .  $\bar{S}(t)$  is

the lifetime average service quality of the product sold at time  $t - L/2$ . Parameter  $v$  is a function of  $\theta$  and  $\bar{S}(t)$ . It implies that customer is more likely to repurchase if the product's failure rate is low and service quality of warranty is high. Thus, the demand model is constructed as follows:

$$f(t) = \begin{cases} q(t), & 0 \leq t \leq \frac{L}{2} \\ q(t) + q'(t), & \frac{L}{2} \leq t \leq L \end{cases}, \text{ where } q(0) = 0$$

For ease of analysis, we let  $q(0) = 0$  to make  $f(t)$  a continuous function. Since  $f(t)$  is at least continuous in  $[0, L/2]$  and  $[L/2, L]$ , we can also deal with it even  $f(t)$  is discontinuous.

The accumulated sales volume,  $Q(t)$ , is given by

$$Q(t) = Q_0 + \int_0^t f(t) dt,$$

where  $Q_0$  is a parameter which captures the past experience at  $t = 0$ , and  $Q_L = Q(L)$  is the total sales volume over the life cycle.

### 97.2.3 The Cost Function

The cost function involves manufacturing cost, warranty cost and warranty delivery cost. Warranty delivery cost is the cost of making the warranty claim easier and faster. In another words, it is the cost of service quality. We denote  $s(t)$  and  $D(s(t))$  to be the service quality and the warranty deliver cost, respectively. We assume (as well as in Teng and Thompson; Coughlan and Soberman) that the quality-related cost  $D(s(t))$  is an increasing convex function of  $s(t)$  (Teng and Thompson 1996; Coughlan and Soberman 2005). In the present paper, we define  $D(t) = k_4 s(t)^2$ . In fact, the service quality is the length of the claiming time. If you want to improve the service quality of the warranty you have to curtail the claiming time. In order to do that, you need more warranty reserve inventory and more logistic deployment. We define these costs as warranty deliver cost.

For the manufacturing cost, we refer to Huang's model which is modeled as follows:

$$C(Q(t), \theta) = (A_1 + B_1 \exp(k((\theta_{\max} - \theta)/(\theta - \theta_{\min}))))/Q_L \\ + K(A_2 + B_2 \theta^{-i})(Q_0/Q(t))^\mu$$

where  $A_1, B_1, k > 0, 0 < \mu < 1$  and  $\theta$  is the product reliability parameter. The first part is the development cost and it is a monotonically increasing function of production reliability. The second part is the production cost and it is decreasing with  $Q(t)$  because of learning effect.

Although there are many kinds of warranty policies and failure distributions, we simplify the warranty cost by choosing a free replacement warranty policy and assume the warranty claims have a Poisson distribution since we focus on service quality. The parameter of the Poisson distribution is the products' failure rate (reliability  $\theta$ ). We denote the warranty cost as  $\omega(w, \theta)$  and we have:  $\omega(w, \theta) = \theta w$ .

### 97.2.4 The Decision Model

We now concern with the problem in which the present value of profit, in terms of four decision variables (i.e., reliability, price, warranty length and service quality) and one state variable (i.e., cumulative sale volume), is to be maximized. The decision model with a discount rate  $\delta$  and a planning horizon  $L$  (product life cycle) may be formulated as

$$\text{Max}\pi = \int_0^L \{[p(t) - C(Q(t), \theta) - \omega(w(t), \theta)]f(t) - D(s(t))\}e^{-\delta t} dt$$

Subject to  $\dot{Q}(t) = f(t)$ , where  $p(t)$  is the unit price at time  $t$ ,  $w(t)$  is the warranty length at time  $t$ ,  $s(t)$  is the service quality at time  $t$ ,  $Q(t)$  is cumulative sales volume at time  $t$ ,  $C(Q(t), \theta)$  is the manufacturing cost of unit product,  $\omega(w, \theta)$  is the average warranty cost of unit product,  $f(t)$  is the sales rate at time  $t$ ,  $D(s(t))$  is the delivery cost at time  $t$ . To improve clarity, we will in future omit the function arguments when this does not cause confusion.

## 97.3 Model Optimization Analysis

In this section, we discuss the optimization of our model in two scenarios. The first scenario is stable market when the price, warranty length and service quality are constant over the product life cycle. The second scenario is dynamic market when these three decision variable can be changed over the product life cycle. Since the reliability is determined by development cost, it is determined before putting the product in the market and keeps the same over the product life cycle.

### 97.3.1 Stable Market

Let  $p^*$ ,  $w^*$ ,  $s^*$  and  $\theta^*$  be the optimal values of  $p$ ,  $w$ ,  $s$  and  $\theta$  which maximize  $\pi$ . In stable market, a necessary condition for  $p^*$ ,  $w^*$ ,  $s^*$  and  $\theta^*$  to be optimal is that they satisfy (a subscript on a variable denotes partial differential with respect to the variable):

$$\pi_p = 0$$

$$\pi_w = 0$$

$$\pi_s = 0$$

$$\pi_\theta = \tau$$

where  $\tau$  is an arbitrary constant with sign given as follows:

$$\tau = \begin{cases} \leq 0, & \text{if } \theta^* = \theta_{\min} \\ 0, & \text{if } \theta_{\min} < \theta < \theta_{\max} \\ \geq 0, & \text{if } \theta^* = \theta_{\max} \end{cases}$$

### 97.3.2 Dynamic Market

Under dynamic market conditions, we face a dynamic optimization problem. To obtain the optimal solution, we apply the maximum principle. To apply the maximum principle, we first obtain the present value of Hamiltonian. According to Sethi and Thompson (2000), the present value of Hamiltonian is

$$\begin{aligned} H &= [p(t) - C(Q(t), \theta) - \omega(w(t), \theta)]f(t) - D(s(t)) + \lambda \frac{dQ(t)}{dt} \\ &= (p - C - \omega + \lambda)f - D \end{aligned}$$

where  $\lambda$  is the present-value adjoint variable and represent the marginal values associated with  $Q(t)$ , and  $\lambda$  satisfy the following differential equation (for convenience, a dot above a variable denotes the first derivative with respect to time):

$$\dot{\lambda}(t) = \delta\lambda(t) - H_Q = \delta\lambda + C_Q f - (p - C - w + \lambda)f_Q \quad (97.1)$$

with the transversality condition that as  $t = L$ , then  $\lambda(t) = 0$ , i.e.,  $t = L, \lambda(t) = 0$ .

The following necessary conditions hold for an optimal solution:

$$H_p = 0 \Rightarrow p - C - \omega + \lambda = -f/f_p \quad (97.2)$$

$$H_w = 0 \Rightarrow p - C - \omega + \lambda = \omega_w f/f_w \quad (97.3)$$

$$H_s = 0 \Rightarrow p - C - \omega + \lambda = D_s/f_s \quad (97.4)$$

and the Hessian matrix (HM) is a negative definite matrix, that is:

$$H_{pp} < 0; \quad (97.5)$$

$$H_{ww} < 0; \quad (97.6)$$

$$H_{ss} < 0; \quad (97.7)$$

$$H_{pp}H_{ww} - (H_{pw})^2 > 0; \quad (97.8)$$

$$H_{pp}H_{ss} - (H_{ps})^2 > 0; \quad (97.9)$$

$$H_{ww}H_{ss} - (H_{ws})^2 > 0; \quad (97.10)$$

Some immediate consequences can be obtained. From (97.5–97.7), we easily obtain:

$$2f_p - \frac{f}{f_p}f_{pp} < 0 \quad (97.11)$$

$$-\omega_{ww}f - 2\omega_w f_w + \frac{\omega_w f}{f_w}f_{ww} < 0 \quad (97.12)$$

$$\frac{D_s}{f_s}f_{ss} - D_{ss} < 0 \quad (97.13)$$

In order to find the optimal trajectories of p, w and s, we take the time derivative of the optimal price, warranty and service quality given by (97.2–97.4). The result is:

$$\begin{aligned} H_{pp}\dot{p} + H_{pw}\dot{w} + H_{ps}\dot{s} + H_{pQ}f + H_{p\lambda}\dot{\lambda} &= 0 \\ H_{wp}\dot{p} + H_{ww}\dot{w} + H_{ws}\dot{s} + H_{wQ}f + H_{w\lambda}\dot{\lambda} &= 0 \\ H_{sp}\dot{p} + H_{sw}\dot{w} + H_{ss}\dot{s} + H_{sQ}f + H_{s\lambda}\dot{\lambda} &= 0 \end{aligned}$$

Substitute (97.1) for  $\dot{\lambda}$  and rearrange terms. It is shown that the first derivatives of the optimal trajectories p, w and s, represented by Cramer's rule, are uniquely determined:

$$\begin{pmatrix} \dot{p} \\ \dot{w} \\ \dot{s} \end{pmatrix} = -HM^{-1} \begin{pmatrix} 2ff_Q - \frac{f^2}{f_p}f_{pQ} + \delta\lambda f_p \\ -2\omega_w ff_Q - \frac{f^2}{f_p}f_{wQ} + \delta\lambda f_w \\ -\frac{f^2}{f_p}f_{sQ} - D_s f_Q + \delta\lambda f_s \end{pmatrix} \quad (97.14)$$

where

$$HM = \begin{pmatrix} 2f_p - \frac{f}{f_p}f_{pp} & f_w - \omega_w f_p - \frac{f}{f_p}f_{pw} & f_s + \frac{D_s}{f_s}f_{ps} \\ f_w - \omega_w f_p - \frac{f}{f_p}f_{pw} & -\omega_{ww}f - 2\omega_w f_w + \frac{\omega_w f}{f_w}f_{ww} & -\omega_w f_s + \frac{\omega_w f}{f_w}f_{ws} \\ f_s + \frac{D_s}{f_s}f_{ps} & -\omega_w f_s + \frac{\omega_w f}{f_w}f_{ws} & \frac{D_s}{f_s}f_{ss} - D_{ss} \end{pmatrix}$$

## 97.4 Discussion

In this section, we analyze the general formulation discussed in Sect. 97.3 and state some immediate consequences of the optimality condition (97.2–97.4). From (97.2) to (97.4), we easily obtain:

$$\omega_w = -f_w/f_p \quad (97.15)$$

$$D_s = -ff_s/f_p \quad (97.16)$$

These two results are useful for getting the optimal solution (97.14), and what's more, they have some economic interpretations. A simple economic interpretation of (97.15) is that the firm gives a warranty length where the cost of warranty increase equals the price increase that customers are willing to pay. An interpretation of (97.16) is that the service quality has an amplification effect on demand.

Let's look at the cross derivative of Hamiltonian, we can easily obtain:

$$H_{pw} = H_{wp} = f_w - \omega_w f_p - \frac{f}{f_p}f_{pw} \quad (97.17)$$

$$H_{ps} = H_{sp} = f_s - \frac{f}{f_p}f_{ps} \quad (97.18)$$

$$H_{ws} = H_{sw} = -\omega_w f_s - \frac{f}{f_p}f_{ws} \quad (97.19)$$

For (97.17), we know that  $f_w > 0$ ,  $\omega_w > 0$ ,  $f_p < 0$ ,  $f > 0$ . This imply if  $f_{pw} > 0$ , then  $H_{pw} > 0$  i.e., total profit  $H$  at time  $t$  will be increased by increasing (or decreasing) both price and warranty length.

For (97.18), we know that  $f_s = 0$  in  $[0, L/2]$  and  $f_s > 0$ ,  $f_p < 0$ ,  $f > 0$  in  $[L/2, L]$ . This implies: in  $[L/2, L]$  if  $f_{ps} > 0$ , then  $H_{ps} > 0$  i.e., total profit  $H$  at time  $t$  will be increased by increasing (or decreasing) both price and service quality.

For (97.19), we know that  $f_s = 0$  in  $[0, L/2]$  and  $f_s > 0$ ,  $\omega_w > 0$ ,  $f_p < 0$ ,  $f > 0$  in  $[L/2, L]$ . This implies: in  $[L/2, L]$  if  $f_{ws} < 0$ , then  $H_{ws} < 0$  i.e., total profit  $H$  at time  $t$  will be decreased by increasing (or decreasing) both price and service quality.

Finally, let's discuss the optimal solution we get in Sect. 97.3. Analyze (97.11), we can obtain these results:

1. If  $f_Q < 0$  and  $f_{pQ} < 0$ , then  $dp/dt > 0$ , i.e., company should raise the price. This means that if the products come to the saturation stage ( $f_Q < 0$ ) and price effect on demand is decreasing ( $f_{pQ} < 0$ ). The company should raise the price. It is intuitive.
2. In  $[0, L/2]$ ,  $f_s = 0$ , if  $f_Q < 0$ , then  $ds/dt < 0$ , i.e., company should decrease the service quality level. This means that if the demand saturates in the first stage (maybe the products are not well designed), the company should decrease the service quality. It is intuitive.
3. In  $[L/2, L]$ ,  $f_s > 0$ , if  $f_{sQ} > 0$ , then  $ds/dt > 0$ , i.e., company should increase the service quality level. Good service quality can increase demand;  $f_{sQ} > 0$  implies this effect of service quality is increasing. Intuitively, the company should increase the service quality level.

## 97.5 Conclusion

In the present paper, we develop a general model to determine reliability, price, and warranty length and service quality for a repeat purchase product. A demand function which characterizes both first purchase process and repeat purchase process is constructed. Warranty delivery cost is defined and modeled. We connect the service quality with product demand which is intuitive. The expected number of renewals based on the warranty length is derived from a Poisson product failure distribution and free renewal warranty policy. Manufacturing cost is evaluated and increasing with the product reliability. Both diffusion effect and learning effect are concerned in our model. We have looked at two scenarios for price and warranty policy: stable market (with constant price, warranty length and service quality) and dynamic market (with price, warranty length and service quality changing over the product life cycle). A solution approach using maximum principle is described in dynamic markets. Using Hamiltonian, we found the optimal trajectories of  $p$ ,  $w$  and  $s$ . Some results are obtained by discussing the optimal conditions and the optimal trajectories of  $p$ ,  $w$  and  $s$ .

The model can be extended in several different directions. We believe service quality can affect the product demand. In the present paper, we connect service quality with repeat purchase process. However, service quality can affect the first purchase process because of the good or bad word of mouth. This will involve modifying the diffusion model. Another extension is to study this problem with different types of warranties.

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# Chapter 98

## Power Supply Enterprise Human Resources Management Ability Fuzzy Comprehensive Evaluation Based on ANP

Yi-ming Zhao

**Abstract** According to the interrelation among indices of human resources management level evaluation system, and it's difficulty to define object precisely. In this article, we combined the method of network analytic hierarchy process and fuzzy comprehensive evaluation, then implemented comprehensive evaluation towards the power supply enterprise human resources management. Firstly, the ANP method is used to determine the weight of every index, overcome the defects that hierarchical analysis cannot reflect the interrelation between indicators, and then construct the fuzzy comprehensive assessment model based on analytic network process that used to evaluate the uncertainty of human resources management ability. Finally, using the Super Decisions software to implement example analysis verifies the effectiveness and scientificness of the evaluation model.

**Keywords** Analytic network process • Fuzzy comprehensive evaluation • Human resources management ability

### 98.1 Introduction

With the reforming of electricity market, as technology, capital and labor-intensive enterprise, power supply company faced more opportunities and challenges (Teece et al. 1997). Electric power enterprises more apply high technology, need more worker creative participation, human resource has promoted enterprise strategic resources of the most important and the most active factors. Therefore, continuously strengthen and improve the human resources management of electric power

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enterprise, and finally design an evaluation system of enterprise human resources dynamic ability for power supply enterprises have the important practical significance (Zollo and Winter 2002).

The formation of human resources management dynamic capabilities lies in: In environmental changes under the influence of human resources in the resources of an organization's function, constraints or regulation, in order to achieve the goal of environment change rapidly adapt to, using relevant intellectual resources will organize internal and external tangible resources, invisible resources and human resources, so as to realize the organic integration of organizational value of ascension (Schrey and Kliesch 2005). Using the ANP to mutual influence of each index weight and using fuzzy comprehensive evaluation method evaluation indexes, accurately reflect human resource management ability. Based on the characteristics of power generation enterprises, established the ability of human resources management ANP fuzzy comprehensive evaluation model (Tao et al. 2010).

## **98.2 Human Resources Dynamic Capability Evaluation Index System Initially Constructs**

This paper analyzes and summarizes the influences of power supply enterprise human resources management ability. Using Delphi method letters to the expert advice. After consulting, get experts to index importance size opinion (Woo 2009). After consultation, and according to ranking screened influence function of human resources management ability and the corresponding evaluation indexes module, were set up four primary index, 21 s-level indexes, based on these establishment human resources management capability evaluation index system is shown in Table 98.1.

## **98.3 Exposition of Index System**

Human resources idea. Strategic human resource management ability derived from human resources idea keep pace with the times and innovation, this idea of contained in enterprise in the internal and external environment, including the respective fields insight into the development the understanding, operating rules for changes in the environment and the development trend of the cognitive and the response plan formulated such activities (Nilsson 2001). In a world of abundant information for organization, management, environment influence of strategic and performance was deep and wide, the environment also changes with a time, is a dynamic process. Primary task is the enterprise will have enough information to grasp the current situation and forecast the future, and make proper operation rapid and effective strategy (Hartmann 2007).

**Table 98.1** Human resources management capability evaluation index system

Object sets	Factor sets	Factor subsets
The power supply enterprise human resources management ability	Human resources idea B	B1 Environmental changes to the industry forward-facing
		B2 Optimized resource restructuring of the group of support
		B3 The understanding of business strategy to support
		B4 Human resource planning strategic, systematic and guidance
		B5 Human resources annual plan guidance, systematicness
	Researchers identify and configuration C	C6 Recruitment system scientific and reasonable
		C7 Staff match ratio
		C8 Core job employee turnover
		C9 Core post competency model setting up scientific effectiveness
		C10 Human resource supply and demand forecasting model established scientific accuracy
	Personnel training and development D	D11 Training plan of strategic and reasonable
		D12 The annual training plan
		D13 Training success rate
		D14 New employee orientation efficiently
		D15 Talent density equivalent
	Performance evaluation and incentive compensation management E	E16 Performance management strategic, integrity, and availability
		E17 Evaluation result applied effectiveness evaluation
		E18 Special performance improvement counselling staff
		E19 Professional channel construction operability, encouraging
		E20 Core job employee career planning penetration rate
		E21 Salary system of scientific, systematic and affordable

Researchers identify and configuration. Talent is the basic guarantee of organizational capacity improvement, will the right people in the right jobs is placed into full play the necessary conditions of human resource potential. Talent reasonable configuration is gaining and accurate realization human resources

management of the various functions of prerequisites is human resources management capable preparation link (Breachan 2006).

Personnel training and development. Establishing a scientific and reasonable foster development system, improve the strategic human resources management ability to develop purpose is to develop employee new potential, improve its behavior patterns, in order to adapt to the requirements of the development of organization.

Performance evaluation and incentive compensation management (Ryding 2010). Integrated performance evaluation and incentive compensation system, strengthen the organization of dynamic competitive advantage high quality of performance evaluation and incentive compensation effectively combine can promote strategic human resource management ability, form organization lasting competitive advantage.

## **98.4 Styling Empowerment Based on the ANP Evaluation Indexes**

Using the method of evaluation index structure analytic network process (ANP network structure model, through the comprehensive analysis of the relationship between each element of interaction with Super Decisions software, calculated each index weight, can be more system, scientific power supply enterprise human resources management ability index evaluation.

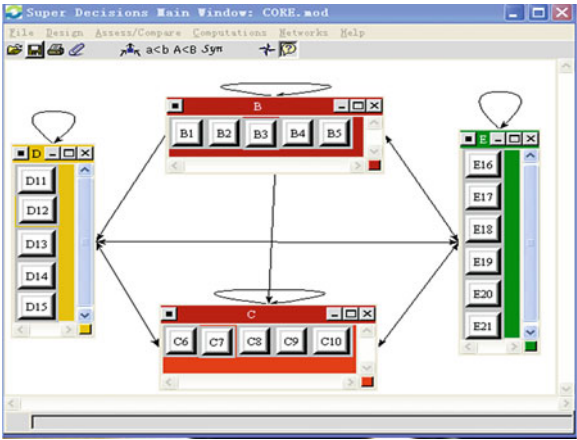
SD software provides a powerful function, this software based on the ANP theory, has successfully will ANP calculation procedure, can calculate any ANP model, and fully express the calculation result, man-machine interface also very friendly, and easy to use.

Press dominations relation will each element of group (cluster) and elements (element) clustering grid formation structure, determine the group (cluster) and between elements (element), the relationship between the main judge whether internal independent element level, whether to have interdependent and feedback relations exist. According to the proportion of scale-free after people judge, according to a goal for the group (cluster, between element) and elements (between each one by comparison, constitute a comparison matrix. Between that and depend on each other, all feedback relations between two comparison.

### **98.4.1 SD Software Input Parts**

SD software interface of municipal power supply enterprise human resources management capability evaluation model. According to the above the evaluation system, constructing the network analysis calculation software with Super

**Fig. 98.1** Super decisions software ANP structure model



Decision tectonic system capacity assessment structure model as shown in Fig. 98.1 shows, SD software interface can be constructed under the hierarchical structure model of network.

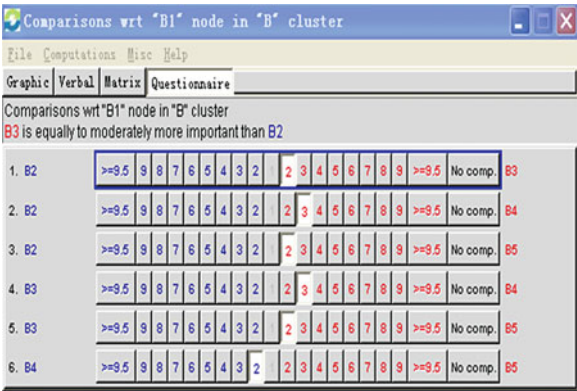
This evaluation target system can be divided into four factors set, that is human resources idea, personnel recognition and configuration, personnel training and development, performance evaluation and incentive compensation management. According to the model above, relevant 21 evaluation index as a child elements are added to each element set, the overall evaluation model is formed namely the network layer.

As the evaluation dimension involves the evaluation criteria are not independent, so we can see ring arrows. Arrows point to say “the... influence. Between each element between each element group, are not independent of each other, annular arrow says the group the mutual influence between each element in the family, the double arrow says there is contact between elements and influence each other. To control and the layer of respectively again 4 criterion index B, C, D, E for judgment standard, the index will element set with binary comparison, as shown in Fig. 98.2.

**98.4.2 SD Software Calculation Output**

According to the first step input part, software can be tectonic super matrix, weighted super matrix, limit super matrix, and ultimately the comprehensive advantages degrees. After the establishment of the judgment matrix, need to validate the consistency. Only in guarantee all judgment matrix is less than 0.1, namely all CR in through the consistency test, to ensure optimal after characteristic value of usability.

**Fig. 98.2** Super decisions software evaluation index pairwise judgment matrix re-graded interface examples



Through the front computation, we can get consistency test results for  $0.0039 < 0.1$  and system of the relative advantage within each index, namely weights degree.

**98.5 The Evaluation Indexes for Fuzzy Comprehensive Evaluation**

In reality, deterministic and stochastic phenomenon is the phenomenon of two things more common mode of existence, and some classification standard not clear, boundary ambiguous fuzzy phenomena, involving such fuzzy factors, appropriate USES fuzzy comprehensive evaluation method (Zhao et al. 2008). Fuzzy comprehensive evaluation method is to use the basic idea of fuzzy linear transform principle and maximum membership degree principle, consider and be evaluation target by the various factors related to the lowest level in turn up the various factors hierarchy, until the highest goal layer, eventually got evaluation results, as shown in Table 98.2.

From Table 98.2 get factors centralization heavy matrix:  
 $W = [0.3509, 0.1091, 0.1891, 0.3509]$   
The son of the weight factor set into:  
 $W1 = [0.0816, 0.1369, 0.5265, 0.2551]$   
 $W2 = [0.0328, 0.5325, 0.3933, 0.0375]$   
 $W3 = [0.2243, 0.0887, 0.6161, 0.0190, 0.0519]$   
 $W4 = [0.0681, 0.0289, 0.1879, 0.3832, 0.1516, 0.1802]$   
Obtained by fuzzy calculation method for fuzzy evaluation matrix R1:

$$R_1 = \begin{bmatrix} 0.2000 & 0.3000 & 0.2333 & 0.2000 & 0.0667 \\ 0.3667 & 0.3333 & 0.1667 & 0.1333 & 0.0000 \\ 0.0333 & 0.1333 & 0.7667 & 0.0667 & 0.0000 \\ 0.3000 & 0.3333 & 0.2667 & 0.1000 & 0.0000 \end{bmatrix}$$

Table 98.2 Evaluation index weight and the results of the evaluation of son factor sets

Element set	Weight	Elements subset	Weight	Evaluation results				
				Very good	Good	Generally	Bad	Very bad
B	0.350913	B2	0.08157	6	9	7	6	2
		B3	0.13688	11	10	5	4	0
		B4	0.52645	1	4	23	2	0
		B5	0.25510	9	10	8	3	0
C	0.109114	C6	0.03277	0	3	19	6	2
		C7	0.53252	0	2	5	20	3
		C8	0.39330	0	0	17	2	1
		C10	0.03752	0	7	12	8	3
D	0.189060	D11	0.22429	3	7	11	6	3
		D12	0.08874	13	9	7	1	0
		D13	0.61606	8	8	9	5	0
		D14	0.01898	11	8	7	4	0
E	0.350913	D15	0.05193	13	9	8	0	0
		E16	0.06810	6	7	13	3	1
		E17	0.02892	0	8	19	3	0
		E18	0.18793	3	7	16	4	0
		E19	0.38324	0	0	0	19	11
		E20	0.15163	0	0	0	3	27
		E21	0.18018	3	5	17	3	2

Choose a weighted average of the type of  $M(\bullet, +)$  operator fuzzy operations, to  $R_1$  symbol “ $\bullet$ ” generalized synthesis operations, said adequate consideration to all factors for the single factor evaluation and keep all the information, optional operators  $M(\bullet, +)$ , i.e. on the weighted average type synthesis operations.

The comprehensive evaluation vector for B:

$$\begin{aligned} B_B = W_1 \times R_1 &= \begin{bmatrix} 0.0816 \\ 0.1369 \\ 0.5265 \\ 0.2551 \end{bmatrix}^T \circ \begin{bmatrix} 0.2000 & 0.3000 & 0.2333 & 0.2000 & 0.0667 \\ 0.3667 & 0.3333 & 0.1667 & 0.1333 & 0.0000 \\ 0.0333 & 0.1333 & 0.7667 & 0.0667 & 0.0000 \\ 0.3000 & 0.3333 & 0.2667 & 0.1000 & 0.0000 \end{bmatrix} \\ &= [0.1606 \quad 0.2253 \quad 0.5135 \quad 0.0952 \quad 0.0054] \end{aligned}$$

Similarly seek C, D, E element group of comprehensive evaluation vector respectively:

$$\begin{aligned} B_C &= [0.0000 \quad 0.0475 \quad 0.3978 \quad 0.3978 \quad 0.0723] \\ B_D &= [0.2546 \quad 0.2639 \quad 0.3060 \quad 0.1530 \quad 0.0224] \\ B_E &= [0.0504 \quad 0.0975 \quad 0.2501 \quad 0.6938 \quad 0.2912] \end{aligned}$$

By  $B_B, B_C, B_D, B_E$  can  $B_E$  obtained first level factor sets of fuzzy comprehensive evaluation matrix:

$$R = \begin{bmatrix} 0.1606 & 0.2253 & 0.5135 & 0.0952 & 0.0054 \\ 0.0000 & 0.0475 & 0.3978 & 0.3978 & 0.0723 \\ 0.2546 & 0.2639 & 0.3060 & 0.1530 & 0.0224 \\ 0.0504 & 0.0975 & 0.2501 & 0.6938 & 0.2912 \end{bmatrix}$$

Use  $M(\bullet, +)$  operator fuzzy computation of  $R$ , get this power supply company human resource dynamic abilities of comprehensive evaluation vector:

$$\begin{aligned} B = W \circ R &= \begin{bmatrix} 0.3509 \\ 0.1091 \\ 0.1891 \\ 0.3509 \end{bmatrix}^T \circ \begin{bmatrix} 0.1606 & 0.2253 & 0.5135 & 0.0952 & 0.0054 \\ 0.0000 & 0.0475 & 0.3978 & 0.3978 & 0.0723 \\ 0.2546 & 0.2639 & 0.3060 & 0.1530 & 0.0224 \\ 0.0504 & 0.0975 & 0.2501 & 0.6938 & 0.2912 \end{bmatrix} \\ &= [0.1222 \quad 0.1683 \quad 0.3692 \quad 0.3492 \quad 0.1162] \end{aligned}$$

## 98.6 Results

Taken together these results, by each index fuzzy operators generated evaluation results, as shown in Table 98.3:

D personnel training and development highest score in the 71.05, suggests the company is doing its best to function management, followed by B strategic human

**Table 98.3** Each index score and sequencing result

Index	B	C	D	E
Score	68.70	43.58	71.05	55.60
Sort	2	4	1	3

resource management concept, scoring 68.70, explain the company’s leadership has certain strategic vision, but specific executive does not reach the designated position, so E performance evaluation and incentive performance salary management and C personnel recognition and configure these human resources specific executive module scores low 55.60, 43.58 respectively:. Overall score 61.81, explain the company’s overall human resource management ability level is acceptable, and strong improve space.

98.7 Conclusion

In this paper, based on the human resource management ability analytic network process ANP fuzzy comprehensive evaluation system, adopting ANP method is used to determine the weighing values for assessment index AHP method, can effectively resolve the index to solve between interaction and mutual feedback problems (Johnson et al. 2002). And using fuzzy comprehensive evaluation method for power supply enterprise human resources management ability to evaluate the comprehensive consideration not only can affect human resource management ability, and retained the variety of factors of evaluation index of every level, the evaluation result all information can be easily transformed into concrete score, solve the real evaluation index difficult to accurately defined problem. Such a comprehensive, integrated assessment model more actual situation; And this model operation is simple and convenient, easy to operate, help power supply company to better understand their human resources management problems for the power supply company, improving the level of human resources management provide more scientific and reasonable decisions.

Because I have knowledge and time is limited, in the knowledge system also has many shortcomings and limitations of case investigation, this paper only on factors enterprise human resources management competence evaluation made some preliminary research, paper itself have more imperfections, and take the research sample also relatively little, may make the analysis result produces deviation. In fact, enterprise human resources management capability evaluation this topic, if you want a more perfect feasible evaluation model, need a lot of research work, expected later can on this basis for further research.

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# Chapter 99

## QoS-Driven Dynamic Pricing Mechanism of SaaS in Cloud Services

Gang Nan and Ya-min Wang

**Abstract** Combining the Quality of Service (QoS) with SaaS pricing, a QoS-driven Software as a Service (SaaS) dynamic pricing mechanism was proposed in this paper. This research analyzed the pricing principle, gave the corresponding algorithm, and described the pricing process. Using this pricing mechanism, SaaS users can find the tradeoff between the best price and performance, and SaaS providers can maximize their profits by improving the resource utilization. Simulation experiments have shown that the algorithm is effective and reasonable.

**Keywords** Dynamic pricing · QoS · SaaS · Service science

### 99.1 Introduction

In the era of network economy, the concept of products has changed greatly. Recently, there have emerged many new forms of information products or service (Huang 2010), and Software as a Service (SaaS) is one type of them. Studies have shown that SaaS has moved quickly to a mainstream phenomenon (Fan et al. 2009). SaaS is a new model that SaaS providers deliver software services to end-users over the Internet, and users can order the software services from them according to their own actual needs (Tong 2010).

As the application of SaaS is becoming more and more widely, the pricing mechanism of SaaS is evolving to an important area of modern information

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technology and economics. Now there are three types of pricing mechanisms which are used widely, namely the flat-rate pricing, the usage-based pricing and the dynamic pricing (He et al. 2011). But none of them can cater to the demand of the market completely.

Quality of Service (QoS) is one of the factors which must be considered in the pricing mechanism of information products and service (Wu and Wang 2008) and more and more users are paying great attentions to that. Though a great amount of research on SaaS pricing have achieved lots of results, but research which combined these two studies together are few.

Therefore, in this paper, we introduced the Quality of Service (QoS) into the SaaS pricing research. Combining the content of micro-economics and science services together, we proposed a dynamic pricing mechanism. SaaS providers can allocate their own service resources in different areas according to the quality of service levels, and charge for different service price in different area. Users can choose different service according to their own actual needs, in this case, users can seek to minimize their costs. So with the price changes dynamically, it can adjust the supply and demand in turn, and further optimize the resource utilization. Experiments have shown that the dynamic pricing mechanism is effective and reasonable.

## 99.2 Related Work

There have been many studies that focus on SaaS pricing, and a lot of scholars have achieved many different conclusions from different perspectives.

Weinhardt et al. (2009) pointed out that the success of cloud services needed to improve pricing mechanisms as a basis. Pay per use is widely used in current pricing model of cloud services. Such as Amazon EC2 and Google App Engine, they are charging users for service fees by the way of pay per use.

Youseff et al. (2008) concluded that different cloud services pricing models generally took one of the following three forms: the tiered pricing, the per-unit pricing and the subscription-based pricing.

The study on SaaS pricing mechanisms mentioned above are mainly focused on fixed pricing. The fixed pricing mechanism is simpler to understand and more straightforward for users compared to the dynamic pricing mechanism. However, not all users do have the same need (Weinhardt et al. 2009). Hence, it is not fair for all users to be charged the same fixed price. Fixed prices also do not allow high price-sensitive users to benefit from lower prices which they prefer to accept in exchange of certain restrictions. In addition, for SaaS providers, using the fixed pricing mechanism can not motivate their users by giving them different prices (Wei 2011). But the dynamic pricing mechanism can adjust the commodity prices based on supply and demand, which allows providers to charge the same goods or services for different prices because of the difference on customer, time, space and so on.

So we draw more attentions to the dynamic pricing mechanism. The existing research of dynamic pricing on cloud services are as follows:

Ouyang et al. (2007) for the problem that SaaS providers rely on a shared resource pool to provide services to multiple users, on the basis of making a deep consideration of the time and demand which have effects on pricing, they used a method of simulation and obtained a dynamic pricing mechanism in utility computing. But the method didn't consider the preferences of the users.

Yeo et al. (2010) pointed out that the fixed pricing mechanism didn't consider the customer's needs, he made a deep analysis of resources, time and other factors on the demand and pricing. He used the empirical method to make a comparison between the fixed pricing mechanism and the dynamic pricing mechanism, and proposed an automated pricing mechanism which can meet users' needs, reach the service requirements and solve other issues.

Essegaier et al. (2002) made a research in the case that the service capacity was limited, using approaches such as fixed price, based on utility and pricing in two-stage, they believed that two important factors deciding the optimal pricing were service capacity and consumer heterogeneity.

Zhang and Seidmann (2002) proposed a two-stage game model, the monopoly provider could segment the market according to consumer's sensitivity to the quality of SaaS, then SaaS providers could use two price discrimination mechanisms based on consumers' self-selection. The idea which distinguishes users reasonable gave us a lot of inspiration.

In summary, existing research focuses on time, market conditions, service levels and other factors on SaaS pricing. Based on these studies, we proposed a QoS-driven SaaS dynamic pricing mechanism. Compared to the related research, our work is novel in the following sense. First of all, SaaS providers segment the market based on the Quality of Service (QoS), and provide different levels of service. Secondly, users can access to different service areas (high-quality of service area, low-quality service area, etc.) selectively according to their needs. More importantly, different service areas have different threshold prices (base price) and dynamic prices. The dynamic price is changing along with the supply and demand in the market over time.

## 99.3 Dynamic Pricing Mechanism of SaaS

### 99.3.1 Problem Description and Assumptions

In this paper, we take the perspective of SaaS providers which allocate their resources in different areas based on different qualities of SaaS. For example, the SAP, which is providing ERP services to users, allocates its resources in different service areas based on the quality of service parameters related to the level of services, such as high-level areas, middle-level areas, low-level service areas, etc.

**Table 99.1** The information of service areas and the corresponding parameters

Service area	Response time (S)	...	Security	Storage capacity
High-level area	<10	...	High	100G
Middle-level area	<20	...	Middle	50G
Low-level area	<30	...	Low	20G

The parameters for each service area are shown in Table 99.1, users can view the partition and the detailed information of each area after getting entered into the main page.

For SaaS providers, they will ensure that the services which is provided to each user can reach the requirements of quality, namely they will comply with the Service Level Agreement (SLA) all the time. Moreover, the system will set a threshold value of the resource utilization for each area. When the accessed users take up too many resources, even the resource utilization exceeds the threshold, and then the standby resources (including servers, storage, etc.) will be launched to ensure the quality of service. Under the normal circumstance the standby resources are not available for users.

Within a period  $T$  (such as one day) in each service area, SaaS providers charge different prices for one unit of service in different time intervals, namely the price is changing dynamically over time. The system will refresh the price list dynamically, which enables users to query it every time. For example, if one user queries the price charged by SaaS providers in a period  $T$  (Such as the December 28, 2011, Wednesday), he can see the result shown in Table 99.2.

Users can determine which area to access and when to access according to their own needs and the different prices charged by SaaS providers in different time intervals. For large enterprises, they often require a higher quality of service, namely require a higher processing speed and a larger storage capacity. Well, they can choose to pay higher price to access to the high-level area. For small and medium business users who are sensitive to price, they can choose to access to

**Table 99.2** The price of every unit service that one SaaS provider charges in different service areas and different time intervals within a period  $T$

Time interval	High-level area	Middle-level area	Low-level area
00:00–02:00	1.83	1.12	0.62
02:00–04:00	1.96	1.29	0.76
04:00–06:00	2.12	1.37	0.86
06:00–08:00	2.34	1.52	1.04
08:00–10:00	2.56	1.78	1.15
...	...	...	...
22:00–00:00	1.98	1.20	0.89

middle-level area or low-level area, or avoid sending service requests in the period of peak demand. In this case, they can reduce a lot of costs.

### 99.3.2 Dynamic Pricing Algorithm

In a certain service area (such as in high-level area), in the next period  $T$  (Such as the December 29, 2011, Thursday), within a certain time interval (For example, 8:00–10:00 a.m.), the price of per unit service charged by SaaS providers is  $P$ , then

$$P = P_Q + \mu P_q \quad (99.1)$$

In which,  $P_Q$  and  $P_q$  are set by the SaaS provider, different providers generally will set different values. The same provider will also set different values of  $P_Q$  and  $P_q$  in different service areas, for example, the ERP services provider SAP company will set different values of  $P_q$  and  $P_q$  in different service areas (high-level area, middle-level area, low-level area), namely  $P_{Qh}, P_{Qm}, P_{Ql}, P_{Qh} > P_{Qm} > P_{Ql}$ , and  $P_{qh}, P_{qm}, P_{ql}, P_{qh} > P_{qm} > P_{ql}$ .

$\mu$  is the resource utilization,  $\mu = \frac{S_r}{S_o}$ , where  $S_r$  is the actual resource utilization in a certain time interval (such as 8:00–10:00 a.m.) in a service area (such as in high-level area).  $S_o$  is the total resources provided by the SaaS provider in a certain time interval (such as 8:00–10:00 a.m.) in a service area (such as in high-level area). For a specific SaaS provider, resources that provided by them are generally kept to be the same in different time intervals in a established service area, namely the  $S_o$  remains the same.

$\mu$  is changing dynamically over time, therefore, it requires to be measured dynamically. Within a period  $T$  (such as a day), we divide it into  $n$  time intervals, and set the time horizon as  $L$ , so  $L = \frac{T}{n}$  (such as  $n = 12, L = 2h$ ).

In the  $n$ th time interval, we measure the value of  $\mu$  every  $m$  time units (e.g.,  $m = 30$  min), so the value field of the  $\mu$  is  $\{\mu_1, \mu_2, \mu_3 \dots \mu_k\}$ . Calculate the average  $\mu_n = \frac{\mu_1 + \mu_2 + \dots \mu_k}{k}$ . Then we use the exponential smoothing forecasting method (Hua and Hu 2005) to predict the resource utilization  $\hat{\mu}_{n+1}$  in the  $n$ th time interval during the next period  $T$ , so

$$\hat{\mu}_{n+1} = (1 - \partial)\hat{\mu}_n + \partial\mu_n \quad (99.2)$$

We take the predictive value as the resource utilization in the next period  $T$  of the  $n$ th time interval in one service area (such as the high-level area), so  $\mu = \hat{\mu}_{n+1}$ , the price of per unit of service which is provided by SaaS providers is  $P = P_Q + \hat{\mu}_{n+1}P_q$ , this price  $P$  is changing with the resource utilization  $\mu$  dynamically.

In a certain time interval during one period  $T$ , for example, 8:00–10:00 a.m., resource utilization reflects the supply and demand in the market. Since for SaaS providers, after they installed software and allocated the resources, the resources

that provided by SaaS providers are constant in each service area, namely the  $S_o$  is constant. If the actual usage of resource  $S_r$  become larger, it shows that there are a lot of requests from end-users, then the value of  $\mu$  will become larger, and so will the  $P$  ( $P$  is an increasing function of  $\mu$ ). The higher price will prevent too many users to accessing, which can avoid overloading. On the contrary, if the users' demands become less, the rate of resource utilization will become lower, too. That is to say there are many resources are idle, so the price will become lower to attract more users to access to the appropriate service areas.

### 99.3.3 Dynamic Pricing Process

Based on the pricing algorithm given above, SaaS providers can use dynamic pricing mechanisms to charge for services. This process is driven by the client's request, and the server responds. The steps can be described as follows:

1. The user makes a request which contains the information of the user's ID.
2. And the server authenticates the user first, if the user is authenticated, the system will allow the user to access to the service menu page. On the contrary, if the authentication fails, the user can go to the registration page or choose to quit.
3. On the service menu page, the user can view the information of price, service quality, time interval and so on. Based on that, the user can access to respective service areas according to their own needs, and they also can choose to quit.
4. When the user access to the appropriate service area, the system will allocate resources for it first, and begin billing after the service starts.
5. When the service ends, the user quits the service area, then the billing system will calculate the user's cost and add to the user's account.
6. SaaS providers and users settle the total settlement costs every certain time (a month or year).

Pricing process is showed as Fig. [99.1](#).

## 99.4 Experimental Analysis

Ouyang et al. (2007) used SimJava, a discrete event simulation package, to simulate adaptive pricing algorithms on a utility computing environment, and they have achieved good results. In this paper, we tried to study the characteristics of dynamic pricing algorithm in a particular service area (such as the high-level area). As principles are similar to theirs, therefore, we used the same simulation environment and method in this study.

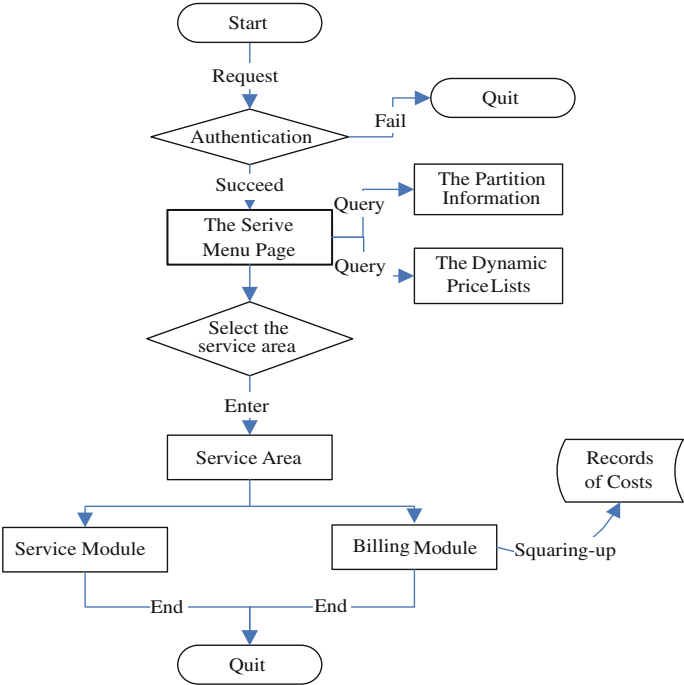


Fig. 99.1 QoS-driven dynamic pricing process of SaaS

In this experiment, the period  $T$  was set to be one day (24 h), and the time interval  $L$  was 2 h. In each time interval, we measured the resource utilization  $\mu$  in 30 min ( $m = 30$  min),  $\mu$  is expressed as a percentage. In the exponential smoothing forecasting method, we set the value of  $\hat{\theta}$  as 0.6. In order to make the experiment simple, we choose the high-level area of a certain SaaS provider to experiment. We set the value of  $P_Q$  as 1.8, set the value of  $P_q$  as 0.4. The optimal resource utilization that the SaaS provider expected is 85–95 %.

Experimental results and analysis are as follows:  
Figure 99.2 shows that, in a period  $T$ , both the observed and predicted values are changing over time, and we can see that the trends between them are similar to each other. That is to say that the estimate trajectory reflects the demand trajectory in general.

Figure 99.3 shows that, the price of one unit service which provided by the SaaS provider is changing dynamically with the resource utilization in a period  $T$ . This gives SaaS users a lot of choices, and users can make their best choices according to their own needs. If we take it together with actual observations showed in Fig. 99.2, we can see that the high resource utilization indicates that the market demand is large, so the price is high. And low resource utilization shows that the market demand is small, thus there are many resources idle, at this point

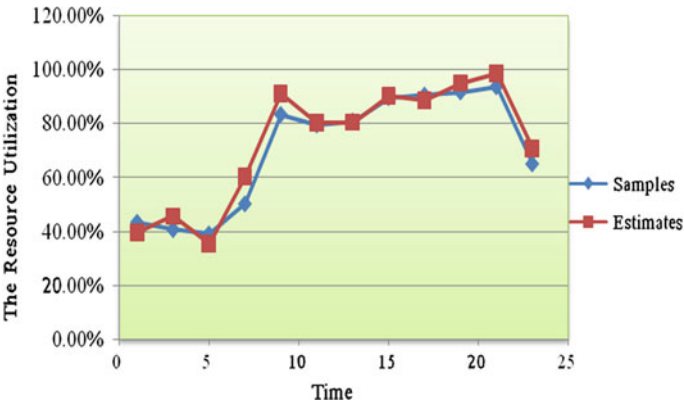


Fig. 99.2 The observations and forecasts of the resource utilization

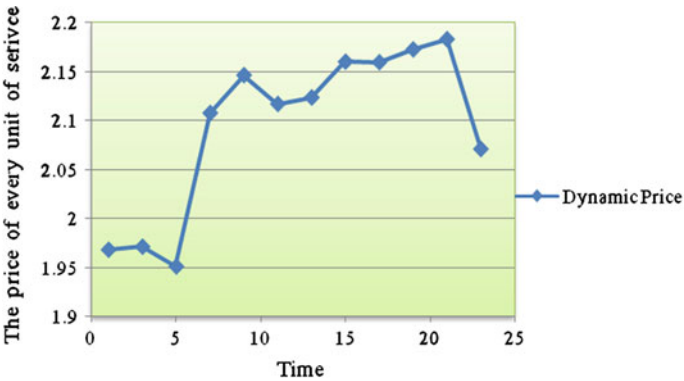


Fig. 99.3 The price of one unit service provided by SaaS providers

the price will become lower. This is not only consistent with the objective laws of economics, but also consistent with our assumptions.

With Figs. 99.3 and 99.4, dynamic price can adjust supply and demand. We can see that, the resource utilization was low from 0:00 to 8:00 in the period  $T$ , so lots of resources were idle for SaaS providers. So in the same time interval of the next period  $T$ , the price became lower to stimulate demand and results showed that the resource utilization has been greatly improved.

And from 15:00 to 20:00 in the period  $T$ , the resource utilization was relatively high, so that the loads were too large, and the price increased accordingly, which could prevent too many users from accessing to this service area at this time. Results showed that the resource utilization decreased in the same time interval in next period  $T$ , and it remained at about 90 %, which fit in with providers' expectations. In short, price can adjust supply and demand continuously, making the resource utilization be maintained at about 90 % in the long run. It will help to

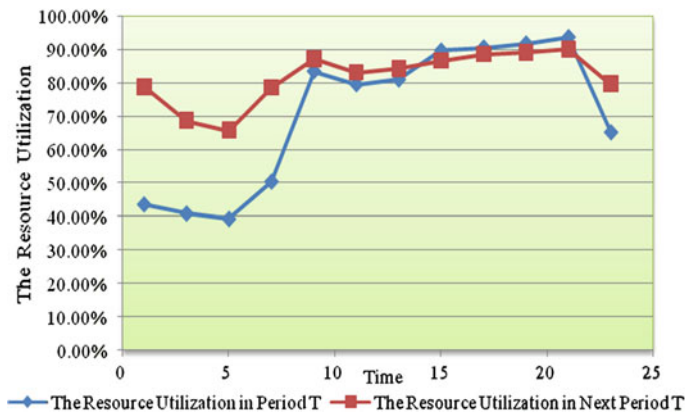


Fig. 99.4 The resource utilization of two successive periods

avoid the waste of resources, but also can avoid the overload of the system, so SaaS providers are able to obtain the maximum benefit from that.

In all, the experimental results show that, this dynamic pricing algorithm is reasonable and effective, it can adjust the supply and demand dynamically and optimize the profits of both SaaS providers and users’.

### 99.5 Conclusion

In this paper, we introduced the knowledge of microeconomics and service science into the research of SaaS pricing, and proposed a QoS-driven dynamic pricing mechanism of SaaS in cloud services. Simulation results showed that the pricing is reasonable and feasible. Compared to traditional pricing mechanisms, this dynamic pricing mechanism can reflect the changes of users’ needs and resource utilization. Using this pricing mechanism, SaaS users can find the tradeoff between the best price and performance, and SaaS providers can maximize their benefits by improving the resource utilization.

For future research, in addition to improve the pricing mechanism, we also need to explore how to measure the resource utilization accurately and dynamically beyond the boundaries of time intervals.

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# Chapter 100

## Research on the Mechanism of Energy Service Outsourcing Vendors Trust in ESCOs

Yu-lu Wang and Xiao-hong Zhang

**Abstract** Energy service outsourcing is a new flourishing outsourcing industry. This paper analyzes how energy service vendors develop the trust in energy service companies from the view of principal-agent theory and reputation theory. The empirical analysis illustrates that ESCOs' reputation and energy-saving value identification have significant positive correlation with outsourcing vendors' trust in ESCOs. Besides, the empirical analysis illustrates that task efficacy of ESCOs and communication play mediating effects in the trust building.

**Keywords** Energy service outsourcing · ESCOs · Principal-agent · Reputation · Trust

### 100.1 Introduction

With the rising energy price, government's increasingly stringent environmental control, companies are facing increasing pressure in the field of energy-saving and energy efficiency. As a result, many companies began to outsource energy services to professional Energy Service Companies (ESCOs) in order to improve energy efficiency, reduce carbon emissions and reduce energy costs. ESCOs usually provide vendors with services including diagnosis of energy efficiency, financing, equipment modification and so on. Using their professional energy management skills and advanced equipment, ESCOs help vendors to save energy costs, and take the risk of energy efficiency improvements, share energy-saving benefits (Steven

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2007; Dhingra and Julena 2005). In a word, Energy service outsourcing is a new type of outsourcing and has begun to flourish. At the end of 2011, the number of ESCOs in China was nearly 3,900, and the output value of energy services industry has broken through 100 billion. It is expected that the output value of Chinese energy services industry will exceed 300 billion Yuan in 2015.

Energy-saving service is a professional service with high asset specificity and high uncertainty (Sorrell 2007). Compared with other kinds of service outsourcing, energy service outsourcing is a relatively new and more complex service in operation which needs ESCOs and energy service outsourcing vendors develop a mutual trust relationship. Before project implementation, vendors need to provide their energy use information and communicate many problems with ESCOs, for example energy efficiency financing; in the implementation of the project, ESCOs need to transform energy systems and energy equipment, interact with energy vendors; after project implementation, ESCOs allocate energy-saving performance with vendors (Jan and Daniel 2008). In brief, whether ESCOs and vendors trust each other will affect to a great extent the vendors' understanding of energy-saving projects, the co-ordination of energy-saving projects as well as energy service outsourcing performance.

Using principal-agent theory and reputation theory, this paper attempts to shed light on what factors influence energy service outsourcing vendors develop trust in the ESCOs. In the next section, we review the relevant theories and establish a theory model. In Sect. 100.3, we put forward six hypotheses. And then, we introduce the sample, variable and test these hypotheses in Sect. 100.4. Finally, we provide conclusions in Sect. 100.5.

## 100.2 Theory Reviews

"Trust" is referred to one party is willing to expose his weaknesses and ignore his monitoring and control in bilateral relationship when he expects the other party will implements very important action on him. Trust is the basis of the service outsourcing relationships; the establishment of trust plays an important role in the management of service outsourcing. Many scholars are more concentrated in the trust and its impact on cooperation, however, research on the trust building mechanism in the service outsourcing is relatively scarce.

Oza et al. (2004) pointed out that previous customer referrals and service providers' outsourcing experience are major factors to acquire customers' trust. Babar et al. (2007) have found out that cultural understanding, feasibility, capacity, and communication in individual level are key factors for trust building in the software outsourcing. Doney and Cannon (1997) summarized five methods to build trust: calculative process, which means determine whether to trust each other through the calculation of the cost and benefit of deceiving or integrity (including financial cost and benefit and reputation); prediction process, that is to say, develop trust according to forecasts and judgment based on the consistency of

past actions and the differences between words and behavior; intentionality process, that build trust based on the existence of common values and norms for both sides which push them understand each other words and deeds and effort to act according to each other's intentions; capability process, that the other party has the ability to fulfill its obligations arising from the trust; transference process, that third parties, on the other side's description from the third parties can be used as the basis to establish a trust relationship with them. Doney's empirical studies have shown that firm size and customization willingness have a significant correlation with trust building, on the other hand, the expertise of sales staffs in the trustee and their business contacts frequency, similarity, affinity with the vendors have a positive impact on trust building.

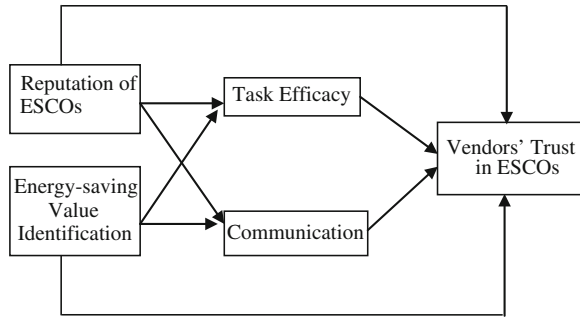
As a professional service with high asset specificity and uncertainty, energy service outsourcing has some difference from other kinds of service outsourcing. Which means previous research on inter-organizational trust and outsourcing trust have some reference to trust building in energy service outsourcing, but they can't fully guide us how to build trust in energy service outsourcing.

First of all, agents' information mastered by principals is a very important factor when we discuss the determinants of inter-organizational trust. Many models (Shapiro et al. 1992; Gulati 1995) imply an assumption that the partners understand each other. When the principals and the agents had cooperation history, previous of cooperation experience and performance will provide important information to help build a "knowledge-based trust". As for the energy service outsourcing, many companies have never participated in the energy-saving services and never cooperated with the ESCOs. For this reason, the ESCOs' reputation is important external information for energy service outsourcing vendors. We should look corporate reputation as a concentrated expression of enterprise, because it covers all aspects information of the enterprises. Therefore, corporate reputation is an important variable that may influence vendors trusting in ESCOs.

In addition, the moral hazard and adverse selection often arise in the process of outsourcing partner selection. Moral hazard arises when agents tend to evade their responsibilities, although they have the ability to perform their tasks. Adverse selection is manifest when agents exaggerate their skills or service quality and result principals give overestimation to the agents. Therefore, principals and agents have different interests in the cooperation is an important source of principal-agent problem. In this case, their identification on the energy-saving values helps to bridge their differences. In a word, the identification of energy-saving's values is another important variable that may influence vendors trusting in ESCOs.

In our opinion, ESCOs' reputation, identification on the energy-saving values will affect vendors' perception of the professional performance of the ESCOs and communication, thereby affecting the vendors' trust in ESCOs. Based on above reasoning, this paper establishes the following theoretical model (As shown in Fig. 100.1).

**Fig. 100.1** The theory model of this paper



### 100.3 Research Hypotheses

Corporate reputation is a comprehensive reflection of its past behavior and results which reflect the output capacity of the enterprise providing to stakeholders. As a basis of trust, corporate reputation can help other companies without direct connection trust them easier (Humphrey 1998). Larson (1992) pointed out that corporate reputation is an important judgment and should be looked as an alternative of other information, when companies lack of previous cooperation experience. In the trust building period, because of the lack of interaction history, the trustor has to find other sources to obtain information. Reputation is an important source to prove the trustee's ability (Kwon and Suh 2004). In other words, reputation will affect the early disposition to trust, especially for the enterprise short of any experience (Chu and Fang 2006).

Once most of people think a corporation having good reputation, it is difficult to shake their trust in the corporation (McKnight et al. 1998). Houston and Johnson (2000) have found that reputation has a significant impact on preventing opportunistic behavior, and many companies look credibility as an element attracting other companies. Ganesan (1994) also pointed out that reputation is built on the basis of reliable and consistent behavior in a long time, and the reputation can easily spread among companies so that they will further strengthen the credibility of the enterprise. Good reputation is an important asset for an enterprise. If companies with good reputation breach in the cooperation, their intangible assets long-term accumulation will face the danger of destroyed, which improve the breach cost. As a result, these companies will try their hard to maintain the image of trustee. The energy service outsourcing vendors may look into the contractors' reputation, to be judged on their ability, professional, and cooperation in good faith, thereby affecting the behavior and outsourcing decisions. In summary, ESCOs' reputation has a significantly positive correlation with trust. These analyses lead to one hypothesis.

**Hypothesis 100.1** The higher the reputation of ESCOs, the higher of outsourcing vendor trust in ESCOs.

Previous research has found consistency and compatibility are the antecedents of trust, which can be classified as corporate values. Shared values are the power of voluntary standard that social members recognized. Rempel et al. (1985) argued predictability was an important feature that determines trustee's trustworthiness. From the perspective of shared values and social norms, Doney and Cannon (1997) has put forward that the key of predictability is practice what they preach. The practice of trustees what they preach means their words and action follow a set of principles, which make both partners can predict future trend based on their experience.

In the case of principals and agents having different interests, it is helpful for the shared values to bridge their differences. The social identity theory has proved that compatible values can resolve the adverse selection, bring consistent interests, which means values identification is an important mechanism to cultivate trust. Podolny (1994) also pointed out that each parties' ideological similarity is the base of establishing inter-organizational trust. This paper argues that outsourcing vendors and contractors must develop compatibility and recognition in the energy-saving value in order to contribute to the good cooperation relations. This leads to the prediction of the following hypothesis.

**Hypothesis 100.2** The higher the identification of energy-saving value between energy service outsourcing vendors and ESCOs, the higher of outsourcing vendors trust in ESCOs.

Capacity is the primary consideration whether outsourcing vendors trust in contractors or not. When is concerned the capacity in trust, it is referred to the technology, skills and characteristics trustees used to affect certain areas (Mayer et al. 1995). According to the view of Mayer et al. (1995), "capacity" is a multi-dimensional concept, on the one hand is a comprehensive professional and skills (Competence), on the other hand is more micro specific task performance (Efficacy). If vendors have a lower task efficacy or efficiency in a field than other companies, they will tend to outsource, even they have professional competence in the business. This opinion coincides with the view of transaction cost theory.

Task efficacy is a more important concept for the energy service outsourcing. We can define "task performance" as a company's competence to fulfill with the minimum delay and effort. When the competitiveness of contractors in a field is not strong enough to let the outsourcing vendor trust them, the task efficiency and effectiveness will become an important measure. Contractors must be successfully completed before the deadline of the assigned tasks. The role of task efficacy in the development of inter-organization trust has been supported by the principal-agent theory, trust theory as well as transaction cost theory. Therefore, this paper regards the task efficacy of ESCOs as one of the important factors affecting trust building, and has a significantly positive correlation with trust. These analyses lead to two hypotheses.

**Hypothesis 100.3** The task efficacy of ESCOs has a significant mediating effect on the relationship between ESCOs' reputation and trust.

**Hypothesis 100.4** The task efficacy of ESCOs has a significant mediating effect on the relationship between energy-saving identification and trust.

Communication is usually regarded as the glue to keep up with relationship, and information exchange is necessary to reduce misunderstandings and promote mutual understanding (Dwyer et al. 1987). Anderson and Narus (1990) believed that communication is a necessary condition for trust building, and the accumulation of trust will promote the effective and timely communication. Kwon and Suh (2005) pointed out that timely, effective and reliable communication can reduce conflict among enterprises and reduce the uncertainty of corporate behavior and help build trust.

During the process of energy service outsourcing, the incomplete information of ESCOs and vendors comes from the following aspects: (1) limited knowledge of both sides. Limited knowledge not only includes the vendors' limited energy-saving knowledge, but also includes ESCOs' limited knowledge about vendors' energy-saving ideas and energy-using system; (2) the high cost of searching for information; (3) the information owners monopolize information. For example, vendors monopolize information of energy-using system and are reluctant to share information because they think ESCOs are incompetent. However, The ESCOs' reputation provides an external public source for vendors to understand ESCOs; they can search information from the newspapers, TV as well as corporate social network members with lower cost. It is obvious that it will enhance communication. On the other hand, the higher vendors identify the energy-saving value; they identify ESCOs higher, thus reducing the intentions to monopoly their own information. As a result, the success of energy service outsourcing need to create a stable partnership, such as allowing the contract amendments with the transformation of the situation; even establish joint ventures jointly responsible for the energy equipment supply, installation, operation and updating (Yik and Lee 2004).

Good communication makes information exchange becomes more correct and smoother. Furthermore, good communication not only contributes to reducing the cost of information search, but also increasing the mutual understanding in the transaction. Besides, good communication can reduce behavioral uncertainty; increase the extent of trust for both sides. In addition, good communication can effectively solve conflicts among enterprises whereby enhance the extent of trust among enterprises. In short, good communication in the energy service outsourcing can enhance information exchange; and reduce the extent of incomplete information and asymmetric information. Besides, good communication can also become effective in conflict resolving, thus enhance mutual trust in the energy service outsourcing. These analyses lead to two hypotheses.

**Hypothesis 100.5** Communication has a significant mediating effect on the relationship between ESCOs' reputation and trust.

**Hypothesis 100.6** Communication has a significant mediating effect on the relationship between energy-saving identification and trust.

## **100.4 Research Design**

### ***100.4.1 Sample and Data***

This paper has sent 330 questionnaires and effectively received 192. The data collection occurred over a three-month period from early July to late Sep 2010. In 192 valid questionnaires, the vendors' sales volume above 5 billion, from 50 to 5 billion, from 10 to 50 million, and below 10 million account for 40.1, 20.8, 16.1 and 23 % respectively, and vendor's industry belongs to manufacture, information & software, service, and other industries account for 62.1, 10.2, 17.3 and 9.4 % respectively.

### ***100.4.2 Measurement, Reliability and Validity***

To ensure the variables' reliability, a Cronbach alpha test is applied to all six scales. The results indicate that all scales exhibit a satisfactory alpha larger than the threshold (0.60) considered acceptable by Nunnally (1978). All scales used are developed from an extensive literature review. The dependent variable, trust ( $\alpha = 0.782$ ) is measured by five items. The independent variable, reputation ( $\alpha = 0.795$ ) and energy-saving value identification ( $\alpha = 0.850$ ) are measured by five items respectively. In term of the mediators, we use the scales put forward by Cummings and Bromiley (1996) and Caldwell (2003) measure task efficacy of ESCOs ( $\alpha = 0.82$ ), and use the scales put forward by Atuahene-Gima and Li (2002). Atuahene-Gima and Li (2002) and Smith and Barclay (1997) measure communication ( $\alpha = 0.866$ ).

In order to achieve the discriminant construct validity, we conducted a principal component factor analysis using a varimax rotation method for all five variables, resulting in one expected factors with eigenvalues  $>1$ , with cumulative variance are 65.451 % (task efficacy), 62.044 % (reputation), 66.041 % (communication), 66.632 % (energy-saving value identification), 61.449 % (trust). These results indicate that all the items loaded onto their respective factors as expected.

### ***100.4.3 Data Analysis and Result***

According to Anderson and Gerbing (1988), convergent validity can be tested with a measurement model by examining whether each indicator's estimated pattern

coefficient on its posited underlying construct is significant. To test the convergent validity of the model of reputation directly affect trust, a confirmatory factor analysis was conducted resulting in a significant model ( $\chi^2/\text{df} = 0.980$ ,  $p = 0.507$ , goodness-of-fit index [GFI] = 0.964, normal fit index [NFI] = 0.925 and comparative fit index [CFI] = 1.000). Therefore, convergent validity is also achieved. The empirical research has showed that the reputation of ESCOs has a significantly positive correlation with outsourcing vendor trust in ESCOs.

The confirmatory factor analysis for the model of energy-saving value identification directly affecting trust indicates that the model is significant ( $\chi^2/\text{df} = 1.063$ ,  $p = 0.315$ , GFI = 0.937, NFI = 0.895 and CFI = 0.993). Therefore, convergent validity is also achieved. The empirical research has showed that the energy-saving value identification has a significantly positive correlation with outsourcing vendor trust in ESCOs.

The revised confirmatory factor analysis for the mediating effect model of task efficacy of ESCOs indicates that the model is significant ( $\chi^2/\text{df} = 1.198$ ,  $p = 0.090$ , GFI = 0.934, NFI = 0.900 and CFI = 0.981). Therefore, convergent validity is also achieved. The empirical research has showed that the relationship between reputation and trust is fully mediated by task efficacy, and the relationship between energy-saving value identification and trust is partly mediated by task efficacy.

The revised confirmatory factor analysis for the mediating effect model of communication indicates that the model is significant ( $\chi^2/\text{df} = 1.132$ ,  $p = 0.122$ , GFI = 0.954, NFI = 0.920 and CFI = 0.989). Therefore, convergent validity is also achieved. The empirical research has showed that the relationship between reputation and trust is partly mediated by communication, and the relationship between energy-saving value identification and trust is partly mediated by communication.

## 100.5 Conclusion

Our research indicates that ESCOs' reputation and energy-saving value identification have significant positive correlation with outsourcing vendor trust in ESCOs. Therefore, in order to push the trust building, ESCOs must establish a good reputation. In the energy service outsourcing, ESCOs should comply with the outsourcing contract provisions, be confidential to valuable technology, don't infringe vendors' intellectual property rights. Besides, ESCOs and government should educate the energy service vendors so that they aware of the importance of energy-saving, and master the methods and principles in energy service operation.

In addition, our research indicates that task efficacy of ESCOs plays a significant mediating effect in trust building. With the more severe competition in energy service outsourcing, the outsourcing vendors will improve their energy efficiency standards in a lower cost which makes ESCOs have to enhance task efficacy through technical innovation and continuous learning. At the same time, the

change of market and competition environment should be given more attention and the response speed to the market and competition should be improved. Besides, our research indicates good communication plays a significant mediating effect in the trust building. In order to attain good communication, energy service outsourcing vendors and ESCOs have to realize that the importance of knowledge sharing, especially the tacit knowledge sharing for the success of energy service outsourcing and endeavor to establish regular interaction mechanism and knowledge culture.

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# Chapter 101

## Research on Indicator System of Risk Early-Warning in *ITO*

Zhuo Shi, Yu-jie Huang and Xiao-lan Cui

**Abstract** Information technology outsourcing has been appearing an increasing trend in recent years, and it has become the focus in the field of information systems. However, the existence of various uncertainties makes *ITO* involve potential risks. In this paper, the authors analyze *ITO* risks and establish indicators system for risk early warning from 18 aspects. Then by applying method of Fussy Comprehensive Evaluation to a case of *ITO* enterprise, the authors demonstrate the feasibility of this indicator system in warning risk of *ITO*. The result shows that the early warning indicator system constructed in this paper can effectively forecast the *ITO* risks.

**Keywords** Indicators · Information · IT outsourcing · Risk early-warning

### 101.1 Introduction

With the spread of information and network technology, information technology outsourcing (hereinafter, *ITO*) appears an increasing trend. Most of the IT business process except core business is being outsourced increasingly, because enterprises concentrate on developing their core competence. In the process of *ITO*, suppliers can provide various benefits such as special IT talents, better IT products and services, cost reduction, improvement of service quality, and so on. Due to the complex and uncertainty of *ITO* as well as its diversity, enterprises to face many risks, for example the information leakage, the costs increase, and so on.

Although some researchers have explored the risks in *ITO* (Bouchaib and Rivard 2004; Mathew 2006; Jurison 1995; Earl 1996; Lacity et al. 1994; Aundhe

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and Mathew 2009), they pay little attention on the *ITO* risk early warning. So in this paper, the authors establish early warning system and use warning model to warn the risks of *ITO*.

## **101.2 Content of ITO Risk**

### ***101.2.1 Risk of ITO***

Risk refers to the uncertainty of event in the future, or the chance and probability of loss occurring (Ying Luo 2008). For the lack of core competitiveness and the existence of various uncertainties, enterprises may probably outsource certain IT business process. However, in the process of *ITO*, outsourcing risks arises from external risk factors and internal risk factors. For example, suppliers may become the competitor for several reasons including leakage of customer information disclose, theft of customer key technologies, or failure to meet customer needs.

Enterprise can gain more advanced technology and services from suppliers. However, outsourcing provider who provides products and services cannot easily be managed by outsourcers, so outsourcers will become dependent on providers, thus they will lose the chance to learn advanced knowledge and skills.

*ITO* Risk Early-warning is an important part of the *ITO* risk management, it refers to series of activities as risk analysis, evaluation of inference, prediction, sending message. Managers can make business decision-making in advance and take measures to avoid risk and loss.

### ***101.2.2 The Process of ITO Risk Early Warning***

*ITO* risk warning systems in the area of economic can monitor particular economic subjects, find the sources, the range, the degree and the trends of the risks through a series of economic methods, and send out the danger signal as early as possible. *ITO* risk warning is the important component of *ITO* risk management. It means that the enterprises in the *ITO* activities analysis, evaluate and predict the risks, and filter alarm information. It can help the decision makers take measures before the risk occurred, thereby avoid or reduce risk and loss.

## **101.3 Design of ITO Risk Early-Warning Indicator System**

The design of indicator system is essential to *ITO* risk early-warning; so many researchers explore early-warning indicators involved from different areas. For example, Liu proposed external environment risk warning and operation risks

warning in his early warning mechanism, and the mechanism involves 14 secondary early warning indicators including natural environment warning, financial warning, human resource warning, technology innovation warning and information risk warning (Liu 2007). Chai and Han analyze the risk early-warning indicators in the process of technological innovation, they identify the risk in six aspects as technical risks, financial risks and market risks. And then they use AHP and Fuzzy Model demonstrates the feasibility of the indicator system in risk early-warning of technical innovation (Yonghong and Shurong 2008). Yu analyzes management of market risk early-warning in her early warning mechanism, she confirms the feasibility of the evaluation model in market risk early-warning, and proposed five risk factors including customer complaints, contract compliance, technology innovation investment, market share, and she points out that the higher rate of customer complaints will bring about greater market risk (Xia 2004).

By referring to the above research and considering the principles of design indicators system, the authors in this paper study ITO risk in two aspects—external environment risk and internal operational risk, and then analyze early-warning by integrating various risk of early-warning factors. Finally, we choose exchange rate, internal staff resistance, market share, contract compliance rate, customer complaints etc. in order to show that the risk of financial, technological innovation, human resources, and information. Table 101.1 shows the risk early-warning indicator system for *ITO*.

## 101.4 Application of ITO Risk Early Warning Indicator System

### 101.4.1 Determine the Risk Warning Line

This risk level will be identified as five levels, that is highly serious, severe, general, slight, neglect (excellent condition), according to different risk levels, it can be set to different warning signal, a highly serious level display “red light”, a severe level show, “yellow”, generally level appear as “orange”, slightly level display “green”, and neglected level display as “blue”. And warning lines between levels were determined based on the five levels of risk factors, namely, the critical point of each risk level. The paper uses fuzzy evaluation method to evaluate the risk of IT industry, and the risk threshold was set to highly serious [4.5–5], severe [3.5–4.5], general [2.5–3.5], slightly [1.5–2.5] neglect [0–1.5]. Early warning systems will alert according to the signal and risk level, if the changes of an early warning indicator beyond the inspection, the signal system will issue a corresponding signal. The emergence of different warning light will prompt outsourcing decision-makers to make timely adjustments. Various risk levels shown in Table 101.2.

Table 101.1 Indicator system for ITO risk early-warning

Area	Alert indicators	Secondary indicators	Index description
External environment risks	Alert indicators	Policies and laws	Differences in legal environment or promotion of national policy
		Exchange rate	Large exchange rate fluctuations will affect the realization of offshore outsourcing
		Market maturity	If the market imperfections or lack of uniform industry standards, it will produce risks
		Delivery rate timely	Timely and reliable of delivery reflects the capacity of company's delivery
Internal operational risk	Alert indicators	Product qualified rate	The higher the rate of qualified products, the less risk
		Complaints rate	Contracte advance complaints about service quality, price, service
		Professional skills	Ability of the professional skills of staff will affect the client's business goals
		Staff turnover	The key technical and managerial personnel loss of suppliers will affect the capability of developing the entire project team
		Staff resistance	If supplier have staff morale, it will affect the realization of the project, the greater the organization risk
		Goal conflict	The strategic objectives of inconsistencies and conflicts the more differences, the greater the risk
		Technological innovation	Leading to loss of competitive products or services due to lack of technical innovation investment
		Information risk	Suppliers will disclose customer information or become competitors due to steal our technology
		Dependence on few suppliers	If we have a small number of suppliers, customers will in a disadvantageous position in future negotiations
		Contract compliance	Contract compliance by both sides, The higher compliance rates, the less risk
Financial distress	Alert indicators	Market share	The level of market share will affect the size of market share
		Decline in profits	If profits fall, it will lead to efficiency decline of company, if financial deterioration, the risk will produce
	Alert indicators	Increase in costs	Outsourcing costs exceeded the company's budget, the higher the risk

**Table 101.2** Risk rating description of *ITO*

Risk level	Score	Element value	Threshold	Signal	Description
Highly serious	90	5	4.5–5	Red	Outsourcing risk is very serious, which determine the key to outsourcing activities and will appear red warning
Severe	80	4	3.5–4.5	Yellow	The probability of outsourcing risk is high and will appear yellow warning
General	70	3	2.5–3.5	Orange	Once the risk occurs, the cost of internal management of enterprises will to some extent increase. Appear orange alert
Slight	60	2	1.5–2.5	Green	Probability of risk occurrence is low, which is a slight impact on the outsourcing activities. And it is in the normal state and appear the green warning
Neglect (excellent condition)	50	1	0–1.5	Blue	The occurrence of risk had little effect on the outsourcing activities, and it is in excellent condition. It will appear a blue warning

**101.4.2 Application of Risk Early-Warning**

1. *Source of the data:* *ITO* risk early-warning relies on a lot of data, and questionnaire survey is widely used as a data collection method in empirical study. So in this paper, we investigate 20 IT managers to collect data for empirical study. According to the questionnaire survey, we conduct evaluation about *ITO* risk factor, and then obtain the evaluation matrix:

$$R_1 = \begin{bmatrix} 0.1 & 0.2 & 0.05 & 0.55 & 0.1 \\ 0.1 & 0.3 & 0.45 & 0.15 & 0 \\ 0.05 & 0.25 & 0.25 & 0.4 & 0.05 \end{bmatrix} \tag{101.1}$$

$$R_2 = \begin{bmatrix} 0.05 & 0.15 & 0.05 & 0.7 & 0.05 \\ 0.1 & 0.15 & 0 & 0.65 & 0.1 \\ 0 & 0.3 & 0.25 & 0.2 & 0.25 \end{bmatrix} \tag{101.2}$$

$$R_3 = \begin{bmatrix} 0.1 & 0.2 & 0.05 & 0.55 & 0.1 \\ 0.05 & 0.2 & 0.05 & 0.55 & 0.15 \\ 0.05 & 0.2 & 0.15 & 0.55 & 0.05 \\ 0.05 & 0.65 & 0.15 & 0.15 & 0 \end{bmatrix} \tag{101.3}$$

$$R_4 = \begin{bmatrix} 0.35 & 0.2 & 0.05 & 0.65 & 0.05 \\ 0 & 0.3 & 0.05 & 0.5 & 0.15 \end{bmatrix} \tag{101.4}$$

$$R_5 = \begin{bmatrix} 0 & 0.3 & 0 & 0.7 & 0 \\ 0.2 & 0.45 & 0.15 & 0.2 & 0 \\ 0.1 & 0.65 & 0.15 & 0.1 & 0 \end{bmatrix} \quad (101.5)$$

$$R_6 = \begin{bmatrix} 0.05 & 0.2 & 0.05 & 0.5 & 0.2 \\ 0.1 & 0.1 & 0.2 & 0.5 & 0.1 \end{bmatrix} \quad (101.6)$$

2. *Methods of indicators evaluation and Processing of the data:* The evaluation of early risk warning indicators includes analytic hierarchy process, fuzzy evaluation method, neural network method, etc. AHP is the method of decomposing the problem into its component elements, which forms a hierarchical structure by comparing and ranking the importance of the various elements, and then constructs judgment matrixes. Therefore, this method has a certain subjective for its subjective judgement by experts. BP neural network is simulated by a number of biological neurons in the formation of artificial neural networks, and it is significant in areas of information processing, analog identification simulation. While Fuzzy evaluation method applies to the system level which has a fuzzy concept and can be quantified.

*Step 1* Determining factor set  $M$  and the rating scale (Assessment Set)  $N$ . Risk factor  $M = \{a_1, a_2, a_3, \dots, a_n\}$  is the indicators set, and  $M$  is divided into  $P$  parts in accordance with the relationship between the factors, then  $M_i = \{m_{i1}, m_{i2}, m_{i3}, \dots, m_{ip}\}$ ,  $i = 1, 2, 3, \dots, p$ ,  $\bigcup_{i=1}^p M_i = M$  and  $\sum_{i=1}^p M_i = n$ . Assessment set  $N$  is the set to evaluate the level, and  $N = \{b_1, b_2, b_3, \dots, b_n\} = \{\text{highly serious, severe, general, slight, neglect}\}$ .

*Step 2* To determine the weight vector. By using Delphi method, expert anonymously collect opinions from all sides based on a certain process, and given the weight to the various indicators. In this paper, experts derive the risk factors and evaluation of risk factors for sub-set of weights

$$M = \{a_1, a_2, a_3, \dots, a_6\} = (0.2, 0.3, 0.1, 0.1, 0, 0.2) \quad (101.7)$$

All sub-factor weight set:

$$\begin{aligned} M_1 &= \{0.5, 0.3, 0.2\}, & M_2 &= \{0.25, 0.5, 0.25\} \\ M_3 &= \{0.2, 0.2, 0.2, 0.4\}, & M_4 &= \{0.5, 0.5\} \\ M_5 &= \{0.2, 0.4\}, & M_6 &= \{0.5, 0.5\} \end{aligned}$$

*Step 3* Obtain the membership matrix  $R$ . According to the membership of evaluation level  $b_i$  on risk factors  $a_{ir}$ , membership vector  $R_i = \{r_{i1}, r_{i2}, r_{i3}, \dots, r_{in}\}$ ,  $i = 1, 2, \dots, n$ ,  $\sum_{j=1}^m r_{ij} = 1$ , we obtain the Membership matrix

$$R = \{R_1, R_2, R_3, \dots, R_n\}^T = (r_{ij})$$

By using fuzzy evaluation method, we estimate the level of risk with a mathematical model  $B_i = M_i \times R_i$ , Fuzzy subset  $B_i = (b_{i1} b_{i2}) (i = 1, 2, 3, 4, 5, 6, b_{ij} \in$

$[0, 1]$ ) as a comprehensive assessment in the first level, the risk that the extent of each of 5 levels of highly serious, severe, general, slight, Neglect. For instance

$$\begin{aligned}
 B_1 &= (0.5, 0.3, 0.2) \times \\
 &\begin{bmatrix} 0.1 & 0.2 & 0.05 & 0.55 & 0.1 \\ 0.1 & 0.3 & 0.45 & 0.15 & 0 \\ 0.05 & 0.25 & 0.25 & 0.4 & 0.05 \end{bmatrix} \\
 &= (0.065, 0.265, 0.31, 0.325, 0.035)
 \end{aligned} \tag{101.8}$$

Similarly, we can calculate  $B_2, B_3, B_4, B_5, B_6$ , then obtain the final evaluation matrix. Now we evaluate  $R$ :

$$R = \begin{bmatrix} 0.065 & 0.265 & 0.31 & 0.325 & 0.035 \\ 0.0625 & 0.1875 & 0.075 & 0.55 & 0.125 \\ 0.06 & 0.38 & 0.11 & 0.39 & 0.06 \\ 0.175 & 0.25 & 0.05 & 0.575 & 0.1 \\ 0.08 & 0.47 & 0.09 & 0.36 & 0 \\ 0.075 & 0.15 & 0.125 & 0.5 & 0.15 \end{bmatrix} \tag{101.9}$$

### 101.4.3 Processing of the Data

By applying method of Delphi, we obtain the main factor vector as

$$M_i = (a_1 a_2 a_3 a_4 a_5 a_6) = (0.2, 0.3, 0.1, 0.1, 0.1, 0.2) \tag{101.10}$$

Then by using method of fuzzy comprehensive evaluation in the second-level, we have

$$\begin{aligned}
 B_i &= B_i = M_i \times R_i = (0.2, 0.3, 0.1, 0.1, 0.1, 0.2) \\
 &\times \begin{bmatrix} 0.065 & 0.265 & 0.31 & 0.325 & 0.035 \\ 0.0625 & 0.1875 & 0.075 & 0.55 & 0.125 \\ 0.06 & 0.38 & 0.11 & 0.39 & 0.06 \\ 0.175 & 0.25 & 0.05 & 0.575 & 0.1 \\ 0.08 & 0.47 & 0.09 & 0.36 & 0 \\ 0.075 & 0.15 & 0.125 & 0.5 & 0.15 \end{bmatrix} \\
 &= (0.07825, 0.24925, 0.1345, 0.4625, 0.0905)
 \end{aligned} \tag{101.11}$$

We use the fuzzy evaluation method and the weighted average treatment as an approach of Model assessment index. Suppose set  $B$  corresponding evaluation scores as  $B_1 = 90, B_2 = 80, B_3 = 70, B_4 = 60, B_5 = 50$ . The results indicated that the possibility of 7.825 % is 90 min, the possibility of 2.4925 % is 80 min, the possibility of 13.45 % is 70 min, the possibility of 46.25 % is 60 min, the possibility of 9.05 percent is 50 min.  $B = R \times B^T$ , so the composite scores is

$$\begin{aligned} B &= (0.07825, 0.24925, 0.1345, 0.4625, 0.0905) \\ &\times (90.80, 70, 60, 50)^T = 68.6725 \end{aligned} \tag{101.12}$$

Secondly, the weighted average method:

In the evaluation of non-quantitative indicators of qualitative, elements need to be quantified, in Table 101.2, Provides the corresponding element value  $B_1 = 5$ ,  $B_2 = 4$ ,  $B_3 = 3$ ,  $B_4 = 2$ ,  $B_5 = 1$ ,  $B = R \times B^T$ , therefore, evaluation results  $B = 2.80725$ , and  $2.5 \text{ (Threshold)} < 2.80725 < 3.5 \text{ (Threshold)}$

According to Table 101.2, *ITO* system is in the risk of general level, and by principle of risk early-warning indicators, issued orange alert.

### 101.5 Conclusion

Risk early-warning is based on risk management. The risk index system of *ITO* and early-warning model are built on the basis of the risk of early warning theory and related studies. The right of the main factors and factors is determined by marking of experts. The analysis and evaluation of the early warning system of enterprise is made on the base of laws of vague and instances. From the above method, the conclusion is that *ITO* system is in general risk level of orange alerts.

The feasibility of an early-warning is confirmed initially in the study. The risk early-warning system is a complex systems engineering because of the characteristics of universality and complexity of the risk factor. Further studying and exploring of IT risk early-warning system are necessary in order to widely use. For example, warning system to software and seeking more sophisticated mathematical method are very important to achieve a comprehensive evaluation of *ITO* industry. By analysis external and internal business environment, the analysis of prior to events, the control of process and the feedback of afterwards are realized. Therefore, the establishing of the risk early warning and urgent mechanism is necessary in order to prevent *ITO* risks and reduce the risk of loss.

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# Chapter 102

## Research on Innovation Path of Rural Tourism Based on the Innovation Theory: Taking Chongqing as an Example

Li Li and Xue-jun Chen

**Abstract** Innovation is the core element of rural tourism. Based on Schumpeter's Innovation Theory, the paper summarizes five key innovation elements of rural tourism, which includes product innovation, business model innovation, market innovation, supply chain innovation and organizational innovation. Secondly, according to the systematic principle, it constructs the model of innovation path of rural tourism. Thirdly, it analyzes present situation and main problems of rural tourism in Chongqing. Finally, based on the model of innovation path, it puts forward to innovation paths of rural tourism in Chongqing from five aspects, including, optimizing product structure of rural tourism, forming cooperative operation pattern in all forms and at all levels, exploiting regional markets and related-industries markets, building dynamic flexible network platform of supply chain, developing enterprise groups and enterprise alliances.

**Keywords** Innovation • Path • Rural tourism • Supply chain

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## **102.1 Introduction**

### ***102.1.1 Research Background***

Under the combined effect of national policy, local economic development and market demand, rural tourism in China has developed very rapidly. As the end of 2010, agritainment enterprises have been over 1.5 million; large-scale leisure agriculture parks over 18,000; annual rural tourists over 400 million; and annual revenue of rural tourism over 120 billion yuan (Annual revenue of leisure agriculture and rural tourism is more than 120 billion in China 2011). Rural tourism has become an important component of tourism industry in China, and it plays significant role on promoting social-economic development. At present, although rural tourism in China has roughly formed a scale, there are still some problems, such as single development model, homogeneous product competition, weak enterprise competitiveness and so on, which seriously constraint on its sustainable development. Therefore, the research on innovative path of rural tourism has important practical and academic significance; it is conducive to promoting transformation and upgrading of rural tourism.

### ***102.1.2 The Present Situation of Relevant Research***

Academic research achievements on rural tourism are quite abundant, and they center on rural tourism resources, effect, and industry development and so on (Li 2009), but issues related to rural tourism innovation are limited. By searching CNKI journal databases and dissertation database, a total of 31 relevant literatures are retrieved, and the content mainly focused on the following three aspects. The first one was product innovation of rural tourism. Some scholars used empirical research method to put forward to product innovation strategies under the conditions of different regions and backgrounds, such as Zhang, Zhenkeng, Zhu, Zhou, and Wang. The second one is innovation management of rural tourism. Some scholars used new technology and concept to put forward to management countermeasure of rural tourism, such as Chen, Fan. The third one is resource innovation of rural tourism. Zhou proposed cultural factor, Zhu proposed creative agriculture and Cao proposed national traditional festival, all of them were important resource of rural tourism. In summary, relevant literatures have made certain achievements, but innovation system of rural tourism is neither complete nor comprehensive, and the universality of research results is not strong. Thus, on the basis of previous studies, this paper researches innovative path of rural tourism from the perspective of Schumpeter's innovation theory.

## 102.2 Model Construction of Innovative Path of Rural Tourism

### 102.2.1 The Connotation of Schumpeter's Innovation Theory

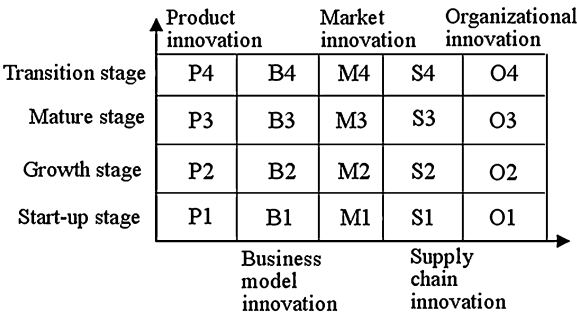
Austrian-American economist Joseph Alois Schumpeter introduced “innovation” into economics in 1912, who explained economic connotation of “innovation” in his representative book *Theory of Economic Development*. Since then, Schumpeter comprehensively summed up innovation theory in his books *business cycle* (1939) and *Capitalism, Socialism and Democracy* (1942). Schumpeter summarized five kinds of innovation: using a new product or a product of new features; adopting a new production method; opening up a new market; controlling a new source of raw materials or semi-manufactures; forming a new organization (Schumpeter 1990). Thus, Schumpeter's “innovation” was not a technical concept, but an economic concept; it was strictly distinguished from technological invention, but introducing technological method into economic organization, so as to form new economic capacity.

### 102.2.2 The Model of Innovative Path of Rural Tourism

On the basis of Schumpeter's innovation theory, combining with characteristics of rural tourism, this paper puts forward to five key elements of rural tourism innovation: the first one is product innovation, which can better meet tourists' demand by improving or ameliorating products and services of rural tourism; the second one is business model innovation, which can enhance economic benefits of rural tourism by using of new technology, production methods, and business models; the third one is market innovation, which can open up new market by finding out potential market of unmet demand; the fourth one is supply chain innovation, which can improve transaction efficiency by controlling travel wholesalers and retailers; the fifth one is organizational innovation, which can make enterprises more efficient by ameliorating organizational structure and management system. These five innovation elements are the most basic and important source of innovation development of rural tourism. This paper constructs the model of innovative path of rural tourism with these five elements.

The horizontal axis of the model represents five innovative elements. Each element contains different choice paths. Product innovation contains content innovation, form innovation, functionality innovation and value innovation. Business model innovation contains tourism enclave model, farmer self-development model, government public model, and participatory development model (Huang 2008). Market innovation contains tourism market diversification, related diversification,

**Fig. 102.1** The model of innovative path of rural tourism



unrelated diversification. Supply chain innovation contains vertical integration, horizontal integration and network. Organizational innovation contains single enterprise, chain enterprise group, loose enterprise alliance and industrial cluster. The vertical axis of the model represents different life cycle stages of rural tourism, including start-up stage, growth stage, mature stage and transition stage. On different life cycle stages, innovation path choice of rural tourism is different. We can use P1, P2, P3 and P4 to respectively represent product innovation on different four life cycle stages; the same as other four innovation elements (see Fig. 102.1). Therefore, on different life cycle stages, path combination of five key elements (PiBiMiSiOi) constitutes innovation path of rural tourism.

102.3 The Present Situation of Rural Tourism in Chongqing

Chongqing rural tourism originated in agritainment which are offered by farmers spontaneously. After years of development, it has gradually formed a system containing agritainment, modern agricultural industrial park, farms, ancient villages, ethnic villages, agricultural new village and so on. Among them, the development of agritainment is more mature correspondingly. There were 20,000 agritainment in 2010, including 6 five-star agritainment, 22 four-star agritainment, 276 third-star, two-star, and one-star agritainment. Chongqing government plans to build three agritainment demonstration districts (Nan'an district, Jiulongpo district, Yubei district), and 30 agritainment demonstration bases including Shapingba Village, Gele Mountain and so on (Chongqing Government Support the development of agritainment 2011). In 2009, there were totally 7,305 rural tourism attractions, rural tourists amounted to 14.545 million, and tourism revenue amounted to 520 million yuan. There is huge growth potential of Chongqing rural tourism market.

However, compared with other developed areas of rural tourism, rural tourism development in Chongqing is still on its infancy stage. It has some problems to be solved, such as low product quality, poor management, narrow market, weak industry strength and so on (Table 102.1).

**Table 102.1** The development situation of rural tourism in chongqing in 2009 (Cai 2010) attraction

Kinds of rural tourism attraction	Number of scenic spot	Reception ability/thousand	Fact number of rural tourist/thousand	Tourism revenue/million yuan
Natural ecology	480	3,000	1,500	120
Forest	240	4,800	2,700	180
Garden	150	180	90	12
Water	180	225	130	15
Agritainment	6,000	14,000	10,000	120
Aquaculture industry	90	120	60	3
Facility of farm work	60	30	15	1.5
Farmland	105	60	50	75
Total	7,305	22,415	14,545	526.5

102.4 Innovative Path Choices of Rural Tourism in Chongqing

Based on the model of innovative path of rural tourism, this paper puts forward to innovation path choices of rural tourism in Chongqing from five aspects.

102.4.1 Path Choice of Product Innovation

Chongqing should adjust product structure of rural tourism according to resource characteristic and existing product base, and it should construct diverse product system including agricultural experience, sightseeing, leisure, vacation, folk-custom, etc. It should improve product quality, to form rural tourism brand with national influence; focus on building four theme rural tourism areas, which are recreation area in main urban and suburban, agricultural experience area in Western Chongqing, rural eco-tourism area in Northeast Chongqing, rural folk-custom area in Southeast Chongqing (Zhao 2008). On product content innovation, Chongqing should take full advantage of local geographical tourism resources; join unique local natural and cultural resources into product development. For example, rural tourism destination with hot spring resources can combine spa landscape with culture and folk, to enhance the value of tourism product and build brand personality (Chen 2008). On product form innovation, rural tourism destination should focus on the integrated use of sound, light, electricity and other forms of high-tech to meliorate traditional tourism products, in order to give brand-new experience to tourists and inspire their potential demand. On product function innovation, we should develop leisure entertainment function, health care function, and learning function of rural tourism products, so as to meet tourists’

entertainment needs, communication needs, self-development needs and other needs (Xu 2011). For example, high-tech agricultural parks can develop “Happy Farm” project, to provide sightseeing, agricultural production experience, agricultural byproduct machining, souvenirs producing, etc. This can not only give tourists a full range of agricultural experience, prolong tourists’ residence time and stimulate tourism consumption, but also opened up the market of “repeat consumption”.

#### ***102.4.2 Path Choice of Business Model Innovation***

At present, business model of rural tourism in Chongqing is mainly farmer self-development model and owner investment and operation, and farmer self-development model accounts for the biggest proportion, resulting in small-scale and weak strength of rural tourism (Qin 2008). Therefore, on business model, rural tourism destination should take integrated advantage of government, enterprises, individual owners, communities, farmers and other social resources to build multi-level cooperation system. Rural tourism enterprises in developed areas (e.g. Jiulongpo district, Nan’an district, Yubei district, Shapingba district etc.) should use the means of capital operation to combine with each other; adopt franchising, commission management, lease operation and other models to form some large scale, high management level enterprise groups. Rural tourism in less developed areas can realize leapfrog development led by government (Sun 2008). Government should make full use of administrative and market instruments to integrate various social resources, choosing government investment model, “government + company” model, “government + company + community” model, “government + community +farmer” model and other models according to actual situation. Rural tourism in moderate developed areas should give priority to market regulation, and supplement with administrative regulation. It can use “company + farmer” model, “stock cooperative enterprise + community +farmer” model, “village collective economy + farmer” model, “farmer + farmer” model, enterprise independent investment model, etc.

#### ***102.4.3 Path Choice of Market Innovation***

Market innovation of rural tourism in Chongqing mainly has two directions. (1) One is market innovation of geographic area. According to the space distance, we can divide Chongqing rural tourism market into three categories. Principal market is Chongqing local tourism market, and it focus on developing silver market, student market, meeting market, family market in urban district of Chongqing. Secondary market contains surrounding provinces, such as Sichuan, Guizhou, Hunan, Hubei, Shanxi, and it can attract tourists in these provinces

through marketing campaign and cooperation between tourism enterprises. Tertiary market contains other domestic provinces and overseas tourism market. To explore tertiary market, rural tourism destination can combine rural tourism with local city landscapes, the Three Gorges, Dazu Rock Carvings, Wujiang River Gallery, Wuling scenery and other tourism brands, so as to gradually improve awareness and reputation of rural tourism. (2) The other one is business market innovation. Business market of rural tourism in Chongqing can be expanded along the path of “low related diversification—high related diversification—low unrelated diversification—high unrelated diversification”. It can firstly expand related market of rural tourism, such as travel agency, transport, catering, entertainment, shopping (Liu 2006), and then further broaden market field, such as public social service industry, agriculture industry, forestry industry, pasturage industry, fishing industry, manufacturing, retail industry, e-business, and real estate market, in order to improve comprehensive profitability of rural tourism.

#### ***102.4.4 Path Choice of Supply Chain Innovation***

On supply chain innovation, it should mainly focus on building a dynamic flexible network platform of supply chain, which is formed by multiple subjects and based on computer and internet technology. Multiple subjects contains various suppliers which provide equipments, products and services for rural tourism, such as electrical equipment supplier, furniture supplier, agricultural product supplier, catering semi-finished product supplier, tourism goods supplier, washing service providers, management consulting company and so on (Chen 2010). Rural tourism enterprises and suppliers can carry on negotiations and transactions through the supply chain network platform. Supply chain network platform has drastically changed competitive mode of rural tourism enterprises. Rural tourism enterprises only need focus on core businesses, and peel off non-core businesses through “business outsourcing”. Under this condition, rural tourism enterprises not only can reduce transaction cost and improve transaction efficiency, but also realize vertical integration and horizontal integration of supply chain (Chen 2007).

#### ***102.4.5 Path Choice of Organizational Innovation***

In allusion to “small, scattered, weak, and poor” situation of rural tourism enterprises in Chongqing, it should set up chain enterprise groups and loose enterprise alliances. (1) One is to set up chain enterprise groups of rural tourism. Enterprise group is an inevitable trend of rural tourism economy. At present, the scale of most rural tourism enterprises in Chongqing are small, so it cannot develop enterprise groups solely through enterprises’ own internal accumulation. Government administrative drive will help rural tourism enterprises to speed up

the process of group development. Government should introduce taxes, land use, financial credit, financial subsidies and other preferential policies to encourage rural tourism enterprises to carry on mergers and acquisitions, so as to form enterprise groups (Duan 2011). Rural tourism destination in Chongqing should break local economy barriers, and introduce foreign tourism enterprise groups to activate the local rural tourism market. By means of the demonstration effect of foreign tourism enterprise groups, it can promote group process. (2) The other one is to set up loose enterprise alliances of rural tourism. From the perspective of industry chain integration, industry associations should muster independent rural tourism enterprises together to establish a loose alliance. Member enterprises can regularly carry on business cooperation and experience exchange; make unified market development and marketing; share reservation network, information services, centralized procurement and staff recruitment and training, to achieve the “ $1+1 > 2$ ” synergy effect. The alliance is carried out by a loose contractual management mode, and member enterprises can reduce differences and enhance cooperation through dialogue and consultation.

## 102.5 Conclusion

After years of development, Chongqing rural tourism has gotten considerable achievement, compared with other developed areas of rural tourism, rural tourism development in Chongqing is still on its infancy stage. Based on Schumpeter's Innovation Theory, this paper constructs innovation development model of rural tourism from five aspects, including product innovation, business model innovation, market innovation, supply chain innovation and organizational innovation. Then, according to the current situation of Chongqing rural tourism, this paper puts forward to corresponding innovation paths from these five aspects. On product innovation, Chongqing should adjust product structure of rural tourism according to resource characteristic and existing product base, and it should construct diverse product system. On business model innovation, rural tourism destination should take integrated advantage of government, enterprises, individual owners, communities, farmers and other social resources to build multi-level cooperation system. On market innovation, it should form cooperative operation pattern in all forms and at all levels, exploiting regional markets and related-industries markets. On supply chain innovation, it should mainly focus on building a dynamic flexible network platform of supply chain, which is formed by multiple subjects and based on computer and internet technology. On organizational innovation, it should set up chain enterprise groups and loose enterprise alliances.

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# Chapter 103

## Service Capability: Capability Quality and Capability Process

Xi-qiu Wang and Can Li

**Abstract** Along with the arrival of the service economy, more and more companies start to pay attention to service capability, but how to enhance the service capability effectively, is still a theoretical and academic question to solve. This paper argue that the nature of service capacity is essentially a kind of energy, and defines the service capability from two dimensions—service capability quality and service capability process, which makes it more operable and provides a viable analysis tool for enterprises to effectively enhance and manage service capability.

**Keywords** Competitive advantage · Service capability · Service capability process · Service capability quality

### 103.1 Introduction

The service industry is characterized by low resources consumption, little environmental pollution and large employment capacity (Chen and Zhou 2009). And manufacturing services, such as logistics, finance, information services, play an increasingly important role in supporting and leading the national economy. In the increasingly fierce market competition, with the homogenization of the manufacturing, the service capability has become an important means to gain competitive advantage of differentiation (Oliva and Kallenberg 2003). It allows the firm to deliver more value to the customers than its rivals, promotes growth and improves returns, which is one of the root causes of gaining competitive

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advantage. Meanwhile, the development of China's service sector is inconsistent with its overall economic growth, and still many enterprises lag behind in service capability (Xiaojuan and Hui 2004). Thus, to improve the service capability has become a top priority of China's enterprises. Some studies suggest that the key to improve service capacity is a substantial increase in investment in services (Gronroos and Ojasalo 2004). It seems that increasing service factor input will inevitably bring about rapid increase in service capability. This paper argues that investment in services is only the necessary condition of service capability but neither the sufficient condition nor the necessary and sufficient condition. Thus before effectively enhancing the service capabilities, a new understanding of service capability, its nature and structure is needed. This paper attempts to redefine the service capacity and analyzes its nature, structure, and internal process of establishment and development.

### 103.2 The Nature of Service Capability

In the service management, it's not a long time since the study on the service capability started. To manage the needs of the customers, Lovelock (1996) began to focus on the study of the service capability management. That is managing customer behavior through the reservation system and queuing system. Fitzsimmons and Fitzsimmons (1998) analyzed how to allocate the tangible service resources to optimize service capability. Li (2004), emphasized the simultaneity and intangibility of the service, regarded service capability as the ability to satisfy customer needs in per unit time, and proposed some practical tactics. Qi (2006) proposed five elements of the service capacity, namely, human resources, facilities, equipment and tools, time and customer participation. In specific, researches of service capability are mostly in areas like public institutions, logistics, and commercial banks. Lai (2004) explored the relationship between service capability and performance of logistics providers and defined service capability as the ability to use resources to satisfy customer needs and improve performance. Most of the above definitions compare service capability to production capability and regard it as the highest output in per unit time, that is, the number of customers being served in per unit time, which is often adversely correlated with service quality. Some studies in specific industries, define service capability as the display of enterprise's comprehensive strength. This paper argues that the definitions of service capability above just demonstrate some important features and parts of service capability, while fail to grasp the comprehensive concept of the service capacity.

We hold that the so-called service service capability refers to the ability of enterprises engaged in service activities, and it is the kind of business competence. Barney (1991) pointed out that corporation exploit unique corporate resources to compete, and these resources are valuable, scarce, difficult to imitate and cannot be replaced. Amit and Schoemaker (1993) proposed that the competitiveness of enterprises is from resources created or controlled by enterprises, that is, the ability to achieve

objectives using resources. According to this view, we think that service capability is resource-based energy or force which is shown through service activities and directly affect the efficiency of service activities. We can understand the definition from the following aspects: First, there are many service resources, such as the company's service culture, the skills of service personnel, corporate working environment and facilities. They are important factors affecting service capability, but they are not the capability itself. Secondly, the nature of service capability is the energy shown when enterprises are engaged in the service activities and the efficiency of process directly affects the size of the energy. Third, service capability is an integrated concept based on service activities. It is the overall performance of enterprises in the completion of service activities. Without specific service activities, the service capability can neither be shown nor developed. When we say that a certain enterprise has a strong service capability, in fact, it means that the enterprise has shown considerate energy in service activities. Obviously, this definition reflects the essential attribute of service capability, and points out the direction for the enhancement of service capability. But we also see that this definition is too abstract and difficult to apply it in operation. It's hard for enterprises to establish and develop the service capability according to this definition. Thus, it's necessary for us to further analyze the service capability, explore its structure and types, the development path of it, and thus provide more practical advice on enterprises to enhance service capability.

### **103.3 Structural Model of Service Capability**

Based on the analysis above, we believe that the nature of service capacity is essentially a kind of energy. What is energy? In physics, it is the ability a physical system has to do work on other physical systems (Faculty.clintoncc.suny.edu 2012). Learning from the physics definition of energy, we propose that service capability is the ability of the enterprise to make use of the facilities and human resources to complete specific service activities. This ability depends on two important aspects, first, the physical conditions, such as facilities and human capital, and the second is the behavioral performance in the process of the enterprises using material and human resources. The former can be called the service capability quality, and the latter can be called the service process capability.

#### ***103.3.1 Service Capability Quality***

Service capability quality is a comprehensive reflection of various resources in the possession of enterprises. It is a holistic and integrated concept. To conduct service activities, the enterprises need the accumulation of knowledge and skills closely

related to this area, certain material facilities and a certain amount of human resources. Therefore, the service capability quality can be seen as a function of these factors. It should be noted that these factors are complementary as well as substitutable to a certain extent, but the substitution between the factors is limited. These factors are indispensable, which are the basis and prerequisite for a company to complete an activity. They work together to influence behaviors of enterprises, and their combinations compose the structure of the service capability quality. The level of service capability quality is depending on the level of these factors and their matches. For example, however advanced the service facilities are, if the enterprise does not own relevant knowledge and skills and the right staff, the overall level of service capability quality will not be that high, thus affecting the level of service capacity.

### ***103.3.2 Service Capability Process***

Service capability process relates to the process that an enterprise uses its knowledge and skills, material conditions and human resources to achieve goals of specific activities. The efficiency of service capability process mainly depends on four factors: the goals, procedures, systems and culture. The goals indicate the desired results of service activities and the direction of behaviors. Without clear operational goals, the enterprise will lose the direction of action, and it is difficult to achieve the desired results of service activities. Procedure reflects the ways and means of activities, and it is the technical assurance of high efficiency of activities. Both systems and culture are norms and constraints of the course of action. The difference is that the system is a hard constraint, which ensures the norms of service capability process itself, and culture is a soft constraint, which constrains the corporate behaviors by influencing people's strength in intention and perseverance to carry out the activities.

### ***103.3.3 The Structure of the Service Capacity Model***

Service capability is the combined result of service capability quality and service capability process. If the level of service capability quality is high but the service capability process is inefficient, or an enterprise has high efficient service capability process but the service capacity quality is low, neither of these situations can guarantee a strong service capability of enterprise. Therefore, the service capability can be expressed as the product of the level of service capability quality and service capability process. Assume using *SCQ* to represent service capability quality, using *SCP* to represent service capability process, and using *SC* to represent the level of service capability, then:

$$SC = SCQ \cdot SCP$$

Based on this structural model, we can draw two basic inferences:

- (a) The service capability quality and the service capability process are two core elements of developing service capability. Therefore, there are two basic ways to enhance service capability: one is to enhance *SCQ*, and the other is to enhance *SCP*.
- (b) There is certain substitution between *SCQ* and *SCP*. Thus different combinations of service capability quality and service capability process can achieve the same level of service capability. Service capability can be enhanced either by improving the service capability quality or by service capability process.

### 103.4 The Internal Process of Establishing and Developing Service Capability

No business is born with service capability. Service capability is established and developed in the continuous process of production and operation activities. As for a new enterprise (or an enterprise engaged in a new activity), it does not have the relevant capability, but it may have some initial capability quality (knowledge and skills, capital, human resources, etc.), when it uses capability quality to do certain activities (that is to combine capability process with capability quality), it will show some energy. The energy shown is just what is owned by the enterprise, in other words, the enterprise establishes some kind of capability. Making use of this capability, the enterprise will continue to find, analyze, and solve problems in the process of serving the customers, accumulate knowledge and skills, and improve ways and means of service activities, thereby enhancing *SCQ* and *SCP*, and allowing enterprises to complete more complex activities and demonstrate a more powerful energy. This cycle repeats itself, and thus service capability can be continuously developed in the process.

The energy shown in the process of service activities is the result of service capability quality and service capability process. So theoretically, the improvement of service capability needs the balanced development of service capability quality and service capability process. Neither the condition that inefficiency of service capability process resulted from low service capability quality nor the loss of service capability quality due to the inefficiency of the service capability process should be avoided. However, the enhancement of service capability quality and the improvement of the efficiency of service capability process have different influencing factors and mechanism, and enterprises have different focus at different times, making it difficult to ensure that the level of *SCQ* and *SCP* are improved simultaneously. Of course, whether the level of *SCQ* and *SCP* is high or not is comparative. Both of them are in the dynamic developing process. When the low service capability quality hinders the efficiency of service capability process,

enterprises will turn to improving the service capability quality; on the contrary, when the efficiency of service capability process cannot realize the potential of service capability quality, enterprises will put more efforts to improve the efficiency of service capability process.

### 103.5 Implications

At present, globally, the proportion of service sector increment accounts for 60 % of GDP (gross domestic product) or more, and this number is over 70 % for western developed countries, and even low-income countries can reach the average of 43 %. Since the reform and opening up, during the 32 years between 1978 and 2010, China's service industry has made great progress. The contribution rate of the service sector (the ratio of increment of service industry to the increment of GDP) has increased from 17.3 to 38.5 %. But compared with developed countries, the overall level of development of China's service industry is still relatively low. The service sector accounts for 43.1 % of GDP in 2011, and mostly distributed in the labor-intensive industries while knowledge-based modern service industry is lagging behind (China Statistical Yearbook 2011). If being measured from service competence, service quality, customer satisfaction and competitive advantage, the gap may be even greater.

In general, the service capabilities of most companies in China are still low (Dan and Changjie 2012). According to "quality-process" model established in this paper, there are two reasons: First, the service capability quality is low. On the one hand, the average personnel quality in service sector is low. Much rural surplus labor flows to the service industry, and the quality of these workers is not high. On the other hand, most of them went to the traditional services, such as transportation, commerce and catering. As for the service resources input, the technical elements are not given enough attention. Second, efficiency of service capability quality is low. Naihua and Jiangfan (2006) used the stochastic frontier production function model and panel data to analyze the efficiency characteristics of the services sector in China from 1992 to 2002. The results showed that the Chinese service sector failed to exploit the potential of resources and technologies and was characterized by extensive growth.

For this reason, we believe that in order to improve service capability, China's companies need to substantially improve the level of service capability quality—increase the accumulation of knowledge and skills and strengthen the human resources inputs as well as the scientific and technological input. More labor education and vocational skills training should be carried out, and more high-quality labor should be attracted into the service sector. However, capital and human resources investment is limited in a certain period of time, and its effect in improving the service capability is also limited if the resources cannot be made full use of. For most China's enterprises, to improve the service capability in a short time, they should not only improve inputs in service capability quality, but also

enhance the efficiency of capability process, which is more urgent and more important. Through clear objectives, the rationalization of process, development of a more scientific system, and cultivation of an advanced culture, the firm can greatly improve the efficiency of service capability process and thus improve service capability. Both efforts are indispensable.

## 103.6 Conclusions

On the one hand, the service capability exists objectively, and on the other hand, it is very abstract. It's hard to grasp it and apply it in management effectively because of its abstraction. This paper redefines the service capability from two dimensions—service capability quality and service capability process, which makes it more operable and provides a viable analysis tool for enterprises to effectively enhance and manage service capability. This is only a preliminary research and many issues still need the in-depth study and discussion. We hope that this paper can stimulate more valuable researches on service capability.

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# Chapter 104

## The Empirical Research of Urbanization Level Measure from the Spatial Economics: On the Data of Henan Province

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**Abstract** Urbanization degree, accompanied with industrialization, is the key method to measure the regional economic development. The establishment of comprehensive evaluation system in urbanization is the effective way to measure the urbanization degree scientifically. This paper, in accordance with the spatial economics, sets up comprehensive evaluation index system in regional urbanization from the “social”, “economy” and “transportation”, analyzes the measure result by the method of entropy on Henan practical urbanization level from 1996 to 2010, by which the feasibility in its system has been proved. Finally, this paper puts forward relevant policy suggestions in view of the exposed deeper problems in analysis.

**Keywords** Comprehensive measure · Entropy method · Spatial economics · Urbanization level

### 104.1 Introduction

Urbanization, a kind of economic and social phenomenon, plays a vital role in promoting China's urban and rural economic and social development in modern condition, is the powerful motivation in future economic sustainable growth with fast speed, is the key element to achieve the strategic goal of city development. American economist Simon Kuznets once said that: “every country's economic

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growth means sustainable growth per capita or average output, most of the growth is often associated with population growth and the great changes of structure". In the modern age, there are the following industrial structure changes: "the products' origination and resources' destination; from agriculture to non-agricultural activities production activities is the industrialization process; population distribution change among cities and rural areas is the process of urbanization". For China's urbanization evolution, as Joseph Stiglitz said, "the issue is not whether the urbanization process will occur, but how it happened in the coming decades, millions of Chinese high standard of living will depend on the resolution of the urbanization". At present, China is going through the urbanization process, number of cities and scales with high speed. Based on the different understanding of urbanization from different periods and subjects, academics has offered various of methods towards the measurement of urbanization.

Domestically the first researcher in urbanization degree measurement, Longjun (1986) evaluated the post-war population urbanization level, of which quantitative research in recent years is increasing. But in general, the evaluation index selection is more divided into two kinds, and one kind is selecting indicators from "quality state dimension of urban development quality", another kind is getting indicators from "spatial dimensions" on the main function of the city. The former evaluation generally begins its research more around economy, society, life around, resources and environment, infrastructure and coordinated development between urban and rural areas and so on, the latter starts more around production, trade and business, transportation information on science and education and functions. Among the majority of quantitative research methods are principal component analysis (Wang et al. 2011), factor analysis (Jianzhong and Lin 2006), analytic hierarchy process (ahp) (Li 2010) and entropy method (Chen et al. 2011).

However, the urban system development at present in China is more and more influenced by economic integration, industrial development, infrastructure construction, and many other factors, including especially modern transportation system and resources and environment. This paper, in order to explore the scale of urban population with the city's economic development and the correlation of migration and the rule of flow, attempts to set up the comprehensive measurement index system of urbanization and empirical analysis, beginning from the "quantity state dimension" based on special economics city theory, using the method of entropy to take Henan as an example.

## 104.2 Urban Theory of Spatial Economics

In 1991, Paul Krugman has put forward his "Core Periphery Model" in his academic paper "Increasing Returns and Economic Geography" published in *Journal of Political Economy*, which Realizes the general equilibrium analysis in monopolistic competition market between two areas and two departments (agriculture and manufacture) (Krugman 1991). This article is considered as the

academic foundation of Spatial Economics Theory, whose key is connecting D-S Monopolistic Competition Model with iceberg transportation cost model from Heckscher–Ohlin model, explaining the reason of Economic Agglomeration on homogeneous space. C–P model, in a certain, explains some formative factors—regional urbanization progress, metropolis development, rural population decreasing.

In 1999, M. Fujita and Paul Krugman begins with “The Isolated State” from Johann Heinrich von Thünen, based on C–P model, connecting with “iceberg cost” and “CES utility function” to establish the city model. Another type is to select index on the basis of city subject functions spatial dimension (Fujita and Krugman 2004). And gradually increasing the population in manufacturing economy led to the gradual increasing of distance between the edge of the agriculture hinterland and the central city. When in a certain degree, some manufacturing migrating outside from city will result in the new city’s formation. When there are a lot of different industries with sizes and transportation costs in economy, it will give rise to the hierarchy structure in the city, whose tendency depends on parameters from “market potential” (Fujita et al. 1999). The market potential can decide the location of economic activity, whose advantage has a catalytic effect: when a new center appears, the market potential will be formed in this area rather than others generally, and once it is done, it can develop itself and increase its scale by its own power (Krugman 1991). Brakman, after his modification to “city model”, considered “crowded effect” will raise the production cost higher to the enterprises in the agglomeration place, and in which the enterprises tend to migrate to the places with lower crowded effect (Fujita and Thisse 1999). And new manufacturing industry can be formed in the outer area, narrowing the regional differences (Brakmana and Marrewijk 1995). Xionglang (2007) believed that trade costs includes not only the product transportation cost, but also includes factors flow cost, and developed “C–P” model after introducing forward and backward industrial linkages. How to integrate Spatial Economics with Urban Economics discussing its internal structure is a vital task of the spatial economy (Fujita and Mori 2005).

### 104.3 Comprehensive Measure on Regional Urbanization Level

At present in academia there have been put forward many methods in urbanization measure, and in general there following two kinds: the main index method, and complex index method. The main index method is to choose to individual indicators with strong feature in urbanization and simple statistical approach to be measured, at present there are two major indexes, namely population proportion index and land usage index. Complex index method has a comprehensive summary relatively to the connotation of the city, selecting indicators related to

urbanization to be measured, which makes up for the disadvantage of single index reflecting regional urbanization development, so this paper, on the city theory of spatial economics, from the economy, beginning from economy, social development and transportation, has the empirical analysis towards the evolution process of urbanization in Henan by the complex index method to establish index system of urbanization level.

### ***104.3.1 Research Method***

To avoid the overlap of multi-indexes variable and human interference in selection of weights, the method of entropy is used in comprehensive assessment towards Henan urbanization process. To determine the size of objective weight is the basic thought of the entropy by the index of the variability, entropy of information  $e_j$  in a certain index is smaller, which shows that the index variation is bigger. The more information it offers, the more important role it plays in comprehensive evaluation, and the weight follows bigger (Prachee et al. 2005). Therefore, the method of entropy can tell utility value of the information entropy index. The given value of index weight has higher reliability than the analytic hierarchy process (ahp) and expert experience evaluation method, suitable for comprehensive assessment of multivariate indexes.

### ***104.3.2 Index System Construction***

With the help of the existing comprehensive measuring index system results (Zheng et al. 1997), on the theory of city, this paper has concluded 3 subsystems related factors “society”, “economy” and “transportation”.

1. The social subsystems mainly reflect the town concentration degree of population, the current status of social security, and the average cost of living per capita. The purpose of setting index is to embody the stability and sustainability of “labor force”, which is the initial motivation of city development, in the process of urban agglomeration. Among the indexes, “city residents’ income coefficient” and “the proportion of the first industry employment in the total employment” are negative dimensions.
2. The economic subsystems mainly reflect non-agriculturalization transformation and industry development situation under the economic structure with the evolution of urbanization process, the subsystem setting is for revealing the second industry especially industry as present urbanization engine and evolution process relative to the first industry and the overall economy, in which “energy consumptions per GDP” and interdependency of foreign trade is considered as the negative index.

3. The traffic subsystems mainly reflect the change process of regional transportation infrastructure and transportation capacity, which is different from other evaluation index system in the subsystem setting, because from space economics, the size of regional traffic transportation capacity and cost amount of transportation are the vital factors influencing regional industry clustering and orderly development.

There are relation and difference among the above three subsystem to fully accurately reflect the state evolution process on “quantity of dimensions” towards Henan urbanization.

### ***104.3.3 The Empirical Area and Data Sources***

Henan is of 167,000 km<sup>2</sup>. Data are from the 1997–2011 “Henan statistical yearbook”, “China statistical yearbook” and “the science and technology of China statistical yearbook”.

## **104.4 Analysis of Henan Urbanization Level and Evolution Process**

In recent years Henan has obviously faster urbanization process, the population of urbanization rate is up from 16.84 % in 1994 to 38.80 % in 2010, with an average annual growth rate of about 1.29 %, to keep consistent with an average growth rate of China’s urbanization (slightly higher).

But from the total amount, to 2010, value added of industrial enterprises above designated size in Henan has reached 51.75 % of GDP, is nearly 13 % higher than the population urbanization rate in the same period, population urbanization rate and ratio of industrialization is only 0.75, is far lower than the reasonable range of 1.4–2.5 proposed by Hollis B. Chenery, which fully demonstrated Henan urbanization lagged behind the industrialization level.

### ***104.4.1 Result of Urbanization Measure to Henan Province***

By the method of entropy calculation steps, this paper has involved 32 indexes with 1108 original data processing from 1996 to 2010, calculating the weight of each index theory (Table 104.1).

**Table 104.1** Henan urbanization index empowerment at all levels

System layer	First level indicator	Second level indicator	Weight
Society 0.3723	Social development 0.0947	The percentage of urban population in total population	0.0201
		Amount of investment of per capita environmental pollution control	0.0367
		Gini coefficient of urban and rural residents' incoming	0.0125
	Employment 0.1413	Built-up district area	0.0255
		The average payment to the urban employers	0.0350
		The percentage of employers in the first industry in total employers' amount	0.0280
		DPI spread of urban and rural residents	0.0326
		Social security and employment inputs amount per capita	0.0455
	Education and medical care 0.1363	Hospital beds per 10,000 persons	0.0575
		Per capita inputs of education, science, culture, medical care from national financial allocation	0.0468
		College internal students per 10,000 persons	0.0320
Economy 0.3128	Total scale 0.1049	The percentage of retail goods output in GDP	0.0185
		The rate of industrialization	0.0283
		The percentage of industrial fixed assets investment in gross industrial output	0.0415
		The percentage of increasing rate of producer services in GDP	0.0166
	Efficiency 0.1232	Energy consumptions per GDP	0.0162
		Real per capita use of foreign investment	0.0464
		Overall labor productivity	0.0412
	Innovation motivation 0.0847	Interdependency of foreign trade	0.0194
		Percentage of new products development investment in industrial added value	0.0234
		Domestic patent license number	0.0404
Transportation 0.3149	Infrastructure 0.1266	Percentage of R&D funds internal expenditure in GDP	0.0209
		Classified road mileages	0.0396
		Railway mileages	0.0340
		Per capita urban road area	0.0289
	Transportation capacity 0.1511	Motor truck numbers per 10,000 persons	0.0242
		Turnover of passengers	0.0316
		Freight mileage	0.0616
		Percentage of industrial raw materials and energy transportation in total cargo transportation capacity	0.0167
		Increasing rate of road cargo transportation capacity	0.0411
	Economic benefit 0.0372	Percentage of traffic transportation and warehousing output value in GDP	0.0137
		Percentage of traffic transportation postal service investment in the fixed assets in total fixed assets investment	0.0235

### ***104.4.2 Overall Evolution Analysis of Henan Urbanization***

The calculation results from 3.4 (Table 104.1) shows us that maximum weight in “freight turnover index” of “transportation capacity index” reached 0.0616, the important influencing factors of Henan urbanization. Secondly, the index weight from Hospital beds per 10,000 persons, Per capita inputs of Education, science, culture, medical care from national financial allocation, Real per capita use of foreign investment, Social security and employment inputs amount per capita is above 0.045, showing that they produced major impact to urbanization level in Henan from 1994 to 2010. The rest index weights are all under 0.042, explain the unobvious promoting towards the urbanization process in Henan.

From regional urbanization’s subsystem and level indicators, the rest of the index are above 0.1, except “social development”, “innovation motivation” and “economic benefits from traffic”, showing that Henan having been into the acceleration of urbanization development, the population cluster, transportation convenience and fixed asset investment increasing at this stage play an important role, showing externally three subsystems relative stability and rapid growth. From 1994 to 2010 urbanization level increased gradually in Henan, the comprehensive evaluation value increased from 0.0908 in 1994 to 0.8486 in 2010, at the same time population urbanization rate was up from 16.84 % in 1994 to 38.80 % in 2010. There are both strong positive correlations, and Pearson correlation coefficient is 0.9686.

Generally speaking, in more than 10 years, Henan urbanization process has made great development, urban elements of its investment’s utility efficiency improved, the urban environment and urban infrastructure continuously improved, the comprehensive strength of the city, external radiation ability and service ability strengthening as well. But behind this growth, there are a large amount of investment, land occupied and energy consuming, and this extensive urbanization development is not sustainable to Henan, a more population less land, less natural resources.

### ***104.4.3 Analyzing Urbanization Subsystem of Henan Province***

Generally speaking, Henan urbanization presents the overall rise, whose subsystem shows different features respectively (Fig. 104.1). By the influencing factors from City Theory, 2–3 level 2 indicators are taken for the general comparison in three subsystems.

#### **1. Social Urbanization Subsystem**

Social subsystem development has gone through three stages: slow growth stage in which the index was up from 0.0198 to 0.0318 in 1996–2000, the annual

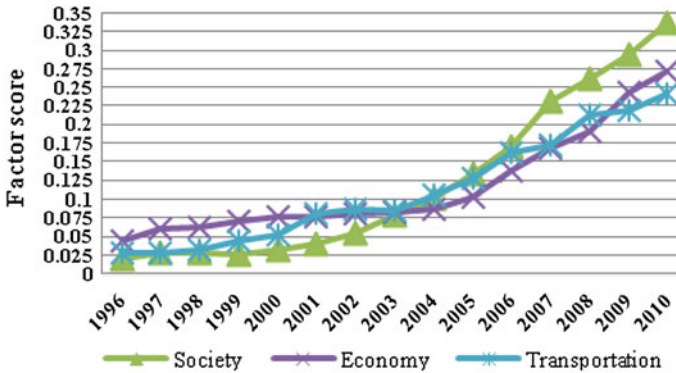


Fig. 104.1 Henan each subsystem urbanization evolution process line chart

average growth of which was 14.44 %, and the average contribution was 21.25 %; rapid development stage in 2001–2007, the index of which was from 0.0408 to 0.2308, the urbanization contribution of the average annual growth was 12.34 %, the average annual growth of 32.87 %. After 2007, later growth slowed down again, the average annual growth of 13.41 %, but the system stability in the contribution of urbanization was from 39 to 40 %. Since 2001 regional economic growth with the industrial economy as a representative had pulled the development of social subsystem, as a large population of Henan, since 2003 the social subsystem which had over passed economic and traffic sub system had played the key role in urging the urbanization of evolution of Henan.

With the government more support to the agricultural infrastructure construction, agricultural productivity can be improved, a lot of surplus rural labors left countryside constantly under the function of income difference (especially during 2000–2003 average annual disposable income of urban and rural residents expand 21.41 %), but because the industry in Henan more focus on energy chemical industry and heavy equipment manufacturing industry, and productive service industry and the third industry foundation is under slow development, leading to the contribution of the population urbanization of cities relatively slow to urbanization, the average growth of 19.95 %, much lower than the annual growth rate (35.78 %) of average payment from urban units employees. On the other hand, because limited capacity from the urban second and third industry, especially after the subprime crisis in the United States 2007, urban unemployment rate increasing, the employment pressure increasing showed exploration and growth of non-standard employment channels, “social security and employment inputs amount per capita” as a security social investment index (Cai and Wang 2004). Judging from the evaluation, population urbanization rate concerned from 1996 to 2006 expressed good tracking, greatly boomed in 2007, and maintains the fast growth tendency.

## 2. Economic Urbanization Subsystem

Economic subsystem is divided into two stages of development in which 2004 is the boundary by the evolution process from 1996 to 2010. The comprehensive evaluation value of the average annual growth in the 1st stage was 9.36 %, much lower than the 2nd of 21.11 %, but the average contribution in the 1st stage was 43.03 %, and the 2nd was lower, relatively around 29 %. The main reason is that the key industry in Henan mainly on energy raw materials industry and the related heavy equipment manufacturing industry, which is in the low end of the value chain, belongs to labor and capital intensive industry, and its rapid growth depends on a lot of fixed assets investment, which could be found from the indicator's development track from the percentage of industrial fixed assets investment in gross industrial output. Since 2002, the fast growth of the industry investment in the fixed assets (the average annual growth of 18.5 %) greatly boosted the development of industrial economy.

By the corresponding change from the other main indexes, the overall Labor productivity, on behalf of the economic efficiency, "domestic patent license number", on behalf of the Economic innovation power, and industry investment in the fixed assets has the very good tacking characteristic. Since 2002 the increasing industry investment in the fixed assets led to the overall Labor productivity growth in 2003, from 12422 RMB/person to 38517 RMB/person in 2010, the average annual growth of 17.67 %, which promoted more domestic patent outputs, the average annual growth of 31.11 % from 2005 to 2010 is higher nearly 16 % than that from 1996 to 2004. But we also see the development of the service industry production is slower, since 2004 "the percentage of Increasing rate of producer services in GDP" slowed down, whose value fell from 11.37 to 9.43 %, and the development of producer services will directly influence the urban economy, especially the transformation from the 2nd industry to the 3rd industry, and this should be given enough attention.

## 3. Traffic Urbanization Subsystem

By the general development of subsystem situation, the traffic urbanization comprehensive evaluation value began steady and rapid growth from 1996, the average annual growth of the comprehensive evaluation score was 17.76 %, the average contribution on urbanization was 32.27 %, which testifies the significant advantage of Henan traffic evolution has a positive role in promoting its urbanization evolution.

By the main index of this subsystem, "Classified Road mileages" and "freight turnover mileages" indexes showed good tracking, especially after 2005 presenting the fast growth trend, which had a very close relationship with the regional features of Henan. Henan is the important transportation hub of China's inland, including the Jingguang, Jingjiu, Longhai railway lines etc., which also is the location advantage of Henan economic development.

## 104.5 Discussion

Evaluation index system establishment in this paper, after the above analysis, can exactly explain Henan urbanization process, but whether, after the measurement research of Henan urbanization evolution, it can conclude the influencing factors of other cities' urbanization development in order to offer some development suggestions, it requires further research, on which this paper puts forward 4 points for further discussions.

First, the urbanization direction must follow priority zones planning policy in national "Twelfth Five-Year", must determine the central function in the city, and implement the center city leading strategy. National "Twelfth Five-Year" points out specifically that it will implement development priority zones, overall planning, rational distribution, perfect functions, follow the development the objective laws, rely on big cities, take mid-sized city as the key point, and gradually form the urban agglomeration with radiating role, promote the coordinated development of mid-sized city and small towns. And at the same time according to the orientation of the city center, it can accelerate the establishment of a modern industrial system, the modern urban system, independent innovation system, promote the transformation and upgrading of economy and enhance the economic development of internal dynamism.

Second, to strengthen the regional network system construction of productive service development. Production services is a kind of service industry to keep the industrial production processes continuity, promote industrial technology progress and industrial upgrading and improve production efficiency for service guarantee; is the supporting service industry with manufacturing related, is connected in the process of enterprise production; is the key link to speed up the second and third industry. And industrialization is the engine of urbanization; the third industry is the follow-up power after the urbanization of the industrial age. Only to catch the key point can push the second and third industry into orderly positive development, and ensure the smooth, fast, continuous urbanization.

Third, to insist intensive development, pay more attention to environmental protection. Urban development scale set is connected to the resources and environment conditions, and promote intensive urbanization. We should be on China's basic national conditions, absorb foreign urbanization experiences and lessons, do high utilization and conservation of resources, and protect the ecological environment, the construction intensive urbanization, improve the comprehensive carrying capacity of the city.

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# Chapter 105

## Would Stress Always Lead to Bad Outcome? The Differentiation of Job Stress and Mediating Effects of Job Engagement

Steven Ji-fan Ren, Cai-hong Hu and Ping Xie

**Abstract** Stress has caused critical problems in information technology-intensified organizations. Besides the relationship between job engagement and job performance, the model highlights the relationship between two kinds of stress (hindrance stress and challenge stress) and job engagement, which are neglected by IT studies. Data will be gathered from IT professionals in Chinese IT companies. The findings can help improving IT professionals' job performance by setting them different difficulties of work tasks to encourage their high level job engagement. Implications and suggestions for future research are discussed.

**Keywords** Challenge stress · Hindrance stress · Job engagement · Job performance · Job stress

### 105.1 Introduction

For a long time, job stress and performance are more and more serious problems that the developed industrial society faces, especially for American. Recently the functional mechanism of how job engagement influences job performance has gotten more and more attention. However, researches on how stress experienced

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by employees affects job performance through are rare. What's more, it has been argued that almost all job stress research and theories were developed and empirically tested in western industrial countries (Jamal 1999). It is therefore important to replicate job stress and job performance research in Chinese societies in order to test the applicability of western organizational theories. What's more, in modern China, with the rapid development of science and technology and the fast renewing of electronics technology, IT professionals face high stress levels. So it is important to do such kinds of researches for the subject of Chinese IT professionals improve their job performance.

Performance and stress, as a hot topic for organizational behavior research, have been extensively studied by many scholars. And the research on factors of job performance has become an important research direction recently. Previous studies have covered the relationship between stress and turnover intentions, organization commitment, job satisfaction and job performance (French and Kahn 1962). Empirical findings on the relationship between stress and performance have been inconsistent in terms of magnitude and direction (Beehr and Newman 1978), such as the inverted U relationship between job stress and job performance (Jamal 1984; Westman and Eden 1997). One explanation for this inconsistency is interpreted as suggesting that stress increases arousal, which increases performance up to some point, after which there will be over arousal, strains, and then a decrease in performance. Another explanation for the inconsistency is that the relationship may depend on the nature of the stress (Jex 1998). Scholars have divided stress into two types (hindrance stress, challenge stress) with respect to important attitudes and behavior (Glaser et al. 2001; Boswell et al. 2004; Cavanaugh et al. 2000; Simmons and Nelson 2001). There also have been researches on the effects of the two forms of stress on learning performance. Hindrance stress was negatively related to motivation to learn, challenge stress was positively related to motivation to learn, and motivation to learn was positively related to learning performance (LePine et al. 2004).

Job engagement is a new study area based on job involvement. Scholars have made great progress over the past decade in identifying correlates of engagement. Many researches have been done in this area to explain and summarize basic theory, such as conceptually defined job involvement and job engagement. Kahn described engagement as a unique and important motivational concept: the harnessing of an employee's full self in terms of physical, cognitive, and emotional energies to work role performances (Kahn 1990). A breakthrough in empirical observation is LePine and Crawford's study in 2010. They used job engagement to explain the influence of individual factors on job performance, and verified the mechanism of how job engagement links the individual and organizational factors with job performance.

According to these previous studies, challenge stress and hinder stress have different effects on job performance and job engagement has a significant positive correlation with job performance, so our research questions are:

- What's the relationship between two kinds of stresses and job engagement?
- Whether job engagement acts as the mediator between two kinds of stresses and job performance.
- Whether theories developed according to western industrial developed countries are applicable to China is explored in this article.

The organization of the study will be as follows. We review the constructs of the introduction and put forward the hypothesis and model of the study on the basis of the existing theories. Theoretical and practical contributions as well as the limitations and implications of the study are presented.

## 105.2 Literature Review

### *105.2.1 Challenge Stress and Hindrance Stress and Their Relationship with Job Performance*

It has been suggested that employees' job performance, which is the final purpose of organizational management, is closely related to stress that they experience. But opinions on the relationship between the two constructs are inconsistent because the focuses are different as some pay attention to the intensity of stress while some pay attention to the final consequences of stress. In this research, we focused on the final consequences of stress and classified stress into challenge stress and hindrance. Although it is suggested that almost all stress would cause exhaustion, there does exist stress that can positively influence employees' behavior and finally helps improve employees' job performance and some stress that can negatively influence employees' behavior and finally causes to decrease employees' job performance (LePine et al. 2004). The former is defined as challenge and the other kind is called hindrance. It is suggested in the definition of challenge stress and hindrance stress that challenge stress is positively related to job performance while hindrance stress is negatively related to job performance. And from the theory of LePine, challenge stress, which is mainly brought by challenge tasks from both quality and intensity, calls more time devotion, energy devotion, cognition devotion and leaves sense of responsibility to employees, thus can improve their job performance. But hindrance stress, which mainly refers to the unfair management mechanism and the inharmonious interpersonal relationship in the organization, will hinder the positive of employees and the decrease their job performance (LePine et al. 2004). The mechanism here is the key elements of this research, which here suggests the mediating effects of job engagement.

### ***105.2.2 Job Engagement and Its Relationship with Job Performance***

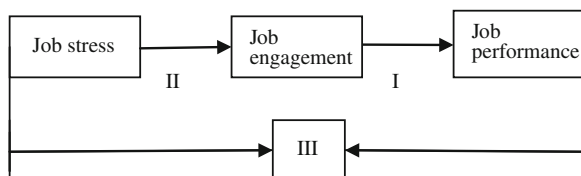
The conception of job engagement is introduced on the basis of job involvement by Kahn who defined job engagement as the harnessing of employees themselves physically, cognitively and emotionally to their work roles. Therefore, job engagement has three dimensions (physical, cognitive and emotional) and is clarified into physical engagement, cognitive engagement and emotional engagement (Lepine et al. 2010). From the measurement of these three constructs, we can see that physical engagement mainly focuses on the efforts one devotes to the work role, cognitive engagement mainly focuses on the extent of employees' absorption to work roles and emotional engagement mainly focuses on the subjective feeling of employee to the work role. In this research we introduced physical engagement, cognitive engagement and emotional engagement as the items to measure job engagement. In their research, LePine et al. (2010) reviewed the former researches on job engagement, and concluded that the antecedents of job engagement are individual characteristics and their perception of organizational environment. He also studied the relationship between job engagement and the antecedents and that between job engagement and job performance. According to their theories, job engagement is positively related to job performance because employees with high job engagement would like to devote themselves to the work roles, so they would like to put more time and energy into their work and when doing the tasks, they were willing to be more careful, with all these devotions on physical, cognitive and emotional level, employees will definitely gain high level of job performance (Lepine et al. 2010).

## **105.3 Theory and Hypotheses**

On the whole, this research tried to explore the mechanism that job engagement functioned as the mediator between job stress and job performance. In order to realize this aim, we divided the research into three parts: firstly we tried to verify the relationship between job engagement and job performance using the existing theories and our understanding of their definitions; secondly, we wanted to know the different effects that challenge stress and hindrance stress had on job engagement and tried to explain the reasons for their different functions; finally we studied the mediating mechanism of job engagement's effects on the relationship between the two kinds of stress and job performance. The frame of this part was showed in Fig. 105.1. Overall, we separately studied the relationship between job engagement and job performance and then we explained the whole model which contains all the three constructs.

According to Sale and Hosck's theory, three pivotal elements to gain job involvement are active spirit to participate, considering career as the core interest

**Fig. 105.1** The frame of this chapter



of life and putting job performance to the primary position in the evaluation of self-achievement. All of these three elements are motivating factors to the improved job performance. Job engagement, which was put forward by Kahn (1990) on the basis of job involvement put forward by Lodahl and Kejner, means the devotion of oneself to what he or she is participating on physical, cognitive and emotional level. Therefore, there does exist bound relationship between job engagement and job performance. And the positive relationship between job engagement and job performance can be explained from the definition of job engagement and the its influencing factors as one who has the active spirit to participate in his or her career, considers career as the core interest of his or her life and puts job performance to the primary position in the evaluation of self-achievement will devote himself or herself to his or her job on physical, cognitive, and emotional level, and with the full scale of one's devotion to his or her job, high job performance should be achieved. On the other hand, through the analysis of LePine& Crawford, job engagement plays essential mediating role between individual differences on characters (core self-evaluations & value congruence) and job performance and between perceived factors from organizations (and perceived organizational support) and job performance (Lepine et al. 2010), which implies the direct positive relationship between job engagement and job performance. From the theories above, we put our first hypothesis as follows:

**H1** Job engagement and job performance are positively related.

According to Rabinowitz and Hall (1981), job involvement is related by individual characteristics, working status and to job performance, of which working status is inclined to be influenced by organizational environment. Job stress, which is defined as individual subjective assessment of certain sources of stress, job satisfaction, job research and pressure related to other negative job achievements (Bretz et al. 1994). According to the consequences of difference stress on outcome variables, his research categorizes stress as challenge stress and hindrance stress, of which challenge stress refers to the pressure that can encourage employees to obtain adept on vocational skills, make progress and fulfillment (Folkman and Lazarus 1981; Lazarus and Folkman 1984). The stress described here belongs to factors of working status. In his research on “the psychological conditions that decide whether or not employees carry out engagement”, Kahn put forward the psychological condition that delimits employees' engagement and disengagement. In the research, Kahn hypothesized that work contents is the determinants of employees' engagement and disengagement with the introduction of employees'

perception as the mediator (Kahn 1990). Therefore, according to Kahn, when challenge stress are felt by employees and perceived as beneficial working status factors, it will encourage their job engagement. On the other hand, from the definition of challenge, we can get that it is mainly related to the work, for example, the amount of the tasks, the difficulty of the tasks, and the intensity of the tasks etc. which call on employees full self-devotion to realize, thus these challenge stress will encourage employees' physical engagement, cognitive engagement and emotional engagement through motivating employees' enthusiasm on active participation. What's more, tasks with challenges can motivate employees' interests to work and mobilize employees' physical enthusiasm, cognitive enthusiasm and emotional enthusiasm, and finally improve their job engagement on these three levels. So from the analysis above, we draw the following hypothesis:

**H2** Challenge stress experienced by employees is positively related to job engagement.

In contrast with challenge stress, hindrance refers to the pressure that prohibits employees to obtain adept on vocational skills, make progress and fulfillment (Lazarus and Folkman 1984). And similarly with the analysis of the relationship between challenge stresses to job engagement, hindrance stress is considered to be negatively related to job engagement as it is the negative working status factors, once felt by employees, it will affect job engagement through the mediating effects of psychological perception. And it can also decrease job engagement by inciting employees' negative emotions toward their work. Therefore, we put forward the hypothesis as follows:

**H3** Hindrance stress experienced by employees is negatively related to job engagement.

Through theory analysis and empirical verification, LePine et al. have get the results of the positive relationship between challenge stress and job performance and the negative relationship between hindrance stress and job performance. Although the mediating effects of job engagement between the two kinds of stress and job performance have not been mentioned and theories in this aspect are limited, we can still analyze the functional mechanism. Once faced with challenge stress, which means that employee should complete quite amount of tasks in certain time, that the tasks are challenging as they call enough energy, time and responsibility, which means that employees faced with challenge stress should donate quite much physical or concrete resources as the necessities to complete the tasks and that the tasks can incite their sense of responsibility and mission, which means the employees should also put enough soul energy such as interest and ambition to aspire themselves have the strong will to complete the tasks. Therefore, employees are willing to engage themselves to the job both emotionally and cognitively, what's more the difficulty and intensity of the tasks call the physically engagement. In this case, challenge stress stimulates employees' engagement on all the three levels (physical, emotional and cognitive levels), and as is suggested by hypothesis 1, employees with high degree of engagement will definitely

increase their efficiency and decrease their error rate, and consequently improve their job performance. From the definition and analysis of challenge stress, we can get the conclusion that it is sort of wholly job related and decided by the objective factors. This is also the theory foundation of the fully mediating mechanism between challenge stress and job performance. Thus, we put forward:

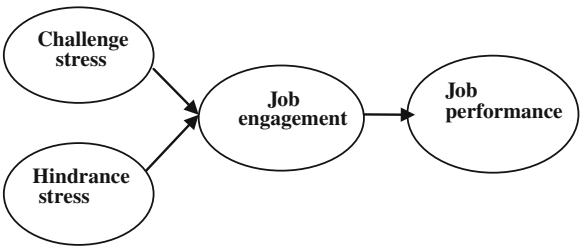
**H4a** Job engagement fully mediates the relationship between challenge stress and job performance.

However, hindrance stress is not absolutely the same case as challenge although it is also suggested that job engagement may function as the mediator between hindrance stress and job engagement because hindrance stress is mainly not job related but more likely interpersonal or organizational related. When organizational decisions are decided by power or personal relationships, when employees felt high degree of ambiguity about their position or responsibility, when employees should go through too many inappropriate procedures, and even when employees feel doubtful about their career, they will lose confidence in the current tasks or they even feel contradictory to the tasks, they will have the feeling that whatever they do cannot change the situation. Therefore, when they are working with such contradictory mood, they will not try to push themselves hard to fulfill the tasks as they have had the thought that whatever they do will be in vain and their job engagement will be low, at least on the emotional level. However, constrained by company’s rules and regulations, organizational interrelationship and their sense of responsibility, the employees will rarely disengage themselves to the tasks fully. They just disengage in the tasks partially and do their tasks just as routines, which mean that they have to do. Once they lose the enthusiasm for the work, they will not pay attention to the detail and they won’t devote themselves to the tasks and they won’t be creative in their job actively. Similarly, it is suggested in hypothesis 1, the low engagement or even disengagement will consequently lead to low performance. From the analysis above, we can see that with the help of organizational rules and regulations, disengagement is not fully influenced by hindrance stress, thus the following hypothesis is put forward:

**H4b** Job engagement partially mediates the relationship between hindrance stress and job performance.

Overall, Fig. 105.2 is the proposed model of this study.

**Fig. 105.2** The proposed model



## **105.4 Discussion**

### ***105.4.1 Contributions***

Theoretically, this research expands Kahn's theory on job engagement through measuring the extent that job engagement influence job performance. Meanwhile it verifies previous theory of job engagement-job performance (Lepine et al. 2010), in which they claimed the more engaged the employees are, the higher performance they will possess. What's more, we apply Kahn's three dimensions of job engagement to explain the functional mechanisms of job engagement's antecedent aspect (stresses to job engagement) and the effective aspect (job engagement to job performance). Finally, we classify stress into challenge stress and hindrance stress to study their different influences on job engagement and job performance. This is a breakthrough of research in this field, because research that comprehensively studying stress, job engagement and job performance is rare, not to mention the research that put the three concepts into together as well as classified stress into challenge stress and hindrance stress.

Practically, our findings of the positive relationship between job engagement and job performance gives managers suggestions to emphasis the function of employees' job engagement on job performance. In addition, the mechanism from challenge stress to job engagement give theoretical guidance to managers to improve employees' job engagement through setting tasks on different degree and finally achieve high job performance.

### ***105.4.2 Deficiency and Implications***

This research has just classified stress into challenge stress and hindrance stress and respectively studied their different influences on job engagement and job performance, but in fact an employee can face challenge stress as well as hindrance stress at the same minute because the job environment incurrent is quite complicated one cannot just experience one kind of stress at a time. So if an employee experiencing both challenge stress and hindrance stress in the meanwhile, how will he or she behave, and what will be the result, can challenge stress overcome hindrance or otherwise? Research that gives them different weights to study their simultaneous effects on job engagements and job performance should be called. That is to say, researches to study the relatively different intensity of challenge to hindrance stress on job engagement and job performance is worth conducting. Another deficiency is this research has applied physical engagement, cognitive engagement and emotional engagement as the three dimensions of job engagement, but has not further studied whether and how each of them plays mediating effects to the stresses and job performance. This is also worth studying for the future research.

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# Chapter 106

## Under the Macro-Control of the Relationship Between Supply and Demand in the Residential Market Study: In the Case of Xi'an

Yan-wei Zhang and Jian-ping Yang

**Abstract** Policy control and financial control work along both lines, control effect is distinct, the real estate industry faces structural adjustment. In this paper, using the principal component method analyze the supply and demand structure of residential market in Xi'an, and further using the housing price to income ratio and housing vacancy rate analyze the housing market bubble degree in Xi'an. The results show that, Xi'an residential market is demand pull type expansion structure, the contradiction of supply and demand is the root of its price fluctuation, there is no bubble threat in Xi'an housing market, meanwhile, it points out clear direction for the further implementation of macro-control policies. So effectively curbing the speculative demand and guiding effective demand at the same time is the key.

**Keywords** Macro-control policies · Principal component analysis · Residential real estate · Supply and demand coordination degree · Tourism real estate

### 106.1 Overview of Residential Real Estate

From the literal meaning, real estate combined property and land property. However, strictly speaking, real estate is the appurtenances general of the land and its fixtures on the land which include buildings, structures, and so on (Meng 2009).

The residential market is an important part of the real estate market. The residential market from the narrow sense refers to the place of activities for

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residence sale and purchase, lease, mortgage, pawn transactions, in a broad sense refers to the sum of the relations of the whole community of residential transactions, including the residential market players, the object, price, capital operational mechanism, which is the basis of the domestic economic operation, is the inevitable product of the domestic economy into the market economy orbit (Zheng 2007). In this paper, real estate market is divided in accordance with Liu (2004). The residential market is made up of three parts which are the transfer of residential land, the residential incremental market and the residential stock market, commercial housing and economic applicable housing is a major component of the incremental residential. This paper research scope is residential incremental market.

## 106.2 Under the Macro-Control of Xi'an Residential Market Analysis

### 106.2.1 Xi'an Residential Market Situation

In recent years, along with China's housing system reform, the enormous size of the excess liquidity, the sustained and rapid economic growth and the acceleration of the urbanization process, China's real estate industry has shown the overall trend of rapid development and become a new economic growth point and consumption hot spots, real mission was born in great quantities, overseas hot money was flocked, the market speculation was rampant, the growth rate of investment in real estate was too rapid, prices rose too high, and so on.

It can be seen from the Table 106.1, the housing market supply and demand structure in Xi'an do not match, there is a serious imbalance, especially affordable housing market supply fluctuations. The analysis of different income groups purchase consumer status found that the indemnificatory housing and commercial housing supply ratio is that low-rent housing is 17 %, affordable housing is 24 %, commercial housing is 59 % by adapting to the Xi'an economic development and housing needs (Shang 2008). Therefore, affordable housing supply is not worth badly in Xi'an. At the beginning of 2003, the pace of housing construction began

**Table 106.1** Residential and affordable housing area index

	2002	2004	2006	2008	2010
Residential construction area growth rate (%)	7.67	6.39	8.1	-2.37	-9.05
Residential area Sales growth rate (%)	23.33	21.55	22.6	-8.58	26.71
Affordable housing completion area growth rate (%)	9.1	-53.25	110.04	13.22	-65.04
The completed affordable housing area/residential area (%)	49.13	16.52	10.06	5.97	9.55

to accelerate, housing development and sales rallied on the news since 2005. After a heavy blow of the international financial crisis in 2008, the state had adopted a number of bailout policies, so that the speculative demand was born in great quantities, and Xi'an residential market gradually went into a strong upward cycle. Along with the policy control throughout 2010, Xi'an property sales showed the state of placid, commodity housing area sales of 15.8781 million square meters was 26.42 % higher than that of the same period last year, residence area sales of 15.2324 million square meters was 26.71 % higher than that of the same period last year.

After the Eight New National policy by the end of January 2011, "limit" policy was introduced, real estate prices were marked, the people's bank of China raised interest rates three times, and the deposit reserve ratio has been raised six times. The policy control of the property markets continued to escalate, the financial markets also continued to close tight, the conventional housing market trades gradually bleak. This series of draconian controls had effectively limited the unreasoning and gambling investment, resulting in the housing market is becoming more and more strong wait-and-see atmosphere of Xi'an. The trade volume of commodity housing area of Xi'an are 10,922,300 m<sup>2</sup> in 2011, compared to the same period in 2010 fell 23.55 %, among which the ordinary housing area are 9,137,500 m<sup>2</sup>, compared to the same period in 2010 28.11 % decline in the same period. Since 2012, the ups and downs of Xi'an residential market, many developers took various promotions and preferential activities to stimulate consumers, in addition, the first suite loan has been basically achieved the benchmark rate, credit environment, housing provident fund loans to the relatively loose and other factors to a certain extent to attract the rigid demands of consumers into the market. But in the macro-control policy under the condition of not changing, Xi'an housing market development in 2012 will be more complicated than in 2011.<sup>1</sup>

### ***106.2.2 The Real Estate Industry is Faced with the Adjustment of Industrial Structure***

Since 2010, with the strong pressure of the national harsh New Deal on the high prices, on the one hand, tourism real estate, culture real estate and pension real estate has become the darling of the eyes of investors. Particularly the tourism real estate, whose main function is tourism, vacation, leisure and entertainment, by virtue of its policy orientation and the scarcity of resource advantages favored by investors, it has become a remarkable new favorite market.

Xi'an as a historical and cultural city, its natural landscape is rich and well-known for all over the world, the tourism industry has become one of the pillar

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<sup>1</sup> <http://www.800j.com.cn/topics/2011spf2/> 2011 Xi'an real estate market report, *Xi'an real estate information network*, January 11, 2012 (chinese).

industries of the five. After February 25, 2011, Xi'an limited to the purchase order, the introduction of tourism real estate projects which rely on tourism resources in Xi'an followed. There is no doubt that, the New Deal for Xi'an and other cities opened up a new world in tourism real estate, which can be described as the development of an unrivaled opportunity at the right time. Needless to say, even in the absence of the real estate New Deal, the prosperity of tourism real estate in Xi'an will also be an unstoppable trend and fashion. On the other hand, affordable housing construction is further fulfilled and accelerated, relevant government departments vigorously implement the "Twelfth Five-Year development Plan" for the indemnificatory housing, the affordable housing and capped-price housing has also become one of the main force control policies, both the affordable housing and the capped-price housing come in a throng.

Under the background of the draconian control policies and the inflation, the real estate industry is confronted with the adjustment of industrial structure. The real estate industry structure ratio will transform from the domination of the residential real estate in the world into the commercial real estate as its core with a collection of the industry chain. Along with the policy changes in recent years, the real estate business financing costs, transaction costs and holding costs have increased gradually, and the residential real estate investment function has been disappeared step by step, thus residential estate will be gradually transformed into a product against inflation. Along with the Chinese enterprises in the industrial restructuring, consumer consumptive habits transformation, the reform of financial system and the adjustment of industrial structure, China's commercial real estate development model will be changed from simple property rental into commercial estate as the core with the integration of the industry chain and capital chain.

### **106.3 Xi'an Residential Market Supply and Demand Analysis**

The real estate supply and demand coordination degree of Shenyang was analyzed by applying the principal component method in 2008, the result was basically consistent with the actual situation, which proved that the principal component method for analysis of the real estate market supply and demand is effective (Liu et al. 2008). China's real estate supply and demand coordination degree was also analyzed by using the principal component analysis method, it also proved that the application of the principal component method in the real estate market supply and demand is effective (Wang 2011). The article draws lessons from the choice criterion of Shenyang and Zhengzhou real estate warning index system, and combined with the development of the Xi'an residential market. I have selected 5 indices which can synthetically reflect the residential market supply and demand coordination: residential area sales/the completed residential area  $X_1$ ; residential pre-sale area/residential area sales  $X_2$ ; residential vacancy/the completed

residential area in the first 3 years  $X_3$ ; residential average price growth rate/urban per capita disposable income growth  $X_4$ ; housing lease price index/residential sales price index  $X_5$ .

1. The principal component analysis method is a multivariate statistical method aims to use the idea of dimension reduction, by researching the inner structure relation of the index system, to transform a lot of indices into a few independent indices which are comprehensive indices contain most information of the original index (80–85 %).

(a) The basic model. There have  $m$  indicators, each indicator observed values for  $n$ , the establishment of the principal component analysis model is as follows:

$$\begin{cases} Z_1 = a_{11}X_1 + a_{21}X_2 + \cdots + a_{n1}X_n \\ Z_2 = a_{12}X_1 + a_{22}X_2 + \cdots + a_{n2}X_n \\ \vdots \\ Z_m = a_{1m}X_1 + a_{2m}X_2 + \cdots + a_{nm}X_n \end{cases} \quad (106.1)$$

in which,  $a_{1i}, a_{2i}, \dots, a_{ni}$  ( $i = 1, 2, \dots, m$ ) is the covariance matrix of eigenvalue of eigenvector of  $X$ ,  $X_1, X_2, \dots, X_n$  is the standardized variable of  $X$ .  $a = (a_{ij})_{m \times n} = (a_1, a_2, \dots, a_m)$ ,  $R_{ai} = \lambda_i a_i$ ,  $R$  is the correlation coefficient matrix,  $\lambda_i$  is the corresponding eigenvalue,  $a_i$  is the unit orthogonal vector, and  $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_n \geq 0$ .

(b) Supply and demand coordination degree of warning

At present our country warning practice the most common warning criterion based on statistical principles in determining, based on the existing experience to judge the severity of harmonious supply and demand to determine the warning area, establishing prices dose model, taking  $3\sigma$  control principle as warning criterion, based on Beijing 1995–2005 years real estate quarterly data differentiate the warning condition, further apply the relevant prediction technology to warn and forecast (Hu et al. 2006). In order to improve the shortcomings of the  $3\sigma$  principle's index mean estimator bias which lead to the low warning effectiveness, using the east of a large city housing completion area index to analyze the improvement ideas which eliminates the alarm interval discrimination and people discriminating knowledge conflict, and raise the alarm discriminant validity.

2. The evaluation process

(a) According to the selected indicators, Xi'an residential market supply and demand coordination relations evaluation system is established, the statistical index and the original data is as shown in Table 106.2.

(b) Using SPSS20.0 software for data standardization processing and principal component analysis calculate Xi'an residential market supply and demand coordination relationship index  $K$ .

(c) Determine the supply and demand coordination relations index range.

**Table 106.2** Esidential market supply and demand to coordinate the relationship between indicators

Particular year	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$
2002	0.8165	0.2351	0.0482	0.5234	0.9813
2003	0.7953	0.2133	0.0609	0.0239	0.9598
2004	0.9086	0.5684	0.0857	3.1645	0.9896
2005	1.5051	0.6027	0.1117	2.3874	0.9781
2006	1.7070	0.6987	0.0940	-0.5556	0.9865
2007	1.8532	0.5844	0.0399	0.2881	0.9916
2008	1.7353	0.7561	0.0327	0.8381	0.9908
2009	2.6508	0.9110	0.0244	-0.0084	1.0220
2010	3.6933	0.9534	0.0204	0.9125	0.9415

**Table 106.3** Xi'an residential market supply and demand coordination index early-warning interval

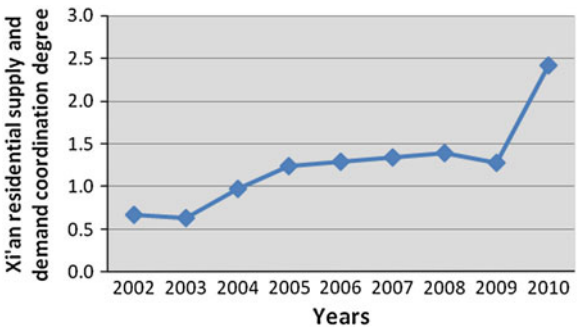
	Abnormal	Basically normal	Normal operation	Basically normal	Abnormal
$K'$	<0.204	0.204–0.727	0.727–1.773	1.773–2.296	>2.296

There can obtain the mean E of statistical data is 1.250, and standard deviation  $\sigma$  of statistical data is 0.523 by calculating. According to  $3\sigma$  principle, there can calculate Xi'an residential market supply and demand coordination degree index warning interval, as shown in Table 106.3:

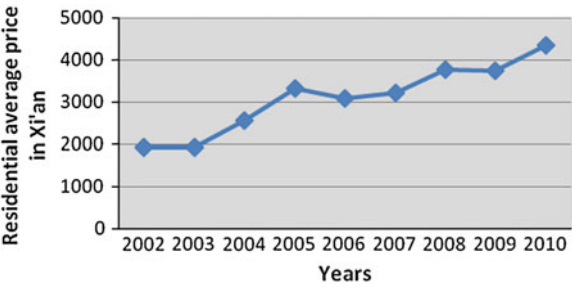
As you can see from Fig. 106.1, supply and demand coordination degree index declined except for 2003 and 2008, Xi'an residential market supply and demand coordination index showed a decreasing upward trend from 2004 to 2007, and has been in a state of supply, especially since 2009 supply and demand market warms up continuously, 2010 supply and demand coordination index rises substantially condition, and enter abnormal operation interval.

It can be seen from Fig. 106.2, except for 2005 and 2008 housing prices rose steadily, and it perfectly coincides with supply and demand coordination degree

**Fig. 106.1** Xi'an residential market supply and demand coordination index early-warning interval



**Fig. 106.2** Xi'an residential market average price



index. According to the common sense of economics, inadequacy of gross of supply, demand will drive prices to rise, Xi'an housing market overall situation is demand pull type expansion structure in recent years, contradiction of supply and demand is the root of the Xi'an residential prices rising.

According to the international practice, the prevailing view that, housing price to income ratio is 3–6 times as a reasonable interval (Case and Shiller 2003), but because of the special housing system and the demand for long-term depression and other reasons, some scholars of our country think that the house price to income ratio in 5–8 times belong to normal, and the housing vacancy rate in 3–10 % as a reasonable interval. From Table 106.4 we can see, after 2006, with the accelerated process of urbanization, the improvement of income, the speculative demand having more and more market, and the policy adjustment, both housing price to income ratio and the housing vacancy rate fall very sharply, especially in 2009 and 2010, the residential vacancy rate is less than 3 %, which indicates that the market supply is insufficient for residents to choose, So there should increase the supply of housing. Therefore, there is no bubble threat in the current housing market in Xi'an.

**Table 106.4** Xi'an residential market supply and demand coordination index early-warning interval

	2007	2008	2009	2010
Residential average price (¥/m <sup>2</sup> )	3,215	3,757	3,749	4,341
Average household price (¥)	257,236	300,566	299,941	347,295
The average number of residents in cities and towns (person)	2.91	2.82	2.84	2.81
The urban per capita Disposable income (¥)	12,662	15,207	18,963	22,244
Household disposable income (¥)	36,846	42,884	53,855	62,506
Housing price to income ratio	6.98	7.01	5.57	5.56
Vacant housing area (m <sup>2</sup> )	39	35	29	26
The accumulative completed housing area in 3 years (m <sup>2</sup> )	967	1081	1,177	1,288
Housing vacancy rate (%)	3.99	3.27	2.44	2.04

## **106.4 Conclusions and Policy Suggests**

Under the strict macro-control background, curbing the speculative demand and guiding the effective demand at the same time is the only key. Eventually, the housing market's healthy development should rely on market adjustment and hierarchical solution.

### ***106.4.1 Focus on the Market Regulation, Meanwhile Deepen Policy Regulation***

Under the market economic system, the residential real estate, like other commodity markets, run under the interaction of the supply and demand mechanism, price mechanism and competition mechanism, but because of the particularity and complexity of the relationship between supply and demand, the supply and demand balance of the residential market is a long and difficult task under normal circumstances. So there should give priority to market adjustment tone, meanwhile continue to use the visible hand to make up for market failure, to correct market irregularities, by the comprehensive use of economic, legal and necessary administrative means to achieve the equilibrium of supply and demand (Ding and Chen 2010). There should strengthen the macro-control policies, the banking and credit system, and actively and effectively play the regulatory role of the property tax, to deepen the policy of regulation, in order to curb the speculative demand and guide the effective demand, prompting prices return to reasonable.

### ***106.4.2 Strengthen the Supervision of Affordable Housing Construction, To Establish a Multilevel Housing Security System***

There should strengthen the government oversight and enforcement, meanwhile improve the laws and regulations for indemnificatory housing. There should accelerate the implementation of the "Twelfth Five-Year Plan" of the indemnificatory housing industry, further enhance the construction of the affordable housing, capped-price housing, public rental housing, low-rent housing as well as the shed housing vigorously. To steadily solve the urban medium-income and low-income residents, city employees (mainly college graduates newly participate in the work) as well as the migrant workers' housing problem in the final. All of this is in order to establish indemnificatory housing supply system step by step, which is based on protection of basic needs and guidance of rational consumption, which is the government mainly to provide basic protection and the market mainly to meet the multi-level needs.

### ***106.4.3 Coordinate at All Levels of Real Estate Markets, Further Balance Supply and Demand***

There should establish the land market monitoring and evaluation system and perfect the land market supervision mechanism. There should improve the differentiation of the land supply policy and increase information disclosure to ensure the land transaction is fair and moderate amount, further stabilize market expectations. There should coordinate the development of secondary real estate market, guide the real estate developers to invest and the buyers consume rationally, and improve the real estate market information system to make the information transparent, in order to avoid blind investment and consumption. There should promote the reform of state-owned real estate enterprises, improve enterprise and personal credit file and evaluation system, to guide the healthy development of the real estate market. We know that China's large population, poor little rich, so less affordable housing in solving the housing problems of lower-middle class is just a drop in the bucket, it's necessary to promote reasonable housing concept vigorously, encourage low-income and middle-income segments to purchase second-hand housing and rental, and guide the second-hand housing market and the residential rental market actively, which play the linkage effects of the real estate markets at all levels to promote the equilibrium of supply and demand (Deng and Chen 2007).

### ***106.4.4 Conform to the Tourism Industry, to Accelerate the Sustainable Development of Tourism Real Estate***

Tourism real estate as the tourism industry and the real estate industry merge into a new industry, in some sense, it is a kind of culture as the soul of the industrial distillation. A good tourism real estate projects should take the culture as the soul, and not simply rely on the tourism resources to create, so developers should combine their own strength, cannot be blindly with residential development ideas on the development of tourism real estate, and erect the reasonable development concept. Firstly, residential real estate should be transformed from low-end to high-end, from a single housing estate to the diversification of the tourism real estate, from one-time development to sustainable development, and increase the diversification of the tourist hotels, vigorously develop the service industry, and then strengthen the real estate industry; secondly, whereby the quality of tourism industry to promote the development of the real estate market, which will be the long-term way of Xi'an development. So there should establish the orderly development of high-end tourism real estate goals, adhere to high standard, high-quality and high-end development principles, to construct a diversified tourism real estate supply system which includes high-star Hotel, the hotel property, high-end leisure residence, and so on (Liu and Hu 2011).

### ***106.4.5 Promote Structural Adjustment of Real Estate Industry, Gradually Promote the Industrialization of Residential***

There should deepen the policy control, promote the structural adjustment of the real estate industry, and establish a diversified real estate product supply system which take commodity housing as a basic, affordable housing as a protection, travel health real estate as a characteristic. Gradually form the housing supply system which has the protection in the low-end, has the support in the medium-end, has the market in the high-end, and has the reputation in the characteristics. There should gradually promote the residential industrialization. First, there should develop a variety of residential standards, and narrow the gap between the standard; Second, there should focus on building energy efficiency, and reduce the construction cost; Third, there should adapt to the needs of the residents, and strengthen the demonstration and driving effect of the government; Fourth, there should take the concept of green and sustainable development(Rocky Mountain Institute 1998), healthy and comfortable living environment as the prerequisite to accelerate the process of housing industrialization.

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# Chapter 107

## Research on Employment Ability Evaluation of Graduates

Xiao-nan Ma and Ye Sun

**Abstract** Through interviewing and questionnaire surveying, this article has determined the constitution of 6 dimensions and 24 concrete abilities from the employer's view which decide graduates' employment ability. Empirical analysis shows that employers' evaluation score on employment ability of graduates is 3 or less, comprehensive satisfaction is not high. Professional ability was the strongest, while practical ability was the weakest. The development of 24 concrete abilities is imbalanced. The single sample T test result indicates that 16 abilities reached generally satisfied level, 5 of them are obviously higher than generally satisfied level, and 3 of them are apparently lower than it.

**Keywords** Graduate · Employment ability · Evaluation target system · T test

### 107.1 Introduction

At the ends of 20th century, with the invention of higher education moving towards the popularity from outstanding education, the recruitment scale of university and college expands rapidly. The graduation increases suddenly from 1,140,000 students in 2001 to 6,310,000 students in 2010. The yearly average growth rate reaches to 18 %. At the same time, under the influence of technical progress and of the global economic slowdown, domestic job position increases slowly. Labor market has a typical "buyer's market" feature, and employment positions for graduates are becoming scarce resource. Under this background,

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employment ability of graduates is not only related to their successful employment and quality of employment, but also to the sustainable development of higher education. This article through empirical research on employment ability of college students, on the one hand help the university understand social evaluation about employment ability of graduates and provide reference for reforming the present personnel training mode and improving the quality of talents; on the other hand make the students understand the employer requirements of employability, make clear learning objectives, and strive to improve their comprehensive ability and enhance employability.

## 107.2 Literature Review

Under the background of popularization of higher education, employment problem of college students has become social hot topic. Employment ability of college students has also become a unique area. The domestic and foreign scholars discussed the structure of employment ability of college students deeply according to its connotation. The training and development association of United States (ASTD 1990) had classified employment ability from five categories: basic competences, communication skills, ability to adapt, ability to group results, ability to influence other behavior (ASTD 1990). United Kingdom higher education quality council (1991) thought that graduates should possess skills of critical thinking, ability of dealing with complex issues, effective communication, working independently, teamwork coordinate and self-constraint (Berdahl et al. 1991). Block (2003) put forward careers and employability from the perspective of education and enterprise, which includes ten items : the application ability of expertise, career planning, development and expression of information capacity, ability to problem-solving skills, personal management skills, organizational skills, team work, negotiation capacities, ability to understand, apply the above employment capacity of the system (Block 2003). Sweden scholar, Gorder Smith pointed out that college students need to have the employment motivation and good individual quality, excellent interpersonal skills, wealth of scientific knowledge, effective work methods and broad perspective (Gorder Smith 1996). The authority of employment ability in the United Kingdom Yorke and Knight (2004) presented the famous USEM model, namely understanding disciplinary knowledge, expertise skill, self-efficacy and meta-cognition (Yorke and Knight 2004). Domestic scholar Zheng (2002) believed that employment ability of college students' ability included learning ability, thinking ability, practical ability, candidates' ability and adaptability. Wang (2005) pointed out that employment ability was constructed by management of basic skills, individual skills and team work skills (Wang 2005). Xiao et al. (2007) stated that the most three important factors which influence the employment ability were: basic practical ability, knowledge development ability and innovation ability (Xiao et al. 2007). Li et al. (2010) thought that employment ability structure should be established from 4 dimensions: basic skills, professional

skills, personal characteristics, social adaptability (Li et al. 2010). Zhang, Li, Yan put forward different employment ability structure according to their empirical researches (Zhu 2009).

Looking at the documents from domestic and foreign countries, research on employment ability of college students has not yet established a theory system. There are large differences on understanding components of employability and many problems need further discussed. Based on the literature, this article tries to construct a set of employment ability system of college students from the employers' perspective and survey the employer's evaluation of employment ability of college students to help high education institutions to find problems in education and strengthen the cultivation of employment ability.

### **107.3 Evaluation of Employment Ability of Graduates**

#### ***107.3.1 Construction of Evaluation Target System***

##### *Initial evaluation item decision*

Employment ability is a kind of comprehensive ability for college students to gain and maintain job and adapt of environment change during their work period. In order to understand the employer evaluation of employment ability of college students, we need to determine the evaluation target system. This study first chooses 20 employers to interview around the topic: "what kind of abilities college students should own to guarantee them to find job smoothly and keep work opportunity over a longer period". Among 20 employers, there are 2 government departments, 5 institutions, 13 enterprises in which there are 5 State-owned enterprises and 8 private enterprises. The interview object is supervisor or administration of human resources departments. According to the interview results, initially set out six dimensions such as basic quality, professional ability, practical ability, communication and coordination ability, ability to adapt to circumstances, ability to application for job. 26 specific qualities and abilities are chosen to reflect the upper six dimensions, namely sense of responsibility, integrity, dedication, hard working, down-to-earth, professional level of theory, research, innovation, learning ability, practical skills, problem solving, executive skills, team collaboration skills, listening skills, presentation skills, reading comprehension, official document writing skills, public relation skills, self adjustment ability, anti pressure ability, anti frustration ability, adaptability, capture information ability, planning ability, self promotion ability, career planning ability.

##### *Evaluation item filtering*

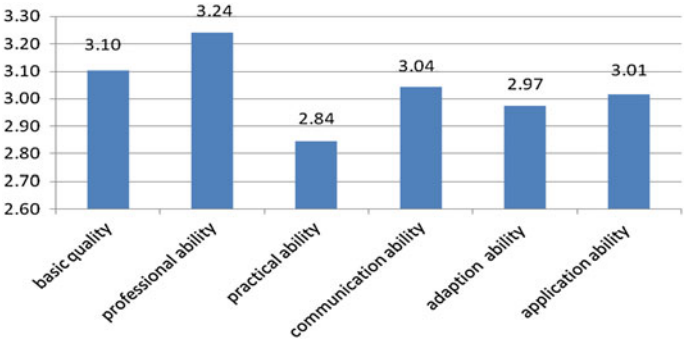
Original questionnaire is made according to the above 24 targets. Questions are randomly arranged with Likert five component table scorecard, which divides each item into 5 grades: very important, important, general important, unimportant, very unimportant, and charge 5, 4, 3, 2, 1 score respectively. Then let participants grade each target according to its importance they think. We hand out 50 questionnaires

to employers and recovery rate is 100 %. To make the questionnaire more validity, evaluates average scores on various topics first. Survey shows that except capturing information ability is less than 3 score, score of other abilities is at around 4. So we delete capture information item. Second, calculate the objectives discrimination. This study refers to Zhu Hui’s research method. Rank according to total score of each item, taking out the 25 % highest score and 25% lowest score, calculating the average score of these two parts. Average difference is the discrimination coefficient of this item. The larger the absolute value of the coefficient is, the higher the discrimination is. So it illustrates that we can retain the item. Results of the analysis show that, except planning ability, discrimination coefficient of other items is higher than 0.45, so delete planning ability item. After filtering, questionnaire reserves 24 items.

According to the previous analysis, evaluation index system of college students’ employment ability consists of six dimensions and 24 concrete indicators. Sorting out the questionnaires, we can get the importance score of each indicator made by employers which are shown in Table 107.1.

**Table 107.1** Structure of employment ability and the importance score made by employers

The first level target		The second level target	
Name of target	Importance score	Name of target	Importance score
Basic quality	4.4	Sense of responsibility	4.8
		Integrity	4.6
		Dedication	4.5
		Hard working	3.9
		Down to earth	4.1
Professional ability	3.8	Professional level of theory	3.8
		Research ability	3.5
		Innovation ability	4.0
		Learning ability	4.0
Practical ability	4.2	Practical ability	4.5
		Problem solving ability	4.1
		Executive ability	4.0
		Collaboration ability	4.3
Communication ability	4.1	Listening ability	3.8
		Presentation ability	4.1
		Comprehension ability	4.2
		Official document writing ability	4.0
		Public relation ability	4.2
		Self adjustment ability	3.8
Adaption to circumstance ability	3.9	Anti pressure ability	3.9
		Anti frustration ability	3.6
		Adaptability	4.2
Application ability	3.6	Self promotion ability	3.8
		Career planning ability	3.4



**Fig. 107.1** Score of six dimensions of employment ability

**107.3.2 Employment Ability Evaluation**

According to the above analysis, we made a questionnaire about evaluation system on employment ability of college students and issued to the employers. Still taking Likert five component scoring method, 5, 4, 3, 2 and 1 respectively represents very satisfied, satisfied, generally satisfied, dissatisfied, very dissatisfied. We handed out 130 questionnaires totally and recovered 111. Recovery rate was 85.4 %.Survey result is shown as Fig. 107.1.

Table 107.2 is a single sample t test results of the various specific targets. Taking 3 points for the test value, establishing significance level as 0.05, we can find that the two-tailed probability p-value of sense of responsibility, integrity, professional level, learning ability, professional ability, teamwork ability, expression ability and adaptability is less than 0.05, which disclose that there exists significant difference between the evaluation results of employer and score 3. So we should refuse zero assumption and draw the following conclusion: college students’ professional ability, teamwork ability and adaptability is less than generally satisfied level, while sense of responsibility, integrity, professional level, learning ability, expression ability is higher than generally satisfied level. P value of other 16 indexes are greater than significance level, which shows employers’ assessment of these targets only reach to generally satisfied level.

**Table 107.2** Single sample T test

Test value = 3						
t	df	Sig. (2-tailed)	Mean difference	95 % confidence interval of the difference		
				Lower	Upper	
VAR00001	2.746	110	0.007	0.3243243	0.090261	0.558387
VAR00002	2.088	110	0.039	0.2072072	0.010551	0.403864
VAR00003	−0.939	110	0.350	−0.0990991	−0.308183	0.109984
VAR00004	0.000	110	1.000	0.0000000	−0.253635	0.253635
VAR00005	0.635	110	0.527	0.0720721	−0.152952	0.297096
VAR00006	4.474	110	0.000	0.4954955	0.276026	0.714965
VAR00007	0.545	110	0.587	0.0720721	−0.189936	0.334081
VAR00008	0.069	110	0.945	0.0090090	−0.251502	0.269520
VAR00009	3.949	110	0.000	0.3783784	0.188484	0.568273
VAR00010	−2.259	110	0.026	−0.2882883	−0.541145	−0.035431
VAR00011	−0.985	110	0.327	−0.1261261	−0.379910	0.127657
VAR00012	−2.755	110	0.007	−0.3153153	−0.542148	−0.088483
VAR00013	−1.205	110	0.231	−0.1621622	−0.428830	0.104505
VAR00014	0.329	110	0.743	0.0450450	−0.226223	0.316313
VAR00015	3.441	110	0.001	0.3513514	0.149001	0.553702
VAR00016	−0.502	110	0.617	−0.0630631	−0.311935	0.185809
VAR00017	−1.239	110	0.218	−0.1621622	−0.421492	0.097167
VAR00018	0.835	110	0.406	0.1081081	−0.148492	0.364708
VAR00019	−0.196	110	0.845	−0.0270270	−0.300741	0.246687
VAR00020	0.676	110	0.501	0.0900901	−0.174165	0.354345
VAR00021	0.843	110	0.401	0.1081081	−0.145972	0.362188
VAR00022	−2.351	110	0.021	−0.2792793	−0.514725	−0.043834
VAR00023	−0.797	110	0.427	−0.1081081	−0.376951	0.160735
VAR00024	0.909	110	0.365	0.1081081	−0.127583	0.343800

107.4 Conclusion

Firstly, from the view of employers, the employment ability of graduates includes six dimensions, namely basic quality, professional ability, practical ability, communication ability, adaptability and application ability. 24 specific targets are selected to explain these six dimensions.

Secondly, employers’ evaluation on employment ability of graduates is generally low. The average evaluation score of each dimension is below 4, which indicates that employers’ satisfaction about employment ability is not high, particularly practical ability has significant difference relative to employers’ expect.

Thirdly, the specific ability develops imbalanced. Sense of responsibility, integrity, professional ability, learning ability, communication ability is significant higher than generally satisfied level, while professional ability, teamwork ability and adaptability is relatively poor.

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# Chapter 108

## An Empirical Study of the Influence Factors of Infrastructure Investment on Promoting Private Investment: Based on the Empirical Data of Jiangsu Province from 1990 to 2011

Guo-qing Han and Hui Wang

**Abstract** The paper analyzes the influence factors of infrastructure service on promoting private investment by the method of factor analysis on the data from 1990 to 2011 of Jiangsu Province. The result finds that the main infrastructure factors on promoting private investment are per capita road area, total electricity consumption, telephone penetration, sewage treatment capacity, comprehensive utilization of industrial solid waste. The level of infrastructure service on promoting private investment from 2003 to 2011 is higher than that of the period of 1990–2002 as cluster analysis. In the end, the paper offers some policy recommendations.

**Keywords** Infrastructure service • Private investment • Factor analysis • Impact factors

### 108.1 Introduction

Infrastructure service provides a large quantity of basic service for citizens, such as roads, railways, ports, bridges, airports, water, electricity, gas, posts, telecommunications and meteorological services, which are needed in production, living,

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development and recreational activities. Because of its basic role and external characteristics, the infrastructure provides necessary protection for private enterprises in normal production and it reduces the information costs and transportation costs of private enterprise. It needs a long time and huge investment to establish a perfect infrastructure system which plays an indispensable role in social development.

The total mileage of highway is 2,886 km at the end of 2005, but it is up to 4,122 km at the end of 2011 in Jiangsu Province. The highway density of Jiangsu Province is maximum in our country. The operation mileage of the railway is more than 2,100 km and the high-speed rail of Jiangsu section is full opened from Beijing to Shanghai. The improved infrastructure creates a favorable environment for private investment. The private fixed assets investment of Jiangsu Province has reached 1.71982 trillion yuan in 2011, an increase of 25 % than the last year. The proportion of private investment increases by 2.2 % points over the previous year, which has up to 65.4 % in the total social fixed assets investment. Therefore, it is important to arrange the total investment, promote private investment and stimulate economic development by investigating the specific factor of infrastructure service on promoting private investment.

Many scholars also study the infrastructure service on promoting private investment from their own perspective. Belloc, de Jong et al. (2010), Zhang (2001), Li (2002), Yang Rong and other scholars believe that the investment of positive fiscal policy is the main focus in the field of the highways, railways and airports. These investments improve the macro environment of private enterprises and promote private investment. Yet some other scholars do not consent to this point, such as Atukeren (2005), González and Pazó (2008), Dai (1999), Liu (2000), Tian Jietang. They believe that the total wealth of the society is limited, the government invests heavily in infrastructure service, so the private investment will be forced to extrusion. Most scholars study the impact of the infrastructure service on promoting private investment on the whole, but the infrastructure is not subdivided. Therefore, this paper analyzes the influencing factors of infrastructure service on promoting private investment.

## 108.2 The Selection of Factor Index

According to the existing research results of domestic scholars, the study, taking into account the practical situation of Jiangsu Province, selects 15 factors on the basis of the scientific, systematic, comparable and available principles. These factors are selected from five areas of transport, energy supply, water and electricity supply, telecommunications, environmental protection. Thus, we can

**Table 108.1** Influence factors of the infrastructure service promoting private investment index system

Target layer	Layer guide lines	Index layer	Symbol
Influence factors of the infrastructure service on promoting private investment evaluation system	transport	Public transport vehicles of every ten thousand people (unit)	X <sub>1</sub>
		Per capita road area (square meters)	X <sub>2</sub>
		Passenger traffic (million)	X <sub>3</sub>
		Transport of goods (10,000 t)	X <sub>4</sub>
	Energy supply	Consumption of raw coal (t)	X <sub>5</sub>
		Total consumption of electricity (million kwh)	X <sub>6</sub>
	Water and electricity supply	Production capacity (million cubic meters every day)	X <sub>7</sub>
		Consumption of saving water (million cubic meters)	X <sub>8</sub>
		Sewage treatment capacity everyday (million tons)	X <sub>9</sub>
		Compliance rate of wastewater discharge (%)	X <sub>10</sub>
	Telecommunications	Telephone penetration rate (the number of every 1,000 people)	X <sub>11</sub>
		The total length of post (km)	X <sub>12</sub>
	Environmental protection	Green coverage (%)	X <sub>13</sub>
		Comprehensive utilization rate of Industrial solid waste (%)	X <sub>14</sub>
		Comprehensive utilization amount of Industrial solid waste (10,000 t)	X <sub>15</sub>

establish evaluation system of infrastructure service index. Using factor analysis, we can analyze the factor of infrastructure service on promoting private investment and filter out the driving factor (Table 108.1).

## 108.3 Empirical Analysis

### 108.3.1 Data Collection

In order to seek the factors of promoting private investment, the paper selects 15 indicators of the infrastructure and analyzes the data of Jiangsu Province from 1990 to 2011 and provides the basis for cluster analysis.

### 108.3.2 Factor Analysis

Using the method of factor analysis model, the paper can determine the parameters of the model and explain the factors on the basis of the results. In order to eliminate the influence of the dimension, the data is standardized by SPSS software, and then we can get the factor rotation. The general model of the factor analysis is as follows:

$$\begin{cases} X_1 = a_{11}F_1 + a_{12}F_2 + \dots + a_{1n}F_n + \xi_1 \\ X_2 = a_{21}F_1 + a_{22}F_2 + \dots + a_{2n}F_n + \xi_2 \\ \dots \\ X_m = a_{m1}F_1 + a_{m2}F_2 + \dots + a_{mn}F_n + \xi_m \end{cases} \quad (108.1)$$

Among the model,  $x_1, x_2, \dots, x_m$  are measured variable,  $a_{ij}$  ( $i = 1, 2, \dots, m; j = 1, 2, \dots, n$ ) is factor loadings;  $F_i$  ( $i = 1, 2, \dots, m$ ) is common factor,  $\xi_i$  ( $i = 1, 2, \dots, m$ ) is special factors. According to the standard of eigenvalue greater than one, the paper selects a factor  $F_1$  ( $\lambda_1 = 13.061$ ). The cumulative variance contribution rate is up to 87.073 %. Therefore, we believe that the common factor is able to explain most of the original data information with good representation (Table 108.2).

Using the method of variance maximum orthogonal rotation (Varimax), the paper rotates the factor and we get the rotated factor loading matrix (Table 108.3).

The common factor ( $F_1$ ) has a relatively large loading in per capita road area  $X_2$  (square meters), total consumption of electricity  $X_6$  (million kwh), telephone penetration rate  $X_{11}$  (number of every 1,000 people), sewage treatment capacity everyday  $X_9$  (million tons), comprehensive utilization amount of industrial solid waste  $X_{15}$  (10,000 t). The five indicators cover transport, energy supply, water and electricity supply, telecommunications, environmental protection and so on, it reflects a lot of content of the infrastructure, so the common factor is named infrastructure factor.

**Table 108.2** Variance explained

Component	Initial eigenvalue			Extraction of square and loading		
	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %
1	13.061	87.073	87.073	13.061	87.073	87.073
2	0.503	3.355	90.427			
3	0.472	3.145	93.573			
4	0.38	2.53	96.103			
5	0.228	1.521	97.624			
6	0.14	0.931	98.555			
7	0.097	0.646	99.2			
8	0.058	0.389	99.589			
9	0.024	0.158	99.747			
10	0.015	0.099	99.846			
11	0.013	0.084	99.93			
12	0.007	0.044	99.975			
13	0.002	0.015	99.99			
14	0.001	0.008	99.999			
15	0	0.001	100			

Extraction Method: Principal Component Analysis

**Table 108.3** Rotated factor loading matrix

Variable	Composition
	1
X <sub>1</sub>	0.062
X <sub>2</sub>	0.076
X <sub>3</sub>	0.074
X <sub>4</sub>	0.073
X <sub>5</sub>	0.074
X <sub>6</sub>	0.076
X <sub>7</sub>	0.063
X <sub>8</sub>	0.069
X <sub>9</sub>	0.075
X <sub>10</sub>	0.071
X <sub>11</sub>	0.076
X <sub>12</sub>	0.068
X <sub>13</sub>	0.073
X <sub>14</sub>	0.064
X <sub>15</sub>	0.075

Extraction Method: Principal Component Analysis

We can get the factor pattern matrix by SPSS. The matrix contains the regression coefficients of the equation which can explain the original variables. The size of coefficient indicates important degree of variable to factor. The factor

score can be calculated from score coefficient and standardized value of the corresponding original variable. The functional equation is as follows:

$$F_1 = 0.062X_1 + 0.076X_2 + 0.074X_3 + 0.073X_4 + 0.074X_5 + 0.076X_6 \\ + 0.063X_7 + 0.069X_8 + 0.075X_9 + 0.071X_{10} + 0.076X_{11} + 0.068X_{12} \quad (108.2) \\ + 0.073X_{13} + 0.064X_{14} + 0.075X_{15}$$

Here we only extract a principal component from the total variance explained. Therefore, the score of overall performance is the main component score value  $F_1$ .

After calculating the score of overall performance, the highest value (1,346,316.82) appeared in 2011, the lowest value (468,795.87) appeared in 1990. From 1990 to 2011, the score of overall performance increases on a yearly basis. The infrastructure service has been greatly improved with increasing investment in infrastructure, including transport, energy supply, water supply, postal and telecommunications, environmental protection. Because of lack of investment funds at the early stages of development of private investment, the level of investment is low in urban facilities, coal, electrical and water supply, post and telecommunications, landscaping. After the infrastructure being improved, the influence is evident in infrastructure service on promoting private investment. Because of the financial crisis from 2009 to 2010, the investment has reduced greatly in state-owned enterprises. Although our government launched the four trillion investment program at the end of 2008, but it did not make an immediate effect in infrastructure construction, so the influence has weakened in infrastructure service on promoting private investment, the score of overall performance had reduced to 1,244,582.3 and 1,263,728.63 in 2009 and 2010.

### 108.3.3 Cluster Analysis

Cluster analysis is a basic principle. According to the intimacy degree of the sample (or target), the first two highest degree of intimacy classes should be combined. After considering the degree of intimacy of the combined classes with other classes, the classes will be combined again, and we should repeat it until all samples (or target) merge into one class. The system clustering method is merged according to the degree of intimacy of the samples or indicators. There are two methods in measuring the degree of intimacy, which are distance and similarity coefficient. Distance is defined that it takes each sample as a point of “ $m$ ” variables corresponding to  $m$ -dimensional space: the closer the distance is, the higher the degree of intimacy is. If the similarity coefficient is close to 1 or  $-1$ , the properties of the sample or indicators are similar. If the similarity coefficient is close to 0, there is no relation between the samples or indicators. The clustering analysis is as follows using Euclidean distance by SPSS.

$$d_{ij} = \sqrt{\sum_{t=1}^p (x_{it} - x_{jt})^2} \quad (i, j = 1, 2, \dots, n) \quad (108.3)$$

Among the formula,  $d_{ij}$  expresses Euclidean distance,  $x_{it}$  expresses t-dimensional coordinates of i point,  $x_{jt}$  expresses t-dimensional coordinates of j point, according to Euclidean distance, the sample can be divided into two classes from 1990 to 2011.

The analysis results take the period as the first class from 2003 to 2011. The infrastructure factors accounted for absolute dominant position, with the development of the economy, the traffic construction, environmental protection and communication facilities have been greatly improved, which reduce the cost of private investment. However, because of the pressure of population, resources and environment, the development of private investment is restrained, especially during the financial crisis in 2008 and 2009, when private investment reduced greatly.

The analysis results take the period as the second class from 1990 to 2002. In the early 1990s, due to the poor infrastructure, the total amount of private investment was low. Yet with the development of urban transportation, urban greening, energy supply and environmental protection, it brought private investment spillover effects. Private capital also increased year by year, but the overall level of infrastructure was low so that the influence of infrastructure service was still weak in promoting private investment.

## 108.4 Conclusions and Recommendations

Using factor analysis method, the paper analyzes the driving factors of infrastructure service on promoting private investment in Jiangsu Province, the conclusions and recommendations are as follows:

### 108.4.1 Five Indicators

The loading of the five indicators is large in per capita road area, total consumption of electricity, telephone penetration rate, sewage treatment capacity everyday, comprehensive utilization amount of industrial solid waste, which are the main infrastructure factors on promoting private investment. The result requires us to pay attention to the five infrastructure factors in the construction of infrastructure. From the view of the per capita road area and the telephone penetration rate, it needs us consider per capita infrastructure and the use of density. We should invest in the infrastructure according to the people of the regions and the usage.

### 108.4.2 Composite Score

From the view of the composite score, except individual years, the score is increasing year by year. 468,795.87 is the lowest in 1990 and 1,346,316.8 is the highest in 2011. The results indicate that with improved infrastructure, the role of infrastructure service in promoting private investment becomes important. If the transportation and communication are convenient, the energy efficiency is high and the environmental protection is perfect, the level of private investment will be enhanced at the same time. It need us continue to push forward the construction of infrastructure, and to improve the macro-environment of private investment. At the same time, the development of private investment not only depends on the infrastructure, but also depends on the economic trends and macroeconomic policies of our country. We should not, therefore, only emphasize infrastructure construction, but should also attach importance to the judgment of macroeconomic situation and the regulation of economic policies.

### 108.4.3 Cluster Analysis

The cluster analysis treats the period from 2003 to 2011 as the first class. With the development of transportation construction, network and communication facilities, environmental protection and pollution treatment in Jiangsu Province, it greatly stimulates private investment; The cluster analysis treats the period from 1990 to 2002 as the second class. Although the pace of infrastructure development is fast, but the overall level of infrastructure service is still relatively low. Because of energy shortage, traffic congestion, environmental degradation, low utilization of the “three wastes”, the degree of the second class is lower than the first class on promoting private investment. The levels of infrastructure service are different between the two *periods*, therefore the role is different in promoting private investment. We know that the construction of infrastructure service is a long-term project. It will be a long process in promoting the development of private investment. It also needs long-term vision and development perspective to promote the construction of infrastructure service, and emphasize the accumulation of the infrastructure investment, and promote the development of private investment by the positive spillover effects.

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# Chapter 109

## A Study on the Satisfaction of Training Program for S&T Talents Based on Modified IPA

Qi Zhang, Qiu-ping Wang and Yi-kai Wang

**Abstract** The satisfaction of training service for science and technology (S&T) talents ought to be carefully measured and evaluated so as to improve their training qualities. An evaluation system with 6 aspects, including training target, overall structure, theory courses, practice exercises, teaching management and employment service, is established and the modified IPA method based on the transformation from the statement importance acquired by direct investigations to the derived importance through partial correlation analysis is employed to test the satisfaction of the training program for S&T talents. With an empirical study of a special major and their investigation data, the satisfaction distributions of each indicators in the evaluation system can be clearly depicted on the IPA map and the count measures can also be put forward according to their corresponding locations in different quadrants. The feasibility and effectiveness of the study can be verified as well.

**Keywords** Training program for S&T talents · Satisfaction · Modified IPA · The derived importance · Case study

### 109.1 Introduction

Nowadays, as the increasing demand for high-qualified science and technology (S&T) talents due to the rapid industrialization and urbanization in China, it is necessary to evaluate and improve the training program of S&T talents (Lin 2011) which is considered the fundamental instruction document of training and the primary basis for teaching organization and revolution during higher education (Li 2011).

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Although most of the Chinese colleges and universities have already established the evaluation systems about different training aspects created by experienced faculties (Bai and Zhao 2010; Xu and Yu 2011; Zhang 2011), there is seldom a overall satisfaction evaluation system about the training programs from the viewpoint of students.

Paying attention to the fact that the students are given the training service by the universities during the performing of the training program, as consumers in the market to some extent, the service satisfaction theory (Gonzalez et al. 2007) can then be employed to measure and evaluate the students responds to their training program in the paper so that both advantageous and disadvantageous attitudes can be not only collected but also offered to the decision-makers for the modification and improvement of the previous training program of S&T talents.

## **109.2 Methodology**

### ***109.2.1 Establishment of the Evaluation System***

Based on the principles of scientificness, objectiveness, feasibility and systematicness, a evaluation system with six primary indicators—training target, overall structure, theory courses, practice exercises, teaching management and employment service—can be established and each of them includes some secondary indicators in detail. As is shown in Table 109.1.

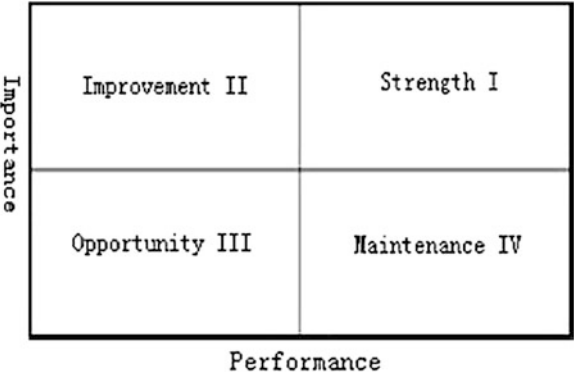
### ***109.2.2 The IPA: A Usable Method to Evaluate the Service Satisfaction***

The Importance-Performance Analysis (IPA) has been widely used in the decision making of service attributes (Li and Qi 2011; Zhang et al. 2011). The key point of IPA is a matrix with two-dimensions, in which the performance attribute was depicted on the X-axis while the importance attributes on the Y-axis. After being divided into four quadrants from I to IV according to AVG of the performance and importance attributes among all the indicators, the IPA matrix can clearly state the 4 kinds of service situation of each indicator, including strength area (Quadrant I), improvement area (Quadrant II), opportunity area (Quadrant III), and maintenance area (Quadrant IV). As is shown in Fig. 109.1.

**Table 109.1** The indicators of the evaluation system of training programs for S&T talents

Primary indicator	Secondary indicator
Training target	The character of training for talents B11
B1	The standard of training for talents B12
Overall structure	The coordinate ratio of theory courses to practice exercises B21
B2	The balance of teaching periods in different semester B22
Theory courses	The depth of theory course B31
B3	The update of theory course B32
	The systematic connection of different theory courses B33
	The amount of teaching periods of theory course B34
	The ratio of the amount of teaching periods among primary course, basic major course and major course B35
Practice exercises	The task of major intern B41
B4	The topic choose of graduation paper (project) B42
	Other practice exercises B43
	The systematic connection of different practice exercises B44
	The amount of teaching periods of practice exercises B45
	The ratio of the amount of teaching periods among different practice exercises B46
Teaching management	The choose of textbooks B51
B5	The teaching methods B52
	The examining methods B53
Employment service	The employment guide B61
B6	The practice in enterprise before graduation B62

**Fig. 109.1** The IPA map



**109.2.3 The Modified IPA and Its Application in the Training Programs Evaluation**

There are two inherent assumptions to apply the IPA (Tan and Chu 2011): (1) the value of importance attributes of each service indicator is independent to the corresponding performance attributes; and (2) the relationship between the performance attributes of each service indicator and the overall satisfaction of the research object is linear and symmetrical.

Due to these two assumptions which can hardly be achieved in reality, the modified IPA is raised based on the transformation from the statement importance acquired by direct investigations to the derived importance through partial correlation analysis.

The logic basis for this transformation is “the service which mostly influences the overall satisfaction is the most important”. The transforming steps from the statement importance to the derived importance are listed as following:

Step 1: Take the natural logarithm of each indicator.

$$P'_i = \ln P_i \ (i = 1, 2, 3, \dots, n) \quad (109.1)$$

In the formula (109.1):  $P_i$  is the performance of each indicator,  $n$  is the amount of indicators.

Step 2: Use the statement importance given by the students who accept the training service as a control variable. Make a partial correlation analysis between the transformed data  $P'_i$  and the overall satisfaction. Use the partial correlation coefficient  $D_{ZP'.I}$  as the derived importance of relevant service indicator.

$$D_{ZP'.I} = \frac{r_{ZP'} - r_{ZI}r_{IP'}}{((1 - r_{ZI}^2)(1 - r_{IP'}^2))^{\frac{1}{2}}} \quad (109.2)$$

In the formula (109.2):  $r_{ZI}$  is the correlation coefficient between the overall satisfaction and the statement importance;  $r_{ZP'}$  is the correlation coefficient between the overall satisfaction and the performance;  $r_{IP'}$  is the correlation coefficient between the statement importance and the performance.

In the above process of making the derived importance, taking the natural logarithm can make a reasonable transformation from the non-linear dependency between  $P_i$  and the overall satisfaction in reality to a linear dependency between  $P'_i$  and overall satisfaction. And through the partial correlation analysis, the relationship of the overall satisfaction and non-linear indicators performance  $P'_i$  can be considered as independent variables without the influence of statement importance. It is obvious that derived importance is more fitted to the two prerequisite assumptions of using IPA method.

In summary, the basic steps of the satisfaction evaluation of training programs based on modified IPA method are as following:

1. Using a questionnaire to investigate the performance and statement importance of the indicators of the training program and the overall satisfaction given by the service consumers (students in the universities).
2. Calculating the derived importance of each indicator in terms of formulas (109.1) and (109.2).
3. Making the IPA locating map of each indicator by using the indicator's performance and derived importance.
4. According to the location of each indicator in the different 4 quadrants, making the relevant strategies so that the training service can be improved.

109.3 A Case Study

Based on the evaluation system shown in Table 109.1, a questionnaire with 20 questions has been designed and sent to 60 students from a engineering major. After collecting and analyzing the questionnaires, both the feedback ratio and the valid ratio are reasonable. Meanwhile, the credibility of this survey is proved to be feasible by the SPSS (Xie 2010).

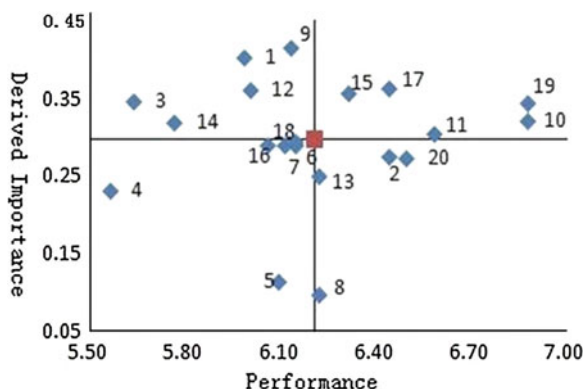
With the help of the basic steps of the modified IPA established in Sect. 109.2.3, the satisfaction situations of the indicators were not only calculated but also depicted in the IPA locating map for analysis, as is shown in the Table 109.2 and Fig. 109.2.

From Fig. 109.2, it is suggested that strategies for the improvement of the training program of this major will vary as follows: the aspects whose indicators are located in the quadrant I should be kept up and require for little improvement, while being deeply focused on and rapidly dealt with in the quadrant II, having smooth active expansions in the quadrant III, and maintaining as well in the quadrant IV.

**Table 109.2** The statistic of statement importance, performance and derived importance of training program for a case major

No.	Primary indicator	Secondary indicator	Statement importance		Performance		Derived importance
			Mean	Standard deviation	Mean	Standard deviation	
1	B1	B11	7.82	1.47	5.98	1.68	0.40
2		B12	8.02	1.39	6.44	1.60	0.28
3	B2	B21	7.89	1.42	5.64	1.67	0.35
4		B22	7.05	1.68	5.56	1.69	0.23
5	B3	B31	7.27	1.62	6.09	1.53	0.11
6		B32	7.67	1.60	6.11	1.56	0.29
7		B33	7.53	1.55	6.15	1.78	0.29
8		B34	7.31	1.35	6.22	1.29	0.10
9	B4	B35	7.45	1.51	6.13	1.52	0.42
10		B41	7.98	1.45	6.87	1.56	0.32
11		B42	7.91	1.42	6.58	1.60	0.31
12		B43	7.05	1.52	6.00	1.52	0.36
13		B44	7.04	1.33	6.22	1.88	0.25
14		B45	7.62	1.55	5.76	1.84	0.32
15	B5	B46	7.65	1.25	6.31	1.45	0.36
16		B51	7.95	1.41	6.05	1.83	0.29
17		B52	7.04	1.75	6.44	1.79	0.36
18		B53	7.11	1.70	6.15	1.79	0.30
19	B6	B61	7.95	1.69	6.87	1.86	0.35
20		B62	7.96	1.50	6.49	1.60	0.28

**Fig. 109.2** Indicators' locating map based on modified IPA method



## 109.4 Conclusion

For the consideration of the significance of training program for S&T talents, the paper establishes an effective evaluation system of satisfaction of training program from the viewpoint of the students and employs the service decision making theory to make a appropriate evaluation process.

The process of the modified IPA, well fitted with the 2 main assumptions which can hardly be achieved in the conventional IPA, is not only raised but also applied in the satisfaction evaluating and improving in the paper. It is believed that some useful guidance for the training programming of S&T talents can be gained as well.

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# Chapter 110

## A Configuration Strategy for Emergency Medical Supplies in Earthquake Disaster

Xue-dong Liang, Rong Huang, Ying-kang Shi, Lei Xie and Jian Liu

**Abstract** Along with the increasing frequency in emergency in our country, medical rescue is becoming more and more important, and the configuration of emergency medical supplies is especially vital. In allusion to earthquake emergency, a classification for earthquake emergency medical supplies is presented firstly, and then the evaluation index of emergency material allocation efficiency is founded. The weight on the evaluation index of emergency material allocation efficiency is gotten by rough sets. Finally, take Wenchuan earthquake for example, the emergency medical supplies configuration of West China Hospital is evaluated, and a viable configuration strategy for emergency medical supplies in earthquake disaster is put forward.

**Keywords** Attribute significance · Emergency medical supplies · Index system · Rough sets

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## 110.1 Introduction

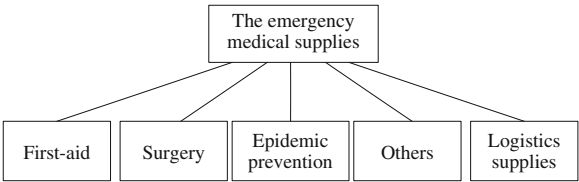
Emergencies can not be avoided or prognosticated, a large scale emergency usually bring a large number of casualties and heavy losses in economy, and decreasing the losses that the emergency has made is always the main goal in medical aid after disasters. After Tangshan earthquake, a lot of large scale emergencies had happened in our country, such as Wenchuan earthquake, Southern ice plague, Yushu earthquake and so on, these all made great economic losses and many casualties. Along with the increasing frequency in emergency in our country, the goal of reducing the losses in disasters is more important; moreover, the medical rescue is an important part in aid after disasters. When in an emergency, some of the casualties didn't die at once during the accident, they died in waiting for the medical rescue because they can not be treated in time or the lack of medical supplies. There can be a great decrease in death if give the casualties correct treatment in the first time. In medical rescue, the configuration of emergency medical supplies is not only the first step but also the key step, so a good allocation for emergency medical supplies can prompt medical treatment to play a more positive role.

In the respect of emergency medical supplies, many research achievements have been reached in our country. Feng and Li (2007) did research in the reengineering program of medical supplies purchase process and they project the purchase business process based on the actual purchasing situation in a hospital; Zhu et al. (2010) put forward a new randomized algorithm on the basis of traditional vehicle routing model to minimize unmet demand and time delays; Li et al. (2010) discuss about the plan of drug-related emergency in primary hospital. Based on the events mentioned above, we can find researches in all respects of emergency medical supplies achieve a remarkable effect, This paper makes a try in another way, investigating the earthquake emergency material allocation efficiency synthetically and reclassifying earthquake emergency material supplies.

## 110.2 Emergency Medical Supplies Analysis

Emergency medical supplies are medical supplies which are needed for emergency treatment when a large scale emergency took place and made people injured. The medical supplies have many types and cover a wide area, the different medical supplies of different emergencies are different, and the same emergency also need medical supplies different in quantity and type when in different stages and different degree. For this reason, the correct analysis of the emergency disaster situation along with the medical supplies it needs and the accurate allocation of these medical supplies are very important.

**Fig. 110.1** The earthquake emergency medical supplies classification



**110.2.1 Emergency Medical Supplies Classification**

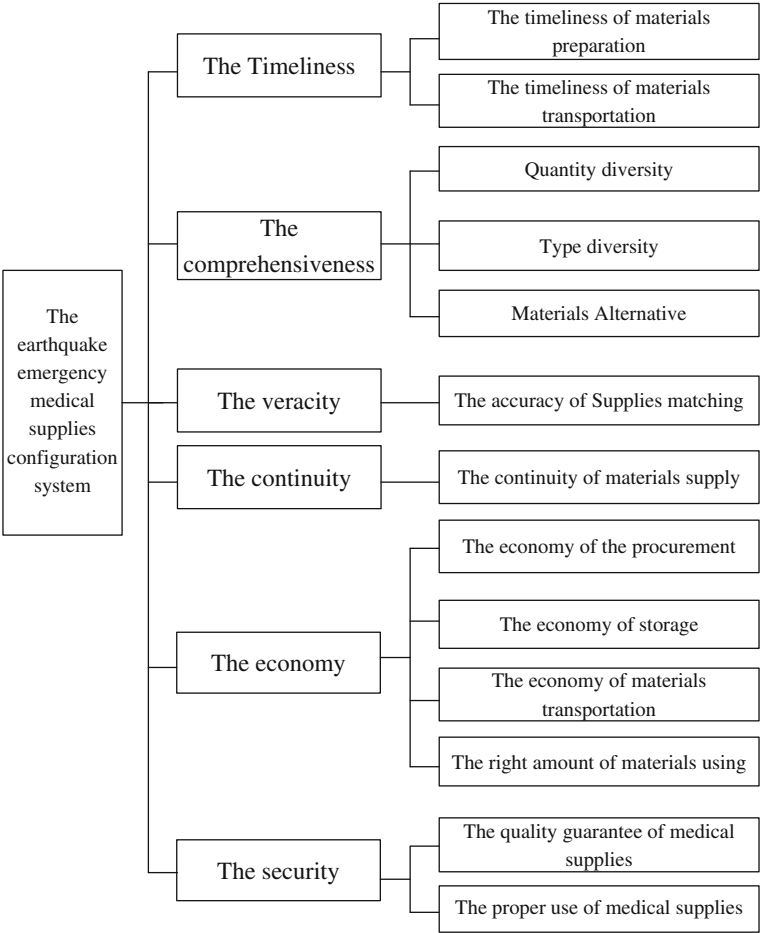
Emergency medical supplies have many types, which mainly include medical drugs, medical equipments, disinfection pharmaceuticals, logistics supplies and so on. According to different emergency medical supplies are needed for different disasters, the roles emergency medical supplies play are different, in order to reach a good configuration effect, different ways to purchase, store, transport and distribute should be adopted for different emergency medical supplies, so it is very necessary to classify the emergency medical supplies.

The emergency medical supplies can be classified in many ways, they can be classified in the type of disaster, the emergency of use, the use and using range, they can also be classified based on different stages of an emergency. According to the use of emergency medical supplies, they are divided into several categories (shown as Fig. 110.1):

**110.2.2 Emergency Material Allocation Efficiency Analysis**

- (a) Emergency medical supplies configuration index analysis  
The emergency medical supplies configuration index system is divided into six primary indexes, each primary index has secondary indexes, there are thirteen secondary indexes in total (Zhao 2011; Xu 2011; Gu 2009; Meng 2007; Zhou 2010; Huang et al. 2009) (as shown in Fig. 110.2)
- (b) Use rough sets (Su 2007; Liu and Li 2008; Sun 2008; Li and He 2008; Li and Yun 2010; Fu et al. 2007) to construct weights on every level of index

Choose sixteen types of emergency medical supplies, then mark the score of every medical supplies in every index by the experts' scoring, at last get a form shown in Table 110.1 by means of average score (set: C<sub>1</sub>-The timeliness of materials preparation, C<sub>2</sub>-The timeliness of materials transportation, C<sub>3</sub>-Quantity diversity, C<sub>4</sub>-Tpye diversity, C<sub>5</sub>-Materials alternative, C<sub>6</sub>-The accuracy of Supplies matching, C<sub>7</sub>-The continuity of materials supply, C<sub>8</sub>-The economy of the procurement, C<sub>9</sub>-The economy of storage, C<sub>10</sub>-The economy of materials transportation, C<sub>11</sub>-The right amount of materials using C<sub>12</sub>- The quality guarantee of medical supplies C<sub>13</sub>-The proper use of medical supplies; D-The score of every material)



**Fig. 110.2** The earthquake emergency medical supplies configuration system

Regard 90–100 as 1, 80–89 as 2, 70–79 as 3, 60–69 as 4, then cluster and discretize the data to get the decision table shown as Table 110.2.

The domain of discourse

$$U = (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16)$$

$$C = (1, 2, 3, 4, 5, 6, 7, 9, 10, 11)$$

from Table 110.2, we can get:

$$\begin{aligned} &U/\text{ind } C = \{C_1\} \\ &= \{(1, 8, 10), (2), (3), (4), (5), (6), (7), (9), (11), (12), (13), (14), (15), (16)\} \end{aligned}$$

**Table 110.1** Sixteen types of emergency medical supplies

Domain of discourse															
Eligible materials	Evaluation index														
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>	C <sub>7</sub>	C <sub>8</sub>	C <sub>9</sub>	C <sub>10</sub>	C <sub>11</sub>	C <sub>12</sub>	C <sub>13</sub>	D	
1	87	90	83	86	80	82	88	81	82	88	94	91	95	84	
2	83	93	76	85	83	89	82	81	78	84	92	95	90	87	
3	90	94	84	79	78	95	96	91	87	90	82	88	88	94	
4	87	83	73	92	81	88	82	85	86	89	90	93	97	83	
5	82	84	76	92	68	86	82	80	81	84	91	90	90	72	
6	90	80	80	72	78	75	92	93	90	91	82	83	81	75	
7	93	87	80	73	79	86	94	90	83	92	85	81	84	88	
8	87	92	83	85	81	88	86	80	84	83	92	94	91	79	
9	83	90	70	92	83	94	85	80	74	82	93	91	90	76	
10	93	96	84	87	83	81	89	86	88	80	95	93	90	92	
11	96	80	88	75	71	93	97	92	81	90	82	80	83	85	
12	92	87	85	90	84	93	91	95	90	90	81	84	80	89	
13	78	90	93	82	88	96	90	94	92	81	93	90	95	95	
14	70	91	95	82	80	81	94	91	91	82	90	90	93	87	
15	96	91	87	94	83	92	95	94	90	97	84	87	88	93	
16	90	94	83	87	84	75	80	89	78	86	90	92	95	86	

**Table 110.2** Eligible materials and evaluation index

Domain of discourse											
Eligible materials	Evaluation index										
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>	C <sub>7</sub>	C <sub>9</sub>	C <sub>10</sub>	C <sub>11</sub>	D
1	2	1	2	2	2	2	2	3	2	1	2
2	2	1	3	2	2	2	2	3	2	1	2
3	1	1	2	3	3	1	1	2	1	2	1
4	2	2	3	1	2	2	2	2	2	1	2
5	2	2	3	1	4	2	2	2	2	1	3
6	1	2	2	3	3	3	1	2	1	2	3
7	1	2	2	3	3	2	1	2	1	2	2
8	2	1	2	2	2	2	2	3	2	1	3
9	2	1	3	1	2	2	2	2	2	1	3
10	1	1	2	2	2	2	2	3	2	1	1
11	1	2	2	3	3	1	1	2	1	2	2
12	1	2	2	1	2	1	1	1	1	2	2
13	3	1	1	2	2	1	1	1	2	1	1
14	3	1	1	2	2	2	1	1	2	1	2
15	1	1	2	1	2	1	1	1	1	2	1
16	1	1	2	2	2	3	2	3	2	1	2

$$\begin{aligned} &U/\text{ind } C - \{C_2\} \\ &= \{(1, 8), (2), (3, 11), (4, 9), (5), (6), (7), (10), (11), (13), (14), (12, 15), (16)\} \end{aligned}$$

$$\begin{aligned} &U/\text{ind } C - \{C_3\} \\ &= \{(1, 8), (2), (3), (4), (5), (6), (7), (9), (10), (11), (12), (13), (14), (15), (16)\} \end{aligned}$$

$$\begin{aligned} &U/\text{ind } C - \{C_4\} \\ &= \{(1, 8), (2), (3), (4), (5), (6), (7), (9), (10), (11), (12), (13), (14), (15), (16)\} \end{aligned}$$

$$\begin{aligned} &U/\text{ind } C - \{C_5\} \\ &= \{(1, 8), (2), (3), (4, 5), (6), (7), (9), (10), (11), (12), (13), (14), (15), (16)\} \end{aligned}$$

$$\begin{aligned} &U/\text{ind } C - \{C_6\} \\ &= \{(1, 8), (2), (3, 6, 7), (4), (5), (6), (7), (9), (10, 16), (11), (12), (13, 14), (15)\} \end{aligned}$$

$$\begin{aligned} &U/\text{ind } C - \{C_7\} \\ &= \{(1, 8), (2), (3), (4), (5), (6), (7), (9), (10), (11), (12), (13), (14), (15), (16)\} \end{aligned}$$

$$\begin{aligned} &U/\text{ind } C - \{C_9\} \\ &= \{(1, 8), (2), (3), (4), (5), (6), (7), (9), (10), (11), (12), (13), (14), (15), (16)\} \end{aligned}$$

$$\begin{aligned} &U/\text{ind } C - \{C_{10}\} \\ &= \{(1, 8), (2), (3), (4), (5), (6), (7), (9), (10), (11), (12), (13), (14), (15), (16)\} \end{aligned}$$

$$\begin{aligned} &U/\text{ind } C - \{C_{11}\} \\ &= \{(1, 8), (2), (3), (4), (5), (6), (7), (9), (10), (11), (12), (13), (14), (15), (16)\} \end{aligned}$$

$$U/D = \{(1, 2, 4, 7, 11, 12, 16), (3, 10, 13, 15), (5, 6, 8, 9)\}$$

$$U/C = \{(1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16)\}$$

$$\text{Pos } C - \{C_1\}(D) = \{2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16\}$$

$$\text{Pos } C - \{C_2\}(D) = \{2, 5, 6, 7, 10, 13, 14, 16\}$$

$$\text{Pos } C - \{C_3\}(D) = \{2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16\}$$

$$\text{Pos } C - \{C_4\}(D) = \{2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16\}$$

$$\text{Pos } C - \{C_5\}(D) = \{2, 3, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16\}$$

$$\text{Pos } C - \{C_6\}(D) = \{2, 4, 5, 6, 7, 9, 11, 12, 15\}$$

$$\text{Pos } C - \{C_7\}(D) = \{2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16\}$$

$$\text{Pos } C - \{C_9\}(D) = \{2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16\}$$

$$\text{Pos } C - \{C_{10}\}(D) = \{2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16\}$$

$$\text{Pos } C - \{C_{11}\}(D) = \{2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16\}$$

$$\text{Pos } C(D) = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16\}$$

Obtain:

$$\sigma_{CD}(C_1) = \gamma_c(D) - \gamma_{C-\{C_1\}}(D) = 1 - 13/16 = 3/16;$$

$$\sigma_{CD}(C_2) = 8/16; \sigma_{CD}(C_3) = 2/16;$$

$$\sigma_{CD}(C_4) = 2/16; \sigma_{CD}(C_5) = 4/16;$$

$$\sigma_{CD}(C_6) = 7/16; \sigma_{CD}(C_7) = 2/16;$$

$$\sigma_{CD}(C_9) = 2/16; \sigma_{CD}(C_{10}) = 2/16; \sigma_{CD}(C_{11}) = 2/16,$$

Because  $C_8$  and  $C_7$  are equivalent, so  $\sigma_{CD}(C_8) = 2/16$ ,  $C_{12}$ ,  $C_{13}$ , and  $C_{11}$  are equivalent, so

$$\sigma_{CD}(C_{12}) = \sigma_{CD}(C_{13}) = 2/16.$$

Normalize:  $w_1 = 0.075$ ,  $w_2 = 0.2$ ,  $w_3 = 0.05$ ,  $w_4 = 0.05$ ,  $w_5 = 0.1$ ,  $w_6 = 0.175$ ,  $w_7 = 0.05$ ,  $w_8 = 0.05$ ,  $w_9 = 0.05$ ,  $w_{10} = 0.05$ ,  $w_{11} = 0.05$ ,  $w_{12} = 0.05$ ,  $w_{13} = 0.05$ .

Assume that a represents the timeliness, b represents the comprehensiveness, c represents the veracity, d represents the continuity, e represents the economy, f represents the security.

Get:  $w_a = 0.275$ ,  $w_b = 0.2$ ,  $w_c = 0.175$ ,  $w_d = 0.05$ ,  $w_e = 0.2$ ,  $w_f = 0.1$

See from the results above, in the emergency medical supplies configuration system, the weight of the timeliness is the largest, the comprehensiveness and economy are the second, the veracity is the third, and the continuity is for the minimum weight.

## 110.3 Case Analysis

### 110.3.1 Medical Supplies Configuration Evaluation

Take the emergency medical supplies configuration of West China Hospital in Wenchuan earthquake for example, and divide the supplies into five types, A-first-aid, B-surgery, C-epidemic prevention, D-others and E-logistics supplies (Chen 2011).

In the basis of the actual situation of configuration at that time, adopt the way of expert scoring, and then get the form below (shown as Table 110.3).

**Table 110.3** Materials and index

Materials	Index					
	a	b	c	d	e	f
a	94.5	87.3	85.2	83.8	85.6	93.4
b	92.8	82.2	88.6	78.2	84.7	90.1
c	89.3	83.7	80.4	72.3	88.5	92.6
d	89.5	78.4	82.5	73.6	89.7	91.8
e	83.7	84.6	84.2	70.9	90.6	96.2

**Table 110.4** All kinds of materials evaluation scores ranking

	Materials				
	a	b	c	d	e
Scores	89.0	87.3	85.9	85.5	86.0
Ranking	1	2	4	5	3

According to the weight of each index obtained above,  $w_a = 0.275$ ,  $w_b = 0.2$ ,  $w_c = 0.175$ ,  $w_d = 0.05$ ,  $w_e = 0.2$ ,  $w_f = 0.1$ , we can get the form shown as Table 110.4.

It's thus clear that the emergency medical supplies allocation efficiency of West China Hospital in Wenchuan earthquake is higher, first-aid is the highest, surgery is the second, others is relative minimum.

**110.3.2 Emergency Medical Supplies Reclassification**  
**(Zhou 2010)**

Divide the performance that the emergency medical supplies performed under each index into highest (1), higher (2) and general (3) three kinds of degree, and accordingly reclassify the emergency medical supplies as the first level, the second level and the third level, 20 experts grade the performance that the emergency medical supplies performed under each index based on their experience, a-the timeliness, b-the comprehensiveness, c-the veracity, d-the continuity, e-the economy, f- the security, the data collection form is shown as Table 110.5:

The weight of each index is known:  $w_a = 0.275$ ,  $w_b = 0.2$ ,  $w_c = 0.175$ ,  $w_d = 0.05$ ,  $w_e = 0.2$ ,  $w_f = 0.1$ , there are:

First-aid = A = [0.275   0.2   0.175   0.05   0.2   0.1]

= [0.675   0.18   0.145];

$$\begin{bmatrix} 0.9 & 0.1 & 0 \\ 0.75 & 0.1 & 0.15 \\ 0.5 & 0.4 & 0.1 \\ 0.6 & 0.25 & 0.15 \\ 0.4 & 0.2 & 0.4 \\ 0.8 & 0.1 & 0.1 \end{bmatrix}$$



**Table 110.6** Emergency medical supplies reclassification

Material classification	Evaluation language			Reclassification
	1	2	3	
a	0.675	0.18	0.145	The first level
b	0.58875	0.26625	0.145	The first level
c	0.41375	0.465	0.12125	The second level
d	0.24875	0.305	0.44625	The third level
e	0.2125	0.2475	0.54	The third level

So we can reclassify the five types of the emergency medical supplies, results are shown as Table 110.6:

110.4 Conclusion

This paper has analyzed the system of emergency medical supplies configuration systematically, the weight of each index in emergency medical supplies allocation system has been obtained by rough sets. Based on the weights, the emergency medical supplies configuration of West China Hospital has been estimated synthetically, which is known from the results. The allocation efficiency of each emergency medical supplies of West China Hospital in Wenchuan earthquake is higher. Meanwhile, based on the weight of each index, the five types of the emergency medical supplies are reclassified as the first level, the second level and the third level. Research shows that the allocation and reclassify of the emergency medical supplies play an important role in the work of medical emergency, and the research on medical treatment resource allocation strategy can contribute to the improvement of allocation efficiency of the emergency medical supplies needed in Natural disasters. The further studies will focus on the medical supplies scheduling rules and strategy of single point to multipoint (Li 2009).

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# Chapter 111

## Analyst Coverage and Earnings Management: Evidence from China

Zhao-hua Lan, Su-sheng Wang, Tao Yu and Zhen Yu

**Abstract** Besides information function, security analysts may play external supervision role in corporate governance which has been verified in developed market. Whether it is popular in China is unresolved. Nowadays, security analysts have become more and more important as intermediary in Chinese flourishing capital market. This paper study the relationship of analyst coverage and earnings management, trying to find direct evidence that security analysts' coverage have restraint effect on managers' earnings management decisions. The empirical result supports the opinion, and this paper contributes to the corporation governance theory and application.

**Keywords** Security analyst · Analyst coverage · Earnings management · Corporate governance

### 111.1 Introduction

Jensen and Meckling (1976) first point out that the securities analysts' activity can influence corporate governance. Moyer et al. (1989) make an empirical test about it based on Jensen and Meckling (1976). The result indicates that the higher degree

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of separation of ownership and control, the less demand for analysts follow. In the other hand, analysts' coverage increase the firm's value (Tobin's Q) (Chung and Jo 1996).

Besides these indirect evidence, Dyck et al. (2008), Yu (2008) found direct evidence about analysts' influence on corporate governance. Analysts play an important role in discovering company's financial fraud, especially like Compaq, Motorola (Dyck et al. 2008). By studying the relationship between analyst coverage and earnings management, Yu (2008) find that firms with more coverage manage their earnings less in developed capital market. But whether it is true or not in China (flourishing capital market) is unresolved.

## 111.2 Data and Methodology

### 111.2.1 Sample Selection

Firstly, all A-share public firms which listed before 2007 in Shanghai and Shenzhen security exchange are selected. Analyst coverage information come from CMSAR database and accounting variables come from Wind. Second, firms with missing values for sales, total assets, net income before extraordinary items, cash flow from operations, market value less than 10 million RMB are deleted. Also, firms from the financial industry are discarded by convention. Due to carrying out of new accounting principle in 1/1/2007, the sample starts from 1/1/2007, to 31/12/2010. The sample consists of 953 firms.

To account for the effect of the type of actual controller, which is specific and can affect both analyst follow and earnings management in China, this paper control it (a dummy variable *Control*) in all tests. The controller information comes from Wind. The value of *Control* equals 1 when the firm is controlled by state or government, others equals 0. Other variables, such as market value, return on net asset (*ROE*), the growth rate of asset, institution ownership, also affect both analysts' follow and earnings management. Furthermore, this paper uses the average value of tradable shares at the beginning and the end of the year. For each firm, the average institutional holdings of four quarters are adopted.

Table 111.1 shows the summary statistics at the firm level. The mean of *Control* is 0.68, indicating that more than half sample is state-owned which is in line with reality in China. The mean logarithm of market value is 8.08, return on net asset is 9.51, growth rate of assets is 0.23 and institutional ownership is 31.11 %, demonstrating the high growth of capital market in China.

Table 111.2 shows the distribution of analysts' coverage among different industries and years. As shown in the table, the differences of average coverage among different industries are apparent. Media and cultural industries have the highest average coverage in all 4 years.

**Table 111.1** Summary of variables this table presents the summary statistics for the sample

Variables	Number of observation	Mean	Median	Standard deviation
Control	3812	0.68	1.00	0.47
LnMV	3812	8.08	7.97	0.98
ROE	3812	9.51	8.36	11.43
GrowAsset	3812	0.23	0.13	0.71
Institution	3812	31.11	28.57	20.49

The sample consists of all A-shares market in both Shanghai and Shenzhen security exchange from 2007 to 2010. *Control* is a dummy variable, which indicates the actual controller of a firm. *LnMV* is the logarithm of market value. Market value equals price multiply by the tradable stock. *ROE* is the return rate of net assets, calculated by return scaled by net assets. *GrowAsset* represents the growth rate of assets yearly. *Institution* is the value of institutional ownership, which is defined by the average institution holdings of four quarters

**Table 111.2** The distribution of analysts' coverage in-code presents different industries

In-code	Number of firms	2007 average coverage	2008 average coverage	2009 average coverage	2010 average coverage
A	17	5.00	11.24	12.06	17.94
B	25	6.52	25.56	21.20	33.28
C-C0	41	6.37	19.44	20.10	26.22
C-C1	37	2.76	6.43	6.68	7.59
C-C2	4	1.50	2.00	7.75	8.75
C-C3	18	6.06	17.39	13.11	11.44
C-C4	92	3.55	9.91	9.88	10.52
C-C5	37	4.19	9.68	8.97	12.51
C-C6	84	7.08	20.06	16.43	25.73
C-C7	144	6.38	17.78	16.83	19.94
C-C8	70	5.91	15.37	14.56	19.13
C-C99	9	6.56	13.67	11.11	13.11
D	57	3.58	8.98	10.82	13.35
E	24	2.83	8.42	8.96	14.71
F	51	7.20	18.47	17.51	22.20
G	47	7.04	17.96	18.43	19.13
H	74	3.99	11.00	12.80	16.07
J	58	4.05	12.38	11.98	14.72
K	22	7.73	22.27	18.68	25.55
L	6	12.00	30.83	36.17	39.83
M	36	1.64	4.64	4.17	5.83
Min	4	1.50	2.00	4.17	5.83
Max	144	12.00	30.83	36.17	39.83

The data of analyst's coverage comes from *CMSAR* database

### 111.2.2 Estimation of Earnings Management

Discretionary Accruals (DA) can be used to present earnings management. Besides cash, other major part, accounting adjustments sometimes are called accruals. Manager always determine the signs and level of accruals according to their experience and estimation, they manipulate accruals easily. But earnings manipulation is just only one part of accruals. For some specific goal, it is needful and suitable to adjust some accrual on a regular basis. Thus, nondiscretionary accruals (NDAs) together with discretionary accruals (DAs) make up total accruals (TAs). A variety of papers use discretionary accruals (DAs) as the proxy for earnings management, such as Bergstresser and Philippon (2006).

There are several models to calculate DAs. According to our sample firms and scope, the modified version of the Jones model would be a good model to estimate the firms' DAs (Jones 1991; Dechow et al. 1995). In the first step, by running the following cross-sectional OLS regression of total accruals (TAs) on changes in sales and fixed assets (FA) within industries, we can estimate coefficients  $\alpha_1$ ,  $\alpha_2$ , and  $\alpha_3$ .

$$\frac{TA_{i,t}}{TAS_{i,t-1}} = \alpha_0 + \alpha_1 \frac{1}{TAS_{i,t-1}} + \alpha_2 \frac{\Delta REV_{i,t}}{TAS_{i,t-1}} + \alpha_3 \frac{FA_{i,t}}{TAS_{i,t-1}} + \varepsilon_{i,t} \quad (111.1)$$

where  $i$  indexes firms,  $t$  indexes time,  $TA_{i,t}$  equals net income minus cash flow from operations;  $\Delta REV_{i,t}$  is changes in sales  $TAS_{i,t-1}$ , legged total asset. All variables used here are scaled by legged total assets. We estimate the cross sectional models separately by each industry and get the value of  $\alpha_1$ ,  $\alpha_2$ , and  $\alpha_3$ .

Then we use the estimated  $\hat{\alpha}_0$ ;  $\hat{\alpha}_1$ ;  $\hat{\alpha}_2$  and  $\hat{\alpha}_3$  to calculate nondiscretionary accruals.

$$NDA_{i,t} = \hat{\alpha}_0 + \hat{\alpha}_1 \frac{1}{TAS_{i,t-1}} + \hat{\alpha}_2 \frac{\Delta REV_{i,t} - \Delta AR_{i,t}}{TAS_{i,t-1}} + \hat{\alpha}_3 \frac{FA_{i,t}}{TAS_{i,t-1}} \quad (111.2)$$

$\Delta AR_{i,t}$  represents the change in receivables. Thus, discretionary accruals can be derived as

$$DA_{i,t} = \frac{TA_{i,t}}{TAS_{i,t-1}} - NDA_{i,t} \quad (111.3)$$

Because all the variables are scaled by total assets at the beginning of each period, the magnitude of a firm's discretionary accruals is demonstrated as a percentage of the assets of the firm.

The magnitude of a firm's discretionary accruals is indicated as a percentage of the lagged assets of the firm. Positive DAs suggests income-increasing manipulations, while negative DAs indicates income decreasing manipulations. Managers have incentives to manage earnings not only upward, but also downward. In good years, they could want to hide some earnings for future reporting use, while, in bad years, they could take a bath (e.g., overstate bad assets or take a large restructuring

**Table 111.3** The distribution of discretionary accruals *AbsDA* is the absolute value of discretionary accruals which is computed through the OLS regression model above

Analyst coverage	Number of firms	AbsDA
0	812	677.20
1–5	1156	744.27
6–10	474	709.94
10–15	298	700.10
15–20	263	697.62
>20	809	615.77

charge) to make future earnings targets easier to meet. Because we are interested in manipulations in both directions, we use the absolute value of discretionary accruals, that is also used in several recent studies (e.g., Bergstresser and Philippon 2006; Warfield et al. 1995; Gu 1999; Klein 2002).

In addition, we split the sample according to the sign of discretionary accruals for all the tests. Doing so allows us to check whether the patterns of effects on signed discretionary accruals are consistent with each other.

Table 111.3 demonstrates the absolute value of discretionary accruals, which means that the more analyst coverage, the less discretionary accruals.

### 111.3 The Effect of Analyst Coverage on Earnings Management

In the first part of this section, we use discretionary accruals as a proxy for earnings management and start the analysis with OLS regressions.

Analyst coverage is associated with many factors, such as firm size, past performance, growth, external financing activities, and volatility of business (Bhushan 1989; Dechow and Dichev 2002; Kasznik 1999). Some of those factors could also affect firms' earnings management. To control for those factors, we first run the following regression:

$$\begin{aligned} \ln(1 + AC_i) = & c_0 + \alpha_t + \gamma_{in} + \alpha_0 \ln MV_i \\ & + \alpha_1 ROE_i + \alpha_2 GrowAsset_i \\ & + \alpha_3 Institution_i + \alpha_4 Control_i + e_i \end{aligned} \quad (111.4)$$

where analyst coverage ( $AC_i$ ) is the number of analysts who made forecasts about firm's earnings in any given year.  $\alpha_t$  are year fixed effects.  $\gamma_{in}$  is the industry fixed effect.  $e_i$  is an error term.  $\ln MV_i$  is the logarithm of market value.  $ROE_i$  represents the profit rate of net asset.  $GrowAsset_i$  are the growth rate of assets.  $Institution_i$  represents institutional ownership and  $Control_i$  is the type of actual controller of firms.

Table 111.4 show the regression result of analyst coverage on independent variables. It can be indicated that  $\ln MV$ ,  $Institution$ ,  $ROE$  is significant at 0.1 %

**Table 111.4** The result of analyst coverage on independent variables analyst coverage (AC) is the number of analysts who made forecasts about firm’s earnings in any given year

Variable	Coefficient	Std. error	t-statistic	Prob.
<i>C</i>	−4.3141	0.1804	−23.9184	0.0000
<i>D1</i>	−0.1925	0.0471	−4.0857	0.0000
<i>D2</i>	0.2406	0.0465	5.1798	0.0000
<i>D3</i>	0.2684	0.0436	6.1570	0.0000
$\gamma_{in}$	YES			
<i>LnMV</i>	0.5776	0.0200	28.9118	0.0000
<i>ROE</i>	0.0244	0.0015	16.4343	0.0000
<i>GrowAsset</i>	0.0604	0.0215	2.8047	0.0051
<i>Institution</i>	0.0149	0.0010	15.6569	0.0000
<i>Control</i>	−0.0628	0.0341	−1.8433	0.0654
R-squared	0.5192	Mean dependent var		1.8053
Adjusted R-squared	0.5159	S.D. dependent var		1.3408
S.E. of regression	0.9328	Akaike info criterion		2.7059
Sum squared resid	3293.7170	Schwarz criterion		2.7501
Log likelihood	−5130.4560	Hannan-Quinn critier		2.7216
F-statistic	157.2160	Durbin-Watson stat		1.7824
Prob(F-statistic)	0.0000			

*LnMV* is the logarithm of market value. *ROE* represents the profit rate of net asset. *GrowAsset* is the growth rate of assets. *Institution* represents institutional ownership and *Control* is the type of actual controller of firms

level, means that the larger market value, the more analyst coverage, and the more institutional holding, the more coverage, the better performance, the more coverage, which is consistent with institution and available literature. Also, year and industry effects, *GrowAsset* and *Control* is significant. The adjusted R-squared is 0.5159, and F-statistic is 157.2160 with *Prob* 0.0000, other statistics is acceptable too, which means the regression model is suitable.

We label the residuals from the above regression as “residual coverage” and use it as the main proxy for analyst coverage. It can be considered as a component of analyst coverage that is uncorrelated with market value, profit rate of asset, growth rate of assets, external financing activities, or volatility of business.

Then we estimate the effect of analyst coverage on earnings management with the following OLS regression:

$$\begin{aligned} AbsDA_{i,t} = & c + d_k + r_s + \alpha_0 AcResidual_{i,t} \\ & + \alpha_1 Control_i + \alpha_2 LnMV_{i,t} \\ & + \alpha_3 GrowAsset_{i,t} + \alpha_4 ROE_{i,t} + e_{i,t} \end{aligned} \tag{111.5}$$

where  $d_k$  is year fixed effects,  $r_s$  is industry fixed effects,  $AcResidual_{i,t}$  represents firm i’s analyst coverage residual in year t.  $Control_i$  is the type of actual control of firm i.  $LnMV_{i,t}$ ,  $GrowAsset_{i,t}$ ,  $ROE_{i,t}$  represent the logarithm of market value, the growth rate of assets and the return rate on net assets.

**Table 111.5** The result of earnings management on analyst coverage

Variable	Coefficient	Std. error	t-statistic	Prob.
<i>C</i>	718.8726	156.0222	4.6075	0.0000
<i>D1</i>	28.6345	40.7607	0.7025	0.4824
<i>D2</i>	22.4723	40.1838	0.5592	0.5760
<i>D3</i>	88.8899	37.7125	2.3570	0.0185
<i>AcResidual</i>	−35.9370	14.0603	−2.5559	0.0106
$\gamma_{in}$	YES			
<i>LnMV</i>	−8.4303	17.2809	−0.4878	0.6257
<i>ROE</i>	2.7999	1.2862	2.1769	0.0296
<i>GrowAsset</i>	334.1501	18.6237	17.9422	0.0000
<i>Institution</i>	−0.7027	0.8247	−0.8521	0.3942
<i>Control</i>	−59.7162	29.4820	−2.0255	0.0429
R-squared	0.1615	Mean dependent var		691.7734
Adjusted R-squared	0.1555	S.D. dependent var		878.0796
S.E. of regression	806.9304	Akaike info criterion		16.2317
Sum squared resid	2.46E+09	Schwarz criterion		16.2776
Log likelihood	−30909	Hannan-Quinn criter		16.2480
F-statistic	26.9882	Durbin-Watson stat		2.0097
Prob(F-statistic)	0.0000			

$d_k$  is year fixed effects,  $r_s$  is industry fixed effects,  $AcResidual_{i,t}$  represents firm  $i$ 's analyst coverage residual in year  $t$ .  $Contol_i$  is the type of actual control of firm  $i$ .  $LnMV_{i,t}$ ,  $GrowAsset_{i,t}$ ,  $ROE_{i,t}$  represent the logarithm of market value, the growth rate of assets and the return rate on net assets

From the Table 111.5, the *AcResidual* is significant at 5 % level, while F-statistic is 26.9882 significantly, and other statistics are acceptable, which infer that security analysts' coverage have restraint effect on managers' earnings management decisions.

### 111.4 Conclusion

Nowadays, security analysts have become more and more important as intermediary in Chinese flourishing capital market. Furthermore, security analysts play external supervision role in corporate governance, indicating that more analyst coverage, less earnings coverage. The result is consistent with developed market. This paper contributes to the corporation governance theory and application. In future, other corporation governance function of analyst coverage, such as reducing tunneling, decreasing information asymmetry, et al. can be explored.

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# Chapter 112

## Research on the Competitive Dimension of Travel Agencies Based on the Marketing Dynamic Capabilities Theory

Na Han, Jian Li and Jian-mei Liu

**Abstract** Complex, dynamic and competitive environment has posed many challenges to travel agencies regarding maintaining competitive advantages and it is imperative that the Travel agencies must have the marketing dynamic capabilities to quickly respond the changes taking place in the market. Based on the theory of marketing dynamic capabilities and the problems being faced by the travel agencies, this paper applies factor analysis to analyze the various dimensions of travel agencies' competitiveness. The results shows that the dimensions included five categories: market information management; social network resources; travel agencies human resources; brand management and travel agency innovation, and the roles of different dimensions to enhance the competitiveness were different.

**Keywords** Dynamic capabilities • Marketing dynamic capabilities • Travel agencies • Factor analysis

### 112.1 Introduction

Proposals of State Council on Accelerating Development of the Tourism inter-alia focus on making this industry as a pillar industry with strategic significance in

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national economy. However, due to the changing customer demands and fierce market competition, the uncertainty and complexity grows increasingly which cause frustrations to many travel agencies while some more factors such as sharp increase in the number of firms; similarity of the products; price competition; damage to corporate reputation etc. also add to it. So, because of such high uncertainty, companies must have the dynamic capabilities to quickly adapt to changes in the industry. However, travel agencies usually focus on price competition. Therefore, obtaining a competitive advantage becomes the disadvantage of many travel agencies.

During last a few years, the theory of dynamic capabilities has become a hot topic among the scholars in the field of marketing. The concept of this theory was first time put forward by Fang and Zou (2009), which reflected the ability of facing the rapidly changing market demand, the speed and efficiency of inter-departmental business processes for the creation and delivery of customer value. Although scholars have proposed the concept of marketing dynamic capabilities, without in-depth research, there are considerable different opinions on the dimensions of marketing dynamic capabilities (Hui and Chunli 2010). Even, the theory of marketing dynamic capabilities for travel agency has not yet been evolved, and this is undoubtedly the most critical capacity for travel agency to respond to dynamic environment. Based on this, Qinhuangdao travel agencies were taken as sample for this research. This paper applies statistics methods to analyze the dimensions of travel agencies and to solve the problem that how to build the marketing dynamic capabilities for travel agencies in dynamic environment which will be helpful for travel agencies to enhance the competitiveness from the perspective of marketing strategy.

## **112.2 Review of the Theory**

Although the literature about dynamic capabilities is available in abundance, however, the current research of marketing dynamic capabilities is still at its infancy stage (Fang and Zou 2009; Linda et al. 2005) and the study focused on travel agency marketing dynamic capabilities is almost nil. This paper aims to enhance travel agencies competitiveness, therefore, review of the theory will include the dynamic capabilities, marketing dynamic capabilities and travel agencies competitiveness.

### ***112.2.1 Application of Dynamic Capabilities in the Marketing Field***

Resource based view (RBV) explains the source of corporate competitiveness, it points out that the heterogeneity of resource is critical to the corporation to obtain

sustained competitive advantage. As, this theory focuses on the internal resources, ignoring impact of external environment on business, therefore, RBV can't explain how to gain competitiveness in highly competitive environment (Eisenhardt and Martin 2000; Teece and Pisano 1997).

Dynamic capability focuses on exploring how to create competitive advantages in highly competitive environment. If an enterprise could learn from customers, better than competitors, to change its core business processes and practices, ongoing reconstruction, upgrading and allocation of resources (Maklan and Knox 2009; Rindova and Kotha 2001), it will create customer value better than competitors, finally gaining excellent performance in the market. By means of dynamic capabilities, enterprise could respond rapidly to market change.

### ***112.2.2 The Concept and Dimensions of Marketing Dynamic Capability***

Research on dynamic capability has formed a relatively complete system in academics, however, study of marketing dynamic capability has not attained enough attention (Linda et al. 2005). Before concept of marketing dynamic capability officially proposed, marketing scholars have discussed marketing specific capacity (Day 2001; Srivastava et al. 1999) or market-based dynamic capabilities (Slater and Narver 1995; Vorhies et al. 2007) instead of marketing dynamic capability. Bruni et al. defined marketing dynamic capability from the perspective of resources and knowledge (Bruni and Verona 2009), they thought that marketing dynamic capability was the basis of long-term building, integrating and reconstructing enterprises capabilities for managers. Marketing dynamic capability reflect the ability of, creating, using and integrating human resources, social capital and managers' cognitive on market knowledge in order to adopt the change in market and technology. Eisenhardt and Martin analyzed marketing dynamic capability from the aspect of business process and they consider that dynamic capability is reflected in a series of business process to respond to the market changes and managers could integrate and use resources to form a strategy of value creation through this process (Eisenhardt and Martin 2000). On basis of earlier achievements.

Scholars have put forward different views on dimensions of marketing dynamic capability. Maklan divided marketing dynamic capability into four following dimensions from the aspect of customer relationship management (Maklan and Knox 2009): (1) demand management; (2) creation of marketing knowledge; (3) establishing brand; (4) customer relationship management. Bruni divided marketing dynamic capabilities into following three dimensions (Bruni and Verona 2009): (1) management belief; (2) human resource; (3) social capital.

### ***112.2.3 Travel Agencies Competitiveness***

Two major research schools of thoughts on enterprises competitiveness are related to Resource Based View and theory of industrial organization. These two theories studies corporate competitiveness and influencing factors from different angles. RBV proposes that heterogeneous resources are the source of enterprises capabilities. Theory of industrial organization considers that external environment has an important impact on competitive advantage. These theories have different emphases, in addition to risk in the market competition, which includes many opportunities, so, the authors believe that enterprises should combine resources with external environment, to creatively enhance the enterprises competitiveness.

Scholars choose price competition as the starting point to solve the problems of travel agencies, involving price-making, industry division, market structure, product innovation and so on. Chang (2004) established the core competitiveness of travel agency from five aspects i.e.: strategic policy, brand operation, application of modern information technology, human resources management and corporate culture. Fang thought that we should build core competitiveness from six aspects (Fang 2003), such as industry management system, corporate credit rating, brand management, corporate culture, customer loyalty and product innovation.

### ***112.2.4 Literature Review and Research Framework***

Presently academic circles have diversified views on the concept and dimensions of the marketing dynamic capability and there are many problems in the development process for travel agency, therefore, it is necessary to apply marketing dynamic capability for travel agencies to explore the key factors. Based on this logic combined with the marketing dynamic capability, this paper explores the following questions: Firstly, what are the dimensions of marketing dynamic capabilities for travel agencies? Secondly, whether the different dimensions play the same function or not?

## **112.3 Study Design**

### ***112.3.1 Defining of Marketing Dynamic Capability for Travel Agencies***

Based on the problems of travel agencies and views of scholars in the past, this paper planned to analyze marketing dynamic capability for travel agencies from

five aspects i.e.: (1) market information management; (2) human resource; (3) product development management; (4) brand development; (5) social relations resources.

### ***112.3.2 Marketing Research and Analysis***

Qinhuangdao travel agencies have been chosen for research for this paper. Out of total 116 Qinhuangdao travel agencies, 88 agencies are chosen randomly for our study, however, 75 questionnaires were delivered successfully i.e. 85.2 % and 64 received back from, i.e. 85.3 %. We have determined 15 variables namely: level of attention to market research ( $X_1$ ), collection and collation of market information ( $X_2$ ), market research ( $X_3$ ), information technology application ( $X_4$ ), keeping abreast of market and adjusting business ( $X_5$ ), innovation ( $X_6$ ), establishing advanced products Group ( $X_7$ ), cooperation with other travel agencies ( $X_8$ ), relationship with hotels and scenic spots ( $X_9$ ), relationship with the authorities and important customer ( $X_{10}$ ), training of employees ( $X_{11}$ ), employees development ( $X_{12}$ ), corporate team-building ( $X_{13}$ ), developing brand ( $X_{14}$ ), customer loyalty ( $X_{15}$ ). The score is assigned from 1 to 7, higher the score the more attention and application.

## **112.4 Testing for Dimensions of Travel Agency Marketing Dynamic Capability**

Among these 15 variables, there might be some interaction effects on each other, so, in order to analyze more scientifically, the authors applied factor analysis to this problem. This paper adopted factor analysis to turn 15 variables into fewer common factors  $F = (f_1, f_2, \dots, f_p)$ , (the number of common factor  $< 15$ ), and then got comprehensive factor value  $Z = b_1f_1 + b_2f_2 + \dots + b_pf_p$ ,  $b_i = \lambda_i / \sum \lambda_i$ ,  $i = 1, 2, 3, 4, 5$ ,  $b_i$  is the weight for the  $i$ th common factor. Common factors extracted were the dimensions of travel agencies marketing dynamic capabilities,  $b_i$  determined the roles of the dimensions on travel agencies competitiveness.

### ***112.4.1 Extracting Common Factors***

Extracting common factors by SPSS 16.0 (Table 112.1). As can be seen from the Table 112.1, the contribution rate of five former characteristic roots was 87.11 %.

**Table 112.1** Total variance explained

	Initial eigenvalues		
	Total	% variance	Cumulative %
X1	4.553	30.352	30.352
X2	3.172	21.145	51.497
X3	2.127	14.182	65.679
X4	1.708	11.388	77.067
X5	1.506	10.043	87.110
X6	0.783	5.217	92.327
X7	0.464	3.096	95.423
X8	0.309	2.060	97.483
X9	0.144	0.959	98.442
X10	0.080	0.530	98.972
X11	0.059	0.395	99.367
X12	0.036	0.241	99.608
X13	0.026	0.175	99.783
X14	0.020	0.136	99.919
X15	0.012	0.081	100.000

### ***112.4.2 Naming for Principal Component***

However, the meaning of five common factors is not clear, so it is difficult to name for common factor extracted. The factor loading matrix is not unique, therefore, rotating them by the method of varimax, it is feasible to name for the rotated principal component factor (Table 112.2).

As can be seen from Table 112.2,  $X_1$ ,  $X_2$ ,  $X_3$ ,  $X_4$ ,  $X_5$  had higher load on the first principal component, these five variables described market research attitude and its implementation, which reflected external market information management, therefore, first principal component  $F_1$  is named as “Market information management”; Similarly, the second principal component  $F_2$  is named “Social network resources”; The third principal component  $F_3$  is named as “Travel Agency Human Resources”; The fourth principal component  $F_4$  named as “Travel Agency Brand Management”; The fifth principal component  $F_5$  is named as “Travel Agency innovation”.

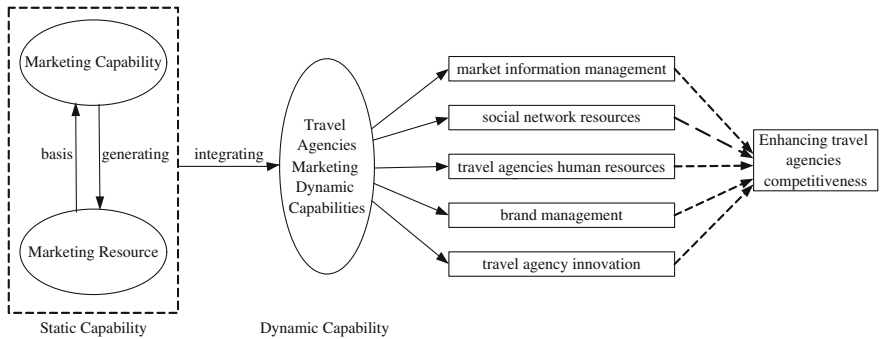
### ***112.4.3 The Dimensions of Travel Agencies Marketing Dynamic Capabilities***

According to the Table 112.2, we could get the function which comprised of principal components and original index variables. We could obtain  $b_i$  from variance contribution in Table 112.1, and then get evaluation model of travel marketing dynamic capability:  $Z = 0.348F_1 + 0.243F_2 + 0.163F_3 + 0.131F_4 + 0.115F_5$ .

**Table 112.2** Rotated component matrix

	Component				
	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>
X <sub>1</sub>	0.910				
X <sub>2</sub>	0.881				
X <sub>3</sub>	0.858				
X <sub>4</sub>	0.870				
X <sub>5</sub>	0.896				
X <sub>6</sub>					0.976
X <sub>7</sub>					0.970
X <sub>8</sub>		0.925			
X <sub>9</sub>		0.871			
X <sub>10</sub>		0.877			
X <sub>11</sub>			0.786		
X <sub>12</sub>			0.887		
X <sub>13</sub>			0.859		
X <sub>14</sub>				0.984	
X <sub>15</sub>				0.985	

As can be seen from the evaluation model,  $b_1$  is the biggest weight in the five common factors, so  $F_1$  (market information management) plays the most vital role, and this dimension has an impact of 0.348 on travel agency competitiveness; Social network resources has an impact of 0.243 on travel agency competitiveness, ranking second in the five dimensions, which suggests that travel agencies pays more attention to external market environment; However, band management has a little impact on travel agency competitiveness, the weight is 0.131; The weight of product invention is only 0.115, which is the least one, so travel agencies hasn't pay much attention to product invention (Fig. 112.1).



**Fig. 112.1** Model of travel agencies marketing dynamic capabilities

## 112.5 Conclusions and Prospect

### 112.5.1 Conclusions

Based on marketing dynamic capability, this paper used factor analysis to study Qinhuangdao travel agencies, obtaining the dimensions of marketing dynamic capability for travel agencies, and finding that different dimensions had different impact on travel competitiveness.

### 112.5.2 Study Limitations and Future Research Directions

This study only selected Qinhuangdao travel agency as research sample. In future, scholars should select different areas and different types of travel agencies to analyze and to ascertain whether there are differences in travel agencies marketing dynamic capabilities.

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# Chapter 113

## Diamond Model of Cultural Theme Blocks

### Operation: Taking “Nanjing 1912” as an Example

Xiao-hu Zhou, Hai-long Jiao, Zhong-jin Zhang and Yun-qin Chen

**Abstract** As economy grows rapidly and growth mode converts, meanwhile, as the culture industry is brought into the national twelfth five-year development plan, cultural theme blocks are emerging unceasingly. However, some problems, for example, blind imitation, wrong positioning, fuzzy operation pattern, limited market expanding, appear when they are built. A long-term survey on “Nanjing 1912” concludes that the successful development of these blocks should follow the diamond model which combines four factors of strategic positioning, space innovation, commercial cluster and profit pattern. Specifically, reasonable positioning is the strategy security of block operation; space innovation improves operation efficiency; commercial cluster exerts the cluster effect; profit pattern helps to make profits successfully. Effective operation of cultural theme blocks is the combined effects of four factors. Factors are connected with each other that they form a mutually promote enhanced system. The operation diamond model can provide a new view for further research.

**Keywords** Block operation · Culture theme block · Diamond model · Space innovation

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### 113.1 Problem Introduction

With China's rapid economic growth and the transition of economic growth mode after 30 years' reform and opening up, a number of cities in China gradually shift from "society of production" to "society of consumption" (Zhang 2002) and the city blocks grow vigorously. As part of the urban public space, city blocks convert their traditional business models gradually in the continuous development process (Liao 2010). On one hand, in the development of the process of renovation, city blocks begin to focus on the import of function elements such as diversification, theme and cluster and make full use of functions including tourism, leisure, entertainment, real estate. And these elements and functions bring new vitality into the development of a city block (Zhang 2007). On the other hand, with the cultural industry taken into national planning, cultural resources will play an increasingly important role in the development of society and economy. Against this background, lots of cultural theme blocks with various different characteristics emerge. These blocks combine culture, history and commerce to highlight the historical and cultural heritage features and meet the needs of shopping, entertainment, leisure and many other demands.

The emergence of large numbers of cultural theme blocks is the result produced by government policies, urban development and market demand together. And also it is both an important trend in the commercial street development and the further extension in the form and further expanding in the connotation of the pedestrian street. The emergence of large numbers of cultural theme blocks is good to regional economic growth, social development and cultural heritage.

However, not only does the development of cultural theme blocks face the theoretical lack, but also they meet the practice challenges. In the development and operation of cultural theme blocks, there are some problems. For example, the number of blocks is big but the volume is small (Liu 2011); some pitfalls arise in the product development and design (Zhang and Deng 2009); the theme positioning is not clear, which blindly imitates (Dong and Xu 2006); the operation model is fuzzy (Xu 2007); the expanding is limited (Liu 2011). These problems hinder the further development of culture and leisure blocks greatly. Some blocks have taken some measures to solve these problems. Nanjing Mizuki Qinhuai leisure block focuses on the effect of business clusters and spatial planning but the positioning is not clear throughout its development which results in the unsustainable development. The spatial distribution and commercial operations of Shanghai Xintiandi are successful, but it's uneasy to go to the whole country because of the imitation of cultural characteristics. And some other blocks adopt traditional "second-landlord" model. All of these restrict the further development and growth of cultural and leisure blocks. In the society which develops rapidly nowadays, how to operate cultural and leisure block has become an important practical issues in the development of culture industry.

## 113.2 “Nanjing 1912” and Four Elements Model

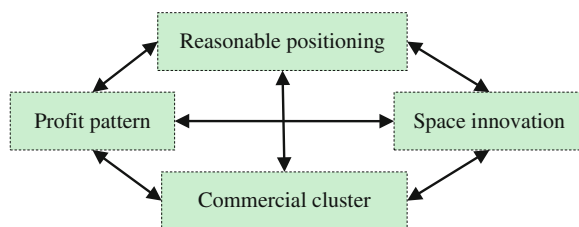
“Nanjing 1912” cultural theme block is located in the interchange of Yangtze River Road and North Pacific Road in Nanjing city which is adjacent to the presidential palace. “Nanjing 1912” covers an area of more than 40,000 square meters which is divided into A, B two regions and “peace”, “love”, “Republic”, “new century” four Street Plazas, a total of more than 20 buildings in the style of the Republic. In these buildings mixed with green gray and brick red, each building is relatively independent and has distinguishing features and sizes with elegant style. These buildings are well-proportioned in the shape of “L” around the presidential palace and become commercial buildings with culture of the republic. The architecture is a mix of Chinese and European style and absorbs commercial elements with modern fashion.

“Nanjing 1912” is the only one block containing dining, entertainment, leisure, sightseeing and party and mixing traditional styles, cultural taste and fashion in Nanjing. Because of the consumption-oriented, all-weather cluster format, the precipitation of the city history and resources of the country and the world-renowned brand make “Nanjing 1912” be the unique urban living room. “Nanjing 1912” changes outsiders and foreigners’ bias of Nanjing economic circle. The slogan, “Beijing has Sanlitun, Shanghai has Xintiandi, Nanjing has 1912”, is popular both at home and abroad.

“Nanjing 1912” has achieved good social effects, economic effects, and brand effect and has become the urban living room mixed culture, history with fashion after 7 years’ development since it opened in 2004 Christmas. In terms of economic effects alone, consumers has reached about 5 million in 2010; the growth of GDP is 400 million RMB every year; and the tax paid to government is more than 100 million each year. “Wuxi 1912”, “Yangzhou 1912”, “Suzhou 1912”, “Changzhou 1912”, “Hefei 1912” have opened, while in Xi’an, Huai’an, Jinan, Luoyang, the 1912 project are promoting actively. So far, More than 100 cities have invited “Nanjing 1912” to join. The pace of “Nanjing 1912” is moving fast and it has become the most famous brand which is in charge of operation of culture theme block.

In the early 2010, our team started to track the “Nanjing 1912” case. After 16 months of investigation and analysis, we find that the 1912 case contains an operation rule, namely, strategic positioning, space innovation, commercial cluster and profit pattern, which is suitable for other cultural theme blocks (Fig. 113.1).

**Fig. 113.1** The diamond framework of culture theme blocks operation



At first, strategic positioning draws up a reasonable and clear positioning strategy and determine target market and target customers to point out the direction for the rapid development of cultural theme blocks. Space innovation means the use of the principle of space production and the innovation of space production and landscape design to annotate the theme of cultural theme blocks (Jiang et al. 2011). Commercial cluster emphasizes the theory of cluster effect and considers the gathering of block formats to exert the constellation effect and synergy effect. At last, profit pattern is to find effective profit way for blocks and pay attention to the relationship and collaboration with stakeholders, such as the cooperation with businesses, management together with government, businesses and customers and so on. Profit pattern needs to update or change in time according to the changes of external environment and internal development.

Effective operation of cultural theme blocks is the interaction of four factors. Factors are connected with each other that they form a mutually promote enhanced system. The effect of each factor depends on other factors. For example, a block that owns a good positioning but doesn't have a good business model, may not achieve good enough. On this basis, a diamond framework of cultural leisure blocks operation is proposed to provide new insights and perspectives for the development and operation of cultural leisure blocks.

### **113.3 Reasonable Positioning Strategy Security of Operation of Cultural Theme Blocks**

Cultural theme block is a living space form with sense of place and convenience which depends on gathered residential areas (Dong and Xu 2006). Its theme is the accumulation of years of culture, the lifestyle, the symbol of a fashion element and the embodiment of charisma. What the selling point of the block is the highlight to attract customers. Not only is the selection of the theme novel, unique and ingenious, but also it highlights the local characteristics and cultural features. Therefore, the effective theme position will directly determine the strategic foundation of the cultural theme blocks.

“Nanjing 1912” identifies three overall positioning principles: first of all, make full use of uniqueness of resource and link up with historical and cultural landscape; second of all, make it be the symbol region which reflects cityscape; at last, ensure the unity of economic and social benefits. These principles set operation management goals for “Nanjing 1912” and provide a standard for the accuracy of theme positioning.

As the developer, “Nanjing 1912” group has had a deep analysis of internal and external environment. At the same time, with the help of PEST analysis, “Nanjing 1912” gives a full description of unique cultural resources and special niche advantage. Thus, “Nanjing 1912” positions itself as an “urban living room which concentrates Nanjing city culture and the republic style history and leads fashion

according to its unique resources and location advantages". Also take "three places and three points" as the core to deepen new brand positioning and development direction of "Nanjing 1912". The positioning goal is to create an urban tourist attraction full of cultural characteristics of the Republic, create a new life, new experiences, new fashion trade area, create a new landmark contains stylish dining, leisure and entertainment.

As the culture base, "Nanjing 1912" carries on summary and upgrades of culture, further heightens and enhances the center position of the presidential palace to create an open Republic Museum of architectural culture. In the future, some events, such as ROC culture exhibition, will be hold to propagandize and packaging the mansion ancient style building to enrich cultural background and make it be the exhibition of republic of culture. In brand building, "Nanjing 1912" insists on experimental consumption route and enhances the operational environment, optimizes retail format, strengthens management, promotes the block's overall brand and image to attract international and domestic famous firms to join in. With these methods, "Nanjing 1912" makes customers to "enjoy life, enjoy the 1912".

Therefore, the positioning of "Nanjing 1912" reflects many superior resources of block which is the unity of history culture and commercial civilization and the mix of fashion elements and classic flavor. It makes "Nanjing 1912" appear in front of customers unprecedentedly and fills the gap in business combination format of Nanjing. At the same time, with the help of the presidential palace which is the mix of the oriental and the western culture, "Nanjing 1912" embodies its perspicuity, superiority, and inimitability which means a higher level of differentiation value and avoids confrontation with highly Sophisticated Trade Centers nearby successfully when it provides its products and services the customers.

### **113.4 Space Innovation Improvement of Operation Efficiency**

Lefebvre clearly pointed out that space is a social product and its production is the same as any other kind of production. Space which is not given but produced is the outcome of social practice. As a special type of space, cultural leisure blocks are not only the material sense of space, but also they are the space with social significance and cultural significance (Liao 2010).

"Nanjing 1912" cultural theme block, which is a special form of urban space, is an important component of the urban cultural heritage. It plays an important role in the continuation of the urban history and culture, and becomes a city's collective memory. Therefore, it is not only a physical space, or a spiritual space, is also a social space. The historic block innovation not only makes the space physical form change, but also changes space and cultural significance. It reflects today's urban consumer society and the social ecology at the context of globalization (Wang and Deng 2009).

Embark from the innovation of space production and landscape design, the space design of “Nanjing 1912” keeps in harmony with the presidential palace. The volume of “Nanjing 1912” is coordinate with that of the presidential palace. The “Nanjing 1912” buildings are as high as a two-layer building approximately 10 meters which stay the same with the height of buildings of the Republic. “Nanjing 1912” draws heavily on the design of the presidential palace in terms of architectural style. The imitation of the French Renaissance style of the office buildings of the President palace, especially the handling of on-line of arches and arches have been fully reflected on “Nanjing 1912”.

The design of traffic line in the block meets the three principles of convenience, privacy and visibility. “Nanjing 1912” is in the shape of “L”. The region along the Yangtze River Road and near the Presidential Palace is the leisure area and the region along the Pacific North Road and near the Yangtze River is the dining area while along the back of Yangtze River Road is the bar area. This setting meets the requirements of the commercial form. Catering, leisure, teahouses and cafe bars should be along the street for the reason that their customers are not fixed while the bar’s customers are fixed which means the demand of location isn’t high. Considering the consumption habits of customers and of the large customers of dinning, the dinning area is set in the centre. Customers can choose whether to go forward to the leisure area or walk backwards to the bar area after meals which increases convenience of consumption. In the meanwhile, the design of traffic line takes privacy into consideration. These subtle and scientific space designs enhance consumer convenience and ensure customers’ satisfaction and loyalty to “Nanjing 1912”.

After the commercial transformation of “Nanjing 1912”, a series of conversion of space features and space functions occur. In the space features, “Nanjing 1912” transforms from a historical block into a commercial traveling culture block while in the space functions, “Nanjing 1912” changes from the original residential functions to the leisure and tourism functions which promotes the transformation from residential space to consumption space. Thus, historical block becomes an urban heritage landscape for tourism and urban consumption space. In the process of space production of “Nanjing 1912”, several relevant groups in social practice are involved. The space production is both a physical process and a production process of social relations which is an interaction result of power, capital and culture. Different stakeholders have cognition, perception and practice in the space which changes the appearance of the historical blocks in the natural sense, psychological sense as well as social sense.

### **113.5 Commercial Cluster Exertion of the Cluster Effect**

Only clear strategic positioning and space innovation are not enough, as the main part of tourism and business operation, the operation of cultural theme blocks also needs to follow the general rules of business operation, especially the application of commercial cluster effect. With the help of density economy, commercial

cluster has the effect of blocks cost advantages, organization advantages and brand advantages to come up with driving effects and forms the whole competitive advantages for the cultural theme blocks (Wang 2002).

Commercial cluster can bring the scale effect of blocks brand and can capture consumers' perceived space effectively and also can help to create and spread blocks brand quickly (Dong 2012). The higher its profile, the more firms would join in the cluster, the easier the cluster develops scale economy and external economy and the more market attractiveness to the enterprise which do not enter this field (Dai 2011). "Nanjing 1912" has attracted number of top business brands, such as South Beauty, Niher Cantonese cuisine, Mazzo, A8, Soho, Starbucks, Pizza Hut. At the same time, "Nanjing 1912" has become the rendezvous of top Fashion consumption brand. The total advertisement of Coke, Chivas regal, Budweiser each year in blocks has reached tens of millions which is more than 50 % of the total advertising expense for the brands in Nanjing, in some part, even more than 80 %. In addition, "Nanjing 1912" has helped more than 40 works of the outdoor scene of film and television photography. As the base of outdoor photography, the block has attracted more than 10 groups of feature camera or photography team per day on average. In addition, "Nanjing 1912" has become an important issue center of new cars with more than ten new car conferences held here every year. Meanwhile, more than one thousand times reception was held for the leaders from all parts of the country every year. All of these have indicated that "Nanjing 1912" has become the important platform for Nanjing city to show city vigor to the domestic and to nations and improve the city's soft power.

Commercial cluster can greatly reduce the cost and time for consumer to search goods in shops and transfer among shops, thus forming a kind of "clusters attractive", also greatly reducing the cost of block operation (Sheng and Fan 2010). After "Nanjing 1912" opened, some commodities in the shops are partly from the same producers, so commercial ads did by manufacturers for their products reduce the cost of merchants. At the same time, not only does the cluster include the convenience and elegant of consumption, but also it contains the completeness of facilities. The improvement of block environment is beneficial to the entire businesses, but the expense is huge. If merchants are only in charge of for their own business, not only is cost larger, but also unharmonious situation appears. With the help of unified planning, construction and conduction of management committee, the cost of construction and maintenance decreases. There is a remarkable attraction of "Nanjing 1912". The number of visitors has reached nearly ten thousand per day and it reaches 50,000–60,000 people in holidays. For example, a record was set that 100,000 people gathered in the 1912 blocks on Christmas Eve. In 2010, the number of consumers had reached 5 million, which can bring as high as 400 million RMB to the added value of GDP each year.

The business cluster of "Nanjing 1912" has promoted an regional economic growth and the economy growth has driven the increasing of disposable income in this area while the increasing of disposable income promotes the development of relevant industries and the increasing of labor demand which in turn, promotes the development of the commercial cluster. And the circulation forms the multiplier

effect for the commercial cluster. After the block operated formally, rental prices of surrounding commercial have risen to more than 2 yuan per square per day on average which creates an record of average rising rate of rent in Nanjing. At the same time, supporting facilities with “Nanjing 1912” at the centre, develop rapidly. The number of convenient hotel has developed from 3 to 14 which gained 470 %; KTV increases from 1 to 4 which gained 400 %. The area of culture and leisure, catering business surrounding “Nanjing 1912” has increased 80,000 square meters rapidly. There are more than 50 business households in “Nanjing 1912” which directly provides more than 5000 jobs, and indirectly creates a great number of job opportunities.

### 113.6 Profit Pattern: Achievement of Profits

In the era of low-profit competition, the competitive advantage of enterprises cannot turn into business profits naturally. Companies should rely on the innovation of profit model to make more increasing sales, revenues and profits than competitors. Profit model needs to define customers, and chooses customers (Zhou and Tang 2009). Also it raises the value proposition to the customers so it offers appropriate products and services to satisfy their needs. With the help of a certain path, or channel, products and services are sent to customers. In the meanwhile, companies get paid from customers and build a connection with them to support them. In addition, a company plays an important role in the value chain, it connects and collaborates with other companies to create values for customers together.

1. Re-define the customers and select the target market. To know customers' need is the beginning of company operation. According to customers' needs, an enterprise proposes value proposition. However, customers' need usually changes. Under this circumstance, re-defining customers is needed. A company re-defines customers, chooses new target customers and comes up with new proposition to innovate profit model (Duan and Li 2007). Considering the characteristic of customers, especially young people who are into fashion and the situation that leisure districts of Nanjing is out of order and Nanjing doesn't have the symbol place for night life, “Nanjing 1912” relies on its characteristic to shows styles of Republic and operates as a block. “Nanjing 1912” is welcomed by customers, for the reason that, not only does it provides a relax place, but also it makes customers to feel the cultural atmosphere and matches the young's needs of pursuing fashion.
2. Strengthen management communication, and promote the relationship integration of stakeholder. In the innovation of profit model, changes will arise inevitably. Sufficient communication is needed that shareholder, employees and other stakeholders can reach agreement on the interest produced by innovation of profit model. Also communication can encourage enthusiasm and ensure the

implementation of innovation. A company should create suitable environment, use management methods and develop enterprise culture to promote a new round of profit model innovation.

In the development process of “Nanjing 1912”, it emphasizes the connection with 4 elements (government, business, employee, consumer). To government—with the help of government’s design and on the basis of policies and its own development planning, “Nanjing 1912” enhances the relationship with government. On one hand, government’s support contributes to provide favorable environment for firm development. On the other hand, firm development is able to benefit tax, employment and so on. To business—by means of preferential investment conditions and excellent supporting facilities, “Nanjing 1912” attracts other firms’ investment; in the same time, with the help of strictly selection and standardize operations, “Nanjing 1912” and cooperative enterprises reach to win-win. To employee—“Nanjing 1912” focuses on training and education and conveys its culture and values so that employees can know them very well and have a sense of belonging. In this way, they can make progress with the firm. To consumer—“Nanjing 1912” continues to highlight its own characteristics and conveys its culture conception to consumers. What “Nanjing 1912” wants to bring to consumers, is more that just consumption, is the experiences of leisure and feelings of culture.

3. Timely to change the profit model and develop a unique value network. In a highly competitive environment, value and profit often move in the industry value chain. The most profitable part of the value chain today may be in trouble tomorrow and the value chain can be broken, compression and re-integration. Considering the segment of profit and its own strength, a firm should select a reasonable position in the value chain. “Nanjing 1912” is eager to develop the relationship with suppliers, distributors and partners to give full play of synergy effect and form a network providing value for customers. A firm who contains a unique value network can have an advantage difficult to imitate. This forms an important thinking of business model innovation.

In the development process of “Nanjing 1912”, it changes its profit model duly to adapt to environmental change to develop better. So far, the profit model of “Nanjing 1912” has been changing three times. In the era of version 1.0, the profit model is traditional “second-landlord” model. In this stage, “Nanjing 1912” is unprofitable. In the era of version 2.0, Nanjing 1912 group collaborates with local government and developers and pursuits more ways of cooperation. And it also involves in the development, implementation planning and construction of projects to create a regional benchmarking projects and lead the development direction of regional economy. In the era of version 3.0, Nanjing 1912 group involves in land operations directly and it pays equal attention to operation and development. In this era, Nanjing 1912 group serves as the role of the Chinese Urban Culture Business Integration operator which is trying to lead the breakthrough innovation of commercial pattern and tap the charm of the cultural consumption of fashion to meet the spiritual needs of the urban consumers.

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# Chapter 114

## Formation and Transcendence: Institutional Change from Moral Autonomy to Heteronomy

Yi-fang Li

**Abstract** The transition of morality from autonomy to heteronomy is determined by examining the historical characteristics of the period of social transformation in China. Moral education, alone, has not been sufficient enough to solve the problem of a changing morality. The transformation of moral autonomy to moral heteronomy has become an inevitable method to solve this problem. Change in external conditions surrounding the moral life of a society, brought about by the transition of the old to the new, has led to a growing disparity of social lifestyles, and created a “moral vacuum”. Society is in bad need of constructing an institutional environment of morality in order to lead by example. If we want to propel the advancement of morality through institutional change, then morality must advance through institutional change, and keep pace and coincide with institutional evolution, conforming to the character of the institution as it undergoes change. Examining the transition from moral autonomy to moral heteronomy, we will proceed along three pathways: (1) by reinforcing building administrative ethic rules and administrative legislation; (2) by strengthening established professional ethics and industry legislation; and (3) by enhancing social morality education and public legislation.

**Keywords** Morality · Autonomy · Heteronomy · Institutional change

Since the advent of reform and opening up in China, productivity of our country has greatly improved. However, as a consequence, a negative phenomenon has arisen in the area of morality which discourages healthy economic growth and sustainability, and goes against the established social order. Moral autonomy, once venerated as an effective means of social control, has not yet been proven to be effective in changing a social moral order. Social moral restraint is needed for the

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purpose of allowing a purely autonomous society to develop into a heteronomous one. Effort exerted in both areas will be required in order to provide the support needed to promote moral development in an economic society.

## **114.1 Morality and its Restraint Mechanism**

### ***114.1.1 Connotation of Morality***

Morality is a unique social phenomenon found only in human society. It is fixed by the demands of economic relations and is maintained by people's inner beliefs, public opinion, and traditional customs. Morality reflects the ideology of good and evil, beauty and ugliness, favoritism and impartiality, honesty and hypocrisy, justice and injustice, etc. Standards of ethical behavior correspond intimately to these ideas. Morality is a mirror reflecting society's moral consciousness, moral criterion, and moral activity.

### ***114.1.2 Moral-Restricting Mechanism: Moral Autonomy and Moral Heteronomy***

"The basis of morality is the autonomy of human spirit." Moral autonomy refers to a moral agent's internalized sense of moral awareness and self-consciousness when consciously performing moral obligations and responsibilities, to the exclusion of any external factors such as people or society. It is the moral agent's inner recognition of moral principles. It is a kind of self-restraint, self-supervision, self-control, and self-management. In short, moral subjects perform moral behavior by their own moral standard, independent of external forces. The basic function of self-discipline is internal sanction. Autonomy is not only the observation of regulation by one's own free will, but also the activity. According to the cognition of environment, social norms, and morals, along with self-knowledge, individual subjects appear to identify matters which should not be acted upon while, at the same time, they appear to identify what matters should be acted upon persistently, as well as what matters should stop, and where they should stop.

Moral heteronomy precedes autonomy. It is aware of the other. It is the disciplined form of morality that operates before moral values and ethical standards internalize as people's inner belief, and acts as their self-disciplined consciousness. External factors are the binding force and orientation of moral heteronomy rather than the moral subject itself. It is not the recognition of inner moral principles, but the subject of the moral agent itself who is subject to the ethics by external force. It fundamentally functions in response to external sanction.

In order to distinguish moral autonomy from moral heteronomy, scholars, led by L. Kohlberg, proposed nine standards: (1) freedom; (2) mutual respect; (3) reversibility; (4) constructive ability; (5) internality; (6) hierarchy; (7) prescription; (8) universality; and (9) selection. It is believed that people in society distinguish, judge, and comment on autonomy and heteronomy in light of these nine standards Guo (1999).

Moral autonomy is predicated on moral heteronomy, and contains it. The moral norm is the social order as defined by the behavior of the people. Approved and accepted by the people at-large, the moral standard reflects moral reason in conjunction with the overall interests of society, and acts as a kind of parameter, guide, and inspiration to individual will. Moral autonomy gradually absorbs and accepts morality as conveyed by moral heteronomy: Its influence—via external heteronomy, as determined by the society and the other—is transformed into the moral agent's inner moral emotion. In the process of consciously accepting heteronomy conduct is the certain behavior of autonomy.

## 114.2 Disordered Moral and Reason of It

Moral norms play an effective role in traditional society. However, in the course of societal transformation, social morality falls out of sync, and a moral crisis emerges. Insufficient efforts to raise ideological and ethical standards can lead to moral decline. As China transitions from a planned economy to a market economy, calculated rationality increasingly influences people's thoughts and behaviors. Autonomy is not adequate enough to rely on the judgment of people. As the breadth and depth of interaction rapidly expands, one-off situations among people also increase, and the community suffers. People are no longer concerned about retribution when the interests of others are damaged. Although they recognize that it is immoral to harm the interests of others, rational calculation often leads individuals to serve their own self-interest. A relatively ordered, moral life hinders not only upon successfully developing an economically healthy and sustainable life, but also upon building a just social order.

Social transformation, by its very nature, lowers morality. The market economy is defined by an economic system that only succeeds when it realizes the most profitable allocation of various kinds of social resources Wengu (1993). It assumes that each subject engaging in economic activity has cultivated a corresponding personal morality in conjunction with the economic activity. It is expected that each subject assume certain moral responsibilities and obligations in order to participate in the market economy. It is reasoned that people must follow a prescribed moral norm: Integrity is the true faith of economic activity. But in a period of social transformation, the old system still exerts power and it is difficult to eliminate its influence in such a short time. People begin to rely on rational calculation for their behavior. The new system begins to arouse the instinct of "material desire" in people. It overwhelms the older inhibitions of the existing

system by encouraging the pursuit of success at any cost to the other. It breeds selfishness as it violates moral conscience in favor of personal self-interest, ruthlessly trampling on the interests shared by society as a whole. The market economy, although affirming the reasonable pursuit of individual interest, finally, creates extreme individualism, and immoral egoism. Therefore, society is in urgent need of constructing a moral institutional environment so that all people can share in the rewards of the market economy.

### **114.3 The Institutionalization of Morals: The Premise of the Transition from Moral Autonomy to Heteronomy**

#### ***114.3.1 Connotation of Institutionalization of Morals***

In a rational world, institutions would have no reason to exist. However, society can only grasp partial information when facing the complexity of reality, and, even then, is limited in its ability to process it. Therefore, it is unrealistic to rely merely on moral autonomy. When uncertainty accumulates, bounded rationality results Xianxiang and Qiaoling (2007), and institutions are needed to guide and regulate moral behavior. Moral institutionalization refers to the regularization of moral requirements, moral regulations, as well as ethical requirements which exert an external influence on the individual, transforming intrinsic moral consciousness into rigid constraint in order to enforce members of society to fulfill corresponding obligations and responsibilities in family and social life Li (2006). It implements strict management and supervision on the behaviors of individuals and groups by stimulating individuals to make moral and ethical behavior choices with external incentives, or by enforcing moral rules with compulsive force. By institutionalizing specific, operable moral norms, the institutional environment of morality achieves the standardization and codification of morals, and, by restraining and normalizing moral conduct, society functions more effectively.

#### ***114.3.2 Necessity of Institutionalization of Morals***

1. Change in external conditions of moral life. Farming land confines the societal boundaries of farmers, and promotes close community ties wherein people share in mutual benefit. Moral supervision is easier to manage. Regulating moral modes with people who share customs and public opinions often have a better effect on people when they are familiar with each other and have long-term, daily interaction. The French sociologist, Emile Durkheim, holds that the more moral significance exchanged and influenced on each other by people, the more strongly

we perceive, and the greater the role it plays in our lives. On the other hand, with the development of a market economic society, the traditional “acquaintance society” has been eliminated. In the new, “strangers society” of the market economy, close, emotional relationships dissolve, and public opinion fails to play a powerful role in controlling and restraining morality in society.

2. Growing disparity of social lifestyles. The moral code of the market economy has proven inadequate in creating an environment of public opinion to support the continuation of traditional morality. It has been unsuccessful in stimulating emotional support to coordinate the interests of the group or society as a whole. Self-interest has replaced group interest. Individuals move away from the community and become disconnected from traditional family life. The growing disparity of wealth has created inequality and uneven access to consumer products that directly impact social lifestyles. This behavior endangers the social order. In order to reintegrate people into the social order, moral standards of behavior must once again appeal to a unified, social conscience. This can only be achieved within the mandatory institutional environment of morality. Only with the support of compulsive moral legislation produced by the institutional environment of morality can morality be restored.
3. “Moral vacuum”. During the social transformation period, the old moral constraints faded, leaving new moral constraints that have yet to be fully defined. Then something unexpected happened. Social moral values became disoriented and anomie resulted, weakening any mechanism of moral control. The community could no longer rely upon its own operating mechanisms or call upon morality to be righteous in the face of a deteriorating general moral tone. To end the instability of moral autonomy and reestablish the proper functioning of social interaction in the future, the construction, operation and coordination of a new social mechanism is required.

## **114.4 Institutional Change: From Moral Autonomy to Moral Heteronomy**

### ***114.4.1 Necessity and Possibility of the Transition from Moral Autonomy to Heteronomy***

The transition of morality from autonomy to heteronomy is determined by examining the historical characteristics of the period of social transformation in China. In the process of transforming traditional society into modern society, we have discovered that modern society is ill equipped to cope with relationships that are dependent on traditional moral education and individual self-discipline. The relatively stable traditional value system is out of balance, and the new moral system has not yet been fully established. This has led to a society devoid of

spiritual beliefs, values and a reasonable moral code. Moral education alone cannot solve the problems caused by lack of morality. It has now become inevitable that a society based on moral autonomy must be transformed into a society based on moral heteronomy in order to solve the problems.

First of all, institutional change requires time. Though institutions can maintain relative stability, it changes slowly. Change, brought about by the relative price of resources, and the interaction of different interest groups, drives institutions. But the evolution of an institution is not only a long-term process of natural development, it also has its own features. "The structure dominating the way we operate is made up of the formal rules, behavior of informal standards and their enforcement characteristics. Of all can we quickly change are the formal rules. We can't change the informal constraints, at least in the short term; even our controlling ability on implementation is also very limited North (2004a, b)."

Therefore, if we want to promote the development of China's market economy through institutional change, we should consider the pace at which institutions evolve, and the characteristics of the institution. "When you work hard on improving economic performance, you can only change the formal rules, this is a very real problem. In fact, you have to change the informal constraints North (2004a, b)." Only gradual and steady development of institutional change can achieve effective economic performance.

Institutional change is path-dependent. North explains that the institution evolves gradually, the past and now is closely related with the future; they are so closely related that history in general is a kind of story of institutional evolution North (1991). Different societies and even different nationalities may possibly choose differing institutional forms "The reason why institutional structure shows path-dependence is that the past behavior, cultural beliefs, social structure and organizations influence values and social development, and thus suppress the flexibility in departure from the old behavior pattern Drobak (2003)." Since our reform and opening up, China has gradually moved into the market economy which is, in and of itself, a type of legal, institutional economy. All the activities of the institution require guarantees of law. Therefore, in the process of morality development, we must follow the same principles of institutionalization. All the rights and obligations that exist between people, the boundaries of behavior, the rules, and principles should also be respected and enforced. This demands inevitable planning from institutions and the legal system and, so, the transformation of moral autonomy to moral heteronomy also becomes inevitable.

#### ***114.4.2 Path of Change from Moral Autonomy to Moral Heteronomy***

Transforming moral autonomy to moral heteronomy works to settle moral problems by legal and institutional means. Just as an institution must undergo change, so morality must change from autonomy to heteronomy. There are two key

requirements that set institutional change in motion: Either it must be mandated or induced to change. Mandatory institutional change is created by the government with the power of the state behind it in accordance with the needs of both the developing economy and society. Without the expressed approval of its societal members, the institution must innovate regardless. Institutional innovation is carried out top-down with the government at the top representing administrative institutional innovation or institutional innovation is mandatory. Induced institutional change is advocated, organized, and implemented by individual or a group of individuals who are opportunists seeking spontaneous benefits Lin (1991). Both mandatory and induced institutional change create specific jobs to construct the moral standards, with the moral legislation undergirding the moral requirements and ethics binding certain social members to the institution and the law. This permits the request to be standardized and clarifies the form as expressly stipulated to ensure the implementation of morality by means of law. In realizing the transformation of morality from autonomy to heteronomy, the key requirements are then accomplished in the following three ways:

1. Reinforce building administrative ethic rules and administrative legislation

Administrative personnel are in charge of a certain degree of public authority. They have some discretion when handling public affairs. If there is no moral restriction, it is possible for abuses of power to occur. This kind of behavior will not only damage the interests of the people, but also directly affect social morality. Therefore, pursuing the construction of the institution of administrative ethic rules and the administrative legislation can prevent or reduce power corruption, and improve the whole social moral environment.

To reinforce the building of administrative ethic rules and administrative legislation, we can look to the successful experiences and practices of foreign institutions. Foreign countries have been constructing moral standards and law since very early times. In particular, the United States, Canada, Britain, Germany, and other countries have enacted similar moral codes. Many Asian countries have also promulgated clear administrative ethic rules and regulations. China should follow the lead from successful experience abroad, so as to promote the rapid development of their moral construction. At the same time, it must establish supervision mechanisms, ensure the rules and legislation are effectively and practically implemented. This will have an immediate impact on the improvement of administrative morality.

2. Strengthen the establishment of professional ethics and industry legislation

The following two ways are considered for strengthening the establishment of professional ethics: First, establish industry association and formulate industry norms. The professional moral standard formulated by industry association has a very strong binding effect on industry practitioners. Strictly speaking, the professional moral standard, based in law, provides the dual function of projecting charisma and applying force of sanctions. Therefore, establishing industry

association strengthens professional ethics as it can more fully benefit from induced institutional change. It adds great weight to improving the moral level of internal employees and cultivates morality in general. Second, strengthening industry legislation legalizes and regulates professional ethics and its rules. Violating professional ethics, or behaving in such a way as to profane professional ethics will be punished severely to discourage illegal or irregular behavior. Violating professional ethics must not only be condemned by public opinion, but also receive sanctions from industry legislation.

### 3. Enhance social morality education and public legislation

In addition to strengthening the administrative areas of the institutional environment of morality and the professional ethics of various industries, it should also enhance the moral construction and legislation in the area of public life. Up until now, public opinion has played the role of China's public life to safeguard traditional customs and the people's moral self-consciousness in an attempt to preserve moral order. However, influenced by the morality of the market economy, traditional morality has deteriorated and the calculated rationalism of the people has only grown stronger in direct proportion to the dissolution of social justice and sense of shame that follows. Social justice ethics and moral fundamentality are destroyed. It is necessary to promote the construction of social morality, and enhance the public morality propaganda and education. It is also necessary to reinforce the establishment of public ethics and morals legislation in order to promote and strengthen social morality construction in the form of institutions and law.

## 114.5 Conclusion

The moral autonomy and heteronomy exist simultaneously. Morality is man's voluntary pursuit of conscience; moral autonomy. As Kant pointed out, "The concept of autonomy and freedom connects each other inseparably, the universal law of morality is always accompanied by the concept of autonomy Kant (2005)." The moral heteronomy provides a simple approach for the effective functioning of morality. Although moral autonomy and heteronomy coexist, it is the irrational institutional structure that attempts to use one kind of institution to replace the other completely. Moral heteronomy can only be a part of the institutionalization of morality. We should not institutionalize all ethics—it is an impossibility—or it will deny the existence of morality all together. In the process of moral transformation from autonomy to heteronomy, we ought to be mindful of our limitations. Institutions must coexist with its agent subjects. It needs to be operated by people who have proven to have good moral character in order to cultivate effective performance and maintain its sense of urgency and authority.

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# Chapter 115

## Empirical Study on Social Responsibility Evaluation of Listed Hotels Based on Set Pair Analysis

Zhong Wang, Lan Hu and Ying-wen Deng

**Abstract** Social responsibility problems of Listed Hotels have increasingly attract social concerns in their business processes. From the view of the investors, this paper constructs an indicator system of social responsibility evaluation for listed hotels, then provides and analyzes an empirical study with the set pair analysis model. Finally, we give our suggestions for the results.

**Keywords** Corporate social responsibility · Indicator system · Listed hotels · Set pair analysis

### 115.1 Introduction

Recently, the hotel industry has got great successes guided by collectivizing and international development. As the leading companies of the hotel industry, listed hotels have achieved rapid development. In 1993, Jin Jiang Hotels was listed and got a good start in listing of hotel industry. Then hotels all over the country

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concentrated competitive resources to list. However, a series of social responsibility problems appeared in the business processes. For example, increasing employees' work hours and intensity opposed to their unreasonable income, infringing consumer interests, evading tax and so on. All these reflect listed hotels lack the cognition of social responsibility and manage passively to social responsibility performance. In addition, listed hotels' sustainable development is also influenced. Therefore, it is meaningful to do empirical research on social responsibility evaluation of listed hotels.

## **115.2 Literature Review**

The concept of social responsibility arose in the beginning of the twentieth century, many domestic and foreign scholars read corporate social responsibility from different angles, which greatly enriched the connotation and extension of social responsibility.

### ***115.2.1 Review on Foreign Research***

Bowen (1953) defined social responsibility as their goals and values requirements in the society which enterprises followed when they making relevant policy, corresponding decision and taking the ideal concrete action. McGuire (1963) thought it is too narrow to only consider economic and legal responsibility, corporate social responsibility should include more widely content. Carroll (1991) broadened the dimensions of corporate social responsibility, which should include economic, legal, moral and charity responsibility. It seemed to Adams (2004) that corporate social responsibility included the quality management, environment management, brand effect and consumer loyalty, etc.

### ***115.2.2 Review on Domestic Research***

Our country is among the latecomers to the research of corporate social responsibility. Yuan Jia Fang is the earliest scholar defined the concept of corporate social responsibility. Qu (2003) thought that it was the different stakeholders' positive reaction in business processes, here stakeholders included the staff, our business partners, consumers, community and country. Zhou (2005) believed that the objects of corporate social responsibility include each related stakeholder. Meanwhile, corporate social responsibility included not only economic responsibility but also moral and legal responsibility. Zhang and Lilong (2007) thought enterprises should pursue the value of all stakeholders'.

More and more scholars combine corporate social responsibility and stakeholder theory to study problems Ye and Cao (2008), Jawahar and McLaughlin (2001), Wood and Jones (1995), Yao et al. (2007), Cornell and Shapiro (1987).

### 115.3 Methodology

On the basis of review on corporate social responsibility, this section firstly we will choose listed hotels as research objects, secondly, attempt to establish a scientific and reasonable social responsibility evaluation indicator system, thirdly, determine the indicator weight by AHP method and then introduce the empirical analysis model–set pair analysis model.

#### *115.3.1 The Construction and Weight of Social Responsibility Evaluation Indicator System*

We also choose stakeholder theory as the theoretical basis when we establish the social responsibility evaluation indicator system for listed hotels, which is the same as the scholars' before. In this paper, firstly, we invite college professors and senior managers who work in the relevant field to do questionnaire survey. Secondly, we do discrimination analysis and correlation analysis on the basis of received questionnaires' indicator data. Finally, we establish a scientific and reasonable social responsibility evaluation indicator system which is classified into investors layer, government layer, employees layer, environment layer, customers layer, suppliers layer and charity layer. Each layer contains several indicators, it totals 28. Then, we use AHP method to establish the weight of social responsibility evaluation indicator system for listed hotels. Because of space limitations, here we don't list specific 28 indicators and their weight data.

#### *115.3.2 The Construction of Set Pair Analysis Model*

Set pair analysis theory is put forward in 1989 by scholar Zhao (2000), which is used to analyze certainty and uncertainty relations.

1. The basic thoughts of the set pair analysis. Now we suppose in a certain problem background (set to  $W$ ), two sets form a set pair  $H = (A, B)$ , which have  $N$  characters but no weight differences. We suppose  $S$  is the number of identical characters of  $N$ ,  $P$  is the number of opposing characters of  $N$ , the rest  $F = N - S - P$  is the number of not completely identical and opposing characters. Then we use  $S/N$ ,  $F/N$  and  $P/N$  which is the set pair  $H$  in the background of  $W$

to represent the same degree, the different degree, the opposing degree (Du 2011). If we use  $\mu(W)$  represent the relation degree, then we can refer to the follow expression (115.1):

$$\mu(W) = \frac{S}{N} + \frac{F}{N}i + \frac{P}{N}j \quad (115.1)$$

$i$  is the difference degree coefficient, value  $[-1, 1]$ ,  $j = 1$ , for opposition degree.

2. The construction of an evaluation matrix Xiao and Hu (2008). We suppose evaluation sets include  $M_1, M_2, \dots, M_n$  listed hotels, then we use  $C_1, C_2, \dots, C_m$  to represent evaluation indicators and  $d_{ij} (i = 1, 2, \dots, n; j = 1, 2, \dots, m)$  to represents the value of indicator. Meanwhile,  $I_1$  and  $I_2$  mean efficiency indicator (the bigger the better) and cost indicator (the smaller the better), so we establish the social responsibility evaluation matrix  $H$  in the expression (115.2):

$$H = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1n} \\ d_{21} & d_{22} & \cdots & d_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ d_{m1} & d_{m2} & \cdots & d_{mn} \end{bmatrix} \quad (115.2)$$

We select the optimal value of the indicators from the evaluation matrix  $H$  to constitute an ideal scheme vector  $M_0 = [d_{01} \ \cdots \ d_{0j} \ \cdots \ d_{0m}]^T$ . In the vector,  $d_{0j}$  means the optimal value of the indicator  $j$  of the listed hotels. We compare those indicator  $d_{ij}$  of the matrix  $H$  to those indicator  $d_{0j}$  of the ideal scheme vector, then we can get an same degree matrix  $Q$  in the expression (115.3), which is not taking weight into consideration. In the matrix  $Q$ ,  $a_{ij}$  represents the ratio of  $d_{ij}/d_{0j}$

$$Q = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} \quad (115.3)$$

3. The construction of an evaluation model. According to the weight  $W$  of indicator system and the same degree matrix  $Q$ , we can get an same degree matrix  $R$  in the expression (115.4), which is taking weight into consideration.

$$R = W * Q = (a_1, a_2, \dots, a_n) \quad (115.4)$$

In the matrix  $R$ ,  $a_i (i = 1, 2, \dots, n)$  means the same degree of the  $i$ th listed hotel' social responsibility compared to the ideal scheme's. According to the value of the  $a_i$  of the  $R$ , we sort the selected listed hotels from great to little, which is positively related with  $a_i$ .

4. The construction of an multilevel evaluation model. A two levels set pair analysis evaluation model are got in the expression (115.5) by dividing the indicator set  $C = \{C_1, C_2, \dots, C_m\}$ .

$$R_0 = W * Q = W * \begin{bmatrix} \omega_1 * a_1 \\ \omega_2 * a_2 \\ \vdots \\ \omega_n * a_n \end{bmatrix} \quad (115.5)$$

$W$  means the weights of the factors of  $C/P = \{C_1, C_2, \dots, C_n\}$ , for example,  $W_i$  means the weight of the  $k$ th factor.  $Q, Q_i$  mean the same degree matrix of  $C/P, C_i$ , which are not taking weight into consideration.  $R_0$  means the same degree matrix of  $C/P, C_i$ , which is taking weight into consideration.

## 115.4 Empirical Study

In the front part, we introduced the researched objects, discussed the theory method and the model which will be took. Now, in this part, evaluation indicator system and set pair analysis model will be applied to selected appropriate samples.

### 115.4.1 Introduction of Samples and Data Source

The sample selection follows the principles of data availability, efficiency and reliability. And eventually 9 listed hotels are selected from all over the country. They are Dongfang Hotel (000524), Xindu Hotel (000033), Huatian Hotel (000428), Jinjiang Shares (600754), Xi'an Diet (000721), Science Town (000975), Wanhaowanjia (600576), Jinling Hotel (601007), Quan Ju De (002186). Sample data derive from the Annual Report of Listed Hotels, Shanghai and Shenzhen Stock Exchange Websites, Security and Financial Website Reports and so on. In this paper, we will select the 9 listed hotels' social responsibility evaluation indicator data from 2008 to 2010, then choose the average as the final indicator value. Due to limited space, we won't list specific data.

### 115.4.2 Empirical Results Analysis

According to the introduction of the set pair analysis model and its operation steps, we use the original indicator data to construct the first level evaluation matrix  $H_{B1}, \dots, H_{B7}$ , then combine with the indicator weight  $W_1, \dots, W_7$ , finally, calculate the first comprehensive evaluated results, which is shown in the Table 115.1.

**Table 115.1** The first layer comprehensive evaluated results

Results	Xindu hotel	Huatian hotel	Dongfang hotel	Xi'an diet	Science town	Quan Ju De	Wanhao wanjia	Jinjiang shares	Jinling hotel
B <sub>1</sub>	0.2409	0.5287	0.1644	0.3937	0.2459	0.6561	0.3873	0.5697	0.3531
B <sub>2</sub>	0.1598	0.0361	0.1644	0.1453	0.0627	0.6719	0.3281	0.0000	0.6719
B <sub>3</sub>	0.2719	0.5237	0.3427	0.3481	0.6587	0.4604	0.1794	0.3733	0.2896
B <sub>4</sub>	0.9105	0.3657	0.3496	0.2373	0.7410	0.6654	1.0000	0.4821	0.6555
B <sub>5</sub>	0.2682	0.2626	0.0306	0.4423	0.2080	0.5832	0.2795	0.3242	0.2443
B <sub>6</sub>	0.3251	0.5795	0.2304	0.2908	0.9892	0.3857	0.2421	0.6699	0.3652
B <sub>7</sub>	0.0129	0.2207	0.3014	0.0943	0.0127	0.2045	1.0000	0.0000	0.0204

**Table 115.2** The second layer comprehensive evaluated results

Results	Xindu hotel	Huatian hotel	Dongfang hotel	Xi'an diet	Science town	Quan Ju De	Wanhao wanjia	Jinjiang shares	Jinling hotel
B	0.3802	0.5488	0.2427	0.4334	0.5002	0.7857	0.5512	0.5483	0.5298

According to the first layer comprehensive evaluated results in Table 115.1, we calculate the second layer comprehensive evaluated results, which is shown in the Table 115.1.

From the Tables 115.1 and 115.2, listed hotels' social responsibilities which perform to investors, environment, employees, suppliers, government, customers and charity are different. The total score falling on the interval of  $[0.7, 1]$  is the Quan Ju De. The total score of Wanhao wanjia, Huatian Hotel, Jinjiang Shares, Jinling Hotel and Science Town are fall on the interval of  $[0.5, 0.7)$ . The total score falling on the interval of  $[0.3, 0.5)$  are Xi'an Diet and Xindu Hotel. Dongfang Hotel's total score is the lowest, which is in the interval of  $[0, 0.3)$ .

1. In the interval of  $[0.7, 1]$ : In all the samples, Quan Ju De has the highest social responsibility total evaluation score of 0.7857 in performing social responsibility as a whole. Especially the input relative strength in investors, environment, government, is the largest of the sample. Checking the original data, it is known that Quan Ju De performs well in making profit for shareholders, using its own capital' efficiency, designating and implementing enterprise environmental protection plans and detailed rules, abiding by relevant tax laws and regulations and contributing to the government. So it is the one that is worthy of imitation
2. In the interval of  $[0.5, 0.7)$ : This is the most numerous interval. Wanhao wanjia's social responsibility total evaluation score is far ahead of others in performing social responsibility to suppliers and the charity. But it is badly behind others in performing social responsibility to employees. The reason was that the rate of its employees' salary increase is a negative value for three years during the research period. Huatian Hotel performs social responsibility smoothly to stakeholders. Jinjiang Shares performs social responsibility badly to the environment and the charity. Jinling Hotel performs very well in

social responsibility to the environment, which keeps up with Quan Ju De. But Jinling Hotel's interest in the charity is not enough. Science Town stresses on employees' income and development, customers' benefit, so it performs well in social responsibility to employees and customers.

3. In the interval of  $[0.3, 0.5)$ : Xi'an Diet and Xindu Hotel fall on this interval. They perform social responsibility badly to stakeholders. Looking back upon the original data, Xi'an Diet has the bad ability to suppliers' payment, so it is difficult to perform social responsibility to suppliers. Although Xindu Hotel's each score is not at the back of a lengthy queue, its evaluation result is on the low side. Listed hotels in this level should strengthen the social responsibility consciousness and perform the social responsibility actively.
4. In the interval of  $[0, 0.3)$ : Only Dongfang Hotel falls on. It has the total evaluation score of 0.2427, the weakest one in performing social responsibility in all samples, especially to suppliers, the government and customers. Looking back upon its original data, it is not hard to find that its indicators such as making profit for shareholders, using its own capital' efficiency, designating and implementing enterprise environmental protection plans and detailed rules, the rate of the sales growth are always in the native states. All these show that Dongfang Hotel should need change its development programs to improve its market competition advantage.

## 115.5 Conclusions

Form the view of the investors, this paper constructs a normative and reasonable indicator system of social responsibility evaluation for listed hotels based on the stakeholder theory, then analyzes an empirical study with the set pair analysis model. The final empirical results show that most of the listed hotels' performance in social responsibility in our country is not enough in the background of the further promotion of sustainable development. Therefore, listed hotels should take active measures to improve the effect of social responsibility performance. Firstly, listed hotels should strengthen social responsibility consciousness and foster employees' social responsibility. Secondly, listed hotels should improve the social responsibility report and other information disclosed mechanism, in order to provide information evidence for listed hotels to evaluate their social responsibility performance effect. Finally, relevant departments can implement policy to standardize and guide social responsibility goals of listed hotels, so that they will be more conscious to consider performing social responsibility to stakeholders during the operation process.

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# Chapter 116

## A Study of Coping Strategies in Emergencies with Group Panic in Large Public Places

Han Wang, Yue-ning Bai, Chun-dong Zheng and Xiao-liang Li

**Abstract** It may cause group panic if a disaster happened in a large public place, and coping strategies could be influenced by group panic. This paper analyzes the characteristics of large public places and the psychology of people in a large public place, then indicates the causes of group panic and summarizes four influences of group panic. At last, this paper suggests four coping strategies using psychology: informing, action, information, enhancing and improving crowd's quality, and brings forward the details in emergency management. It concludes that through effective psychological interventions and detail management, group panic will be largely removed in emergencies in a large public place.

**Keywords** Emergency evacuation · Emergency management · Group panic · Large public places

With the rapid development of global economy and the increasing demand on living quality, the number of large public places presents a remarkable growth. Large public places usually means a place featured by crowded people stream, enclosed and complicated building structure, sophisticated business functions, such as cinema, stadium, railway station, subway, business center, super market, shopping arcade and so on. Due to the features mentioned above, it is very likely to cause casualties and property damage in case of emergency in a large public place, such as fire, explosion, or the even worse, terrorist attack. Therefore, the emergency management in large public places becomes more and more important (Cui et al. 2005).

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Group panic is commonly associated with emergencies because of the large crowd in large public places. The false information in many cases will worsen public panic and thus make coping with emergency more difficult. Moreover, the group panic may result in secondary disasters. Therefore, emergency coping strategies with group panic are also becoming more and more important. In this paper, we apply social psychology, emergency management and other knowledge to analyze group panic in large public places and suggest some coping strategies with good feasibility.

### **116.1 Overview of Emergency Coping Strategies and Group Panic**

Although various efforts can be made to reduce the chance of emergencies in large public places, an emergency situation may still happen. Evacuating people as soon as possible out of the place in emergency can considerably decrease the number of casualties. Therefore, emergency evacuation is one of the core coping strategies in handling public place emergencies.

Intensive studies of emergency evacuation have been conducted in many countries. They utilized advanced computer technologies to propose numerous evacuation models and developed various kinds of analysis and simulation software. Helbing et al. (2000) proposed Social Force Model. This model considers different evacuation occasions of panic behaviors and lays a good foundation for subsequent models. Cui et al. (2005) classified Social Force Model and other models into a note-arc and grid-base model according to the difference among architectural environments and proposed an individual evacuation model in public places based on the concept of grid-base concerning individual characteristics and conformity behaviors. And then Li et al. (2006) introduced a facilitator into individual characteristics and conformity behaviors and investigated the facilitator of evacuation in detail. Cui et al. (2008a) investigated the moving path of the facilitator and proposed the optimal algorithm of dynamic facilitator moving path. In the same year, taking the advantages of the multi-intelligence body in complex system modeling, Cui et al. defined a evacuated person as “agent” and constructed a new evacuation model which simulates the responses of facilitator under the condition of guiding function, fire spread and random obstacles, etc (Cui et al. 2008b). Zhang and Tian (2009) further discussed the characteristics and limitations of these evacuation models and pointed out the trends of future research. Using Social Force Model, Li et al. (2010) investigated the evacuation efficiency of auto gates and escalators in case of a panic.

Some researchers carried out their studies from the viewpoints of building and disaster itself and proposed suggestions and coping strategies for emergency evacuation. Huo et al. (1999) analyzed the spread of fire and people’s reaction timeline and put forward the factors influencing people’s evacuation. Zhao (2009)

examined the factors influencing the evacuation from the perspective of fire safety and brought forward eight constructive safety precautions. There is plenty of research in emergency evacuation; however, the investigation of public panic is not adequate.

Since the emergence of SARS, the panic in emergency has attracted more attentions. Wang and Lin (2003) investigated the fear caused by SARS. They pointed out that the feeling of hollowness is natural and has practical meanings. They also came up with detailed psychological mechanisms and methods to control excessive panic. Chen (2003) pointed out that timely and proper disclosure of information will effectively decrease the level of panic. Wang (2003) analyzed the cause of formation and eliminating methods of public panic in a systemic approach. From the viewpoint of sociology, Qin and Zhou (2006) studied the adverse psychological response of people in emergency with respect to the dimensionalities of public right to know, social trust, and public management. Chen et al. (2009) constructed the spreading model of panic through information computation. This laid a good foundation of studying panic spreading for more scientific research works.

As summarized above, the coping strategies in emergencies in public places are mainly from the perspective of emergency evacuation. These research works are very intensive and individual panic and group conformity behaviors have already been taken into consideration. However, there is no further study about group panic, the consequence of which is much more serious than that of group conformity behavior. Therefore, this paper thoroughly extends the study of coping strategies in emergency with group panic occurring in large public places.

## 116.2 Reasons Causing Group Panic in Large Public Places

Solomon (1998) pointed out that a serious emergency is a kind of situation in which individuals are not able to resist and lose control. The individual in such a situation may be at a loss and disabled. When most individuals exhibit panic emotions, it can be confirmed that the group panic have happened in the group. Strictly speaking, group panic is the psychology of fear and nervous emotions in the whole group and causes irrational and non-cooperation behaviors dominated by this psychology state when a given group is facing a sudden or an unimaginable threat.

Group panic is a kind of public panic. It specifically refers to the panic of a certain group. Public panic is mainly influenced by mass communication, rumor, pressure from the crowd and collective behavior (Wang 2003).

Once group panic breaks out in a large public place, it has four characters which are also the causes for the formation and spread of panic. Firstly, the subject of the group panic is the group of people in public place instead of social public. The

scope of the subject has a certain restriction and the panic spreads more rapidly. Secondly, the group panic being studied in this research is caused by emergency and actual event. However, we cannot assure the equal level of recognition to the event between the group and the administrator of the public place. That is to say, false information may be generated in the group by information asymmetry. Thirdly, people in group panic are personally experiencing the event instead of acquiring it from the mass media. Thus the panic is more likely to happen psychologically. Fourthly, the physical environment of a large public place is usually finite and even enclosed and the density is usually very high. The crowded group makes people worry about failing to escape and thus makes people panic.

When an emergency happens, the public usually has adverse psychological changes, including fear, anxiety, pressure, frustration, attack, guilt, conformity and excessive prevention (Qin and Zhou 2006). Although the emergency is real, people may spread some exaggerated or false information because of fear and anxiety and in turn increase the level of group panic. People will also have conformity psychology and behavior, leading to collective behavior. Collective behavior originates from three aspects: high degree of irritation and implication, emotional contagion and emotional arousal (Wang 2003). Under the pressure of the group, the individual will lose his discretion and is unable to think of the consequence of his behavior. The people in a high density will result in the most inclinable contagion of panic emotion and accelerate its spread. Therefore, once an emergency occurs, providing that the group panic is not dredged properly, the cyclical reaction of panic will be triggered and group panic will be worse.

As can be seen from above, the group panic in large public places originates mainly from the influence of emergency to the group psychology, which has random, uncertain and incremental characters. Using the Sand Pile Model, Zhang and Gao (2009) described the characteristics of panic spread. Similarly, the model can also be used to describe group panic. Different psychological changes of each individual gradually impact the whole group's psychology and behaviors. When the influence reaches a critical point, the whole group's psychology and behaviors will become unstable. Just like the last sand which leads to the collapse of a sand pile, the last subtle change in psychology and behavior will trigger group panic. Moreover, the characteristics of large public places accelerate the falling speed of sands, which increases the probability of group panic.

### **116.3 Effect of Group Panic on Emergency Management in Large Public Places**

It can be concluded from the cause analysis of group panic that once group panic occurs, the group has the following characteristics: people lose their discretion and are all at sea. They are easy to be misled by false views and conform to the idea of the group. Some people will even have psychoreactions such as attack or excessive

prevention and produce violent behaviors. However, such reactions are not common to group panic.

It can be learned that different levels of group panic may have different influence on the choice of emergencies coping strategies in large public places, especially on emergency evacuation. The authors illustrate the simple grading of group panic levels here. It is the lightest group panic if the group produces certain psychological panic but they can still clearly recognize the location of and direction to emergency exits. However, sometimes they may neglect the instructions of the guide. The second level of group panic is that some people are at a loss and cannot recognize emergency exits. Therefore the group will rush in every direction randomly and have some uncontrolled or aggressive movements. Some people may jump out from windows immediately and then many other people will follow and jump because of group conformity such as what happened in the event of September 11. The third level of group panic only happens in large-scale disasters such as various kinds of violence crimes after Haiti earthquake. Generally the group panic on such level will not occur in large public places and are out of the scope of this paper.

First of all, group panic impacts the efficiency of emergency evacuation. The purpose of emergency evacuation is to make the group leave the scene as quickly as possible while the group panic will have the most direct influence on this purpose. When the group panic is on the first level, everyone wants to be the first one who runs away from that large public place. And this is the topic that the majority of emergency evacuation models have studied, namely group conformity seriously affecting the evacuation efficiency. There are many corresponding computational methods to study this issue. However, when the level has increased to the second or the third level, people begin to lose their way and cannot recognize emergency exits, which will make the emergency evacuation more complicated. And such evacuation problems cannot be solved by a fixed model.

Secondly, group panic increases the uncertainty of emergency handling. Once group panic occurs, different people have different psychological endurance and will carry out different behaviors. The uncertainty caused by group panic of the first level is limited and it can only impact the evacuation efficiency. As the level of group panic increases, human evacuation behaviors will be different and evacuation efficiency will be under some uncertainty, which have impact on emergency evacuation for the most part and go against the method making and evacuation implementation. As the level of group panic increases, the uncertainty of emergency evacuation enhances, which further restricts the specific applications of various emergency evacuation models.

Thirdly, group panic may trigger secondary disasters. It will trigger serious stampede once there is a phenomenon such as tumble when the group lose their head. The increase of the uncertainty in group panic will trigger other more serious secondary disasters.

Lastly, group panic seriously impacts the implementation of emergency response plan. It can be known from the analysis above, group panic increases the uncertainty of emergency evacuation handling and emergency response plan itself

may be unable to be adapted in an emergency occurring in reality. During the plan revision and exercises, there is no way to enumerate all issues triggered by group panic through eigenmode. Therefore, there are many difficulties in the implementation of emergency response plan. The failure to reach related workers in a timely manner may make mistakes in emergency evacuation because of the group panic in concrete procedures.

#### **116.4 The Coping Strategies and Methods of Group Panic in Large Public Places**

Through a study of domestic and oversea literature we found that emergency coping strategies mainly focus on the efficiency increases of emergency evacuation. It largely guides the design of public buildings and other infrastructure facilities and simulates different forms of built environments and disasters by computing emergency evacuation models. But this is only the precaution or proactive preparation. Emergencies themselves are various and it is impossible to cope with an emergency just relying on architectural design. What is also needed is the system and mechanism of emergency management. The development of emergency managing systems and flexible programs is a major approach to solve the problem. In this paper, the authors provide some solutions from the perspective of emergency management.

Once an emergency happens, it is the first place to eliminate group panic. The authors consider that we can eliminate group panic from the following four aspects: informing, action, information encouragement and the enhancement of masses' quality.

To begin with, informing refers to minimizing the degree of group panic through voice guidance when it occurs. Once an emergency occurs, the broadcasting system must start immediately and provide the group with latest information. The onsite guidance and useful evacuation directions should be provided and to increase people's confidence.

Secondly, action refers to immediately mobilizing people and facilities of departments concerned to be involved in handling the emergency and give people confidence after an emergency occurs. The emergency response system should be perfected from the perspective of emergency management. It mainly consists of three aspects: improving the emergency plan, strengthening the relevant emergency management and enhancing the personnel management.

Thirdly, information encouragement refers to providing the group with sufficient emergency management information before the emergency happens and making the group confident enough in large public places. This includes two parts. The first is increasing the publicity of emergency management information so that the group can acquire related information. The second is perfecting the sign system

in large public places. An excellent sign system can guide people to evacuate through right direction.

Fourthly, increasing the quality of group refers to increasing the ability of group in coping with emergency as much as possible. Social psychology research shows that a good grasp of coping strategies to emergency is favorable in diminishing panic emotions. Through the daily popularized cognition of group to emergencies and increasing their self-help capabilities, the group becomes competent in coping with emergencies.

## 116.5 Conclusions

This research investigates the reasons and influence of group panic in large public places in detail and indicates that the emergency in large public places can easily cause group panic, which has complicated effects on emergency coping strategies. The group panic caused by an emergency in a large public place should firstly be prevented, decreased and diminished by psychological methods, followed by handling the event and people's evacuation. This paper provides four suggestions and puts forward detailed measures from the perspective of emergency management.

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# Chapter 117

## Cloud Service Model for Safety Monitoring and Assessment of Oil and Gas Pipelines

Si-jian Lin, Xiao-lie Liao, Wei Long and Jun-bi Liao

**Abstract** The traditional assessment model that is used to assess the safety and predict the remaining life of oil and gas pipelines consumes substantial resources, such as manpower and materials. In a sense, it hampers the development of assessment technology. So, we set up a new assessment model, Cloud Service Model, which is based on Cloud Computing, Field Signature Method (FSM) and Dynamic Assessment Technology. With the characteristics of timeliness, high efficiency, resource sharing and low cost, it may have a great application prospect.

**Keywords** Cloud computing · Dynamic assessment · Field signature method · Pipelines · Safety monitoring

### 117.1 Introduction

Pipelines play an irreplaceable role in the transport of oil and gas. A small oil spill of pipelines can become a big catastrophe, as it did in the 2006 spill in the Prudhoe Bay oil field of Alaska. So, it's absolutely necessary to ensure that pipelines work in a safe condition.

In most situations, we don't need to inspect the whole pipelines because of the predictability of most defects' positions. According to the working condition, structure of pipelines and experience of inspectors, we can obtain the sections which have a greater possibility of failure. Then, we can use some useful techniques, such as straight beam ultrasonic thickness examination (UT), Radiographic

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examination (RT), Magnetic Particle (MT), Dye Penetrant (PT) to get the size of defects (American Petroleum Institute 2007).

When having gotten the size of defects and material data of pipelines and other data that are necessary to assessment, we can assess the security or fitness-for-service and estimate the remaining life of the equipment according to standards or codes available, such as API 510, API 570, API 653, API 579 and ANSI/NB-23 (American Petroleum Institute 2007). Then we can make the plan of checking or take some remediation methods to prevent or minimize the rate of further damage (American Petroleum Institute 2007).

However, it's not enough! It's very difficult to check out the whole pipelines, because it may be used in the open-air, underground or subsea condition and often it's not too short (Zhengjun et al. 2011; Chen et al. 2010). Stem from competitive consideration, oil and gas companies possessing a large number of pipelines won't share the inspection and assessment equipment with each other, which may occupy large amount of resources. For the so-called data security consideration, they also may not provide the inspection data of defects to research institutes, although they may develop significant theories to prevent the defects in return. So, there must be a more effective service model to manage the data.

## 117.2 Key Technologies

### 117.2.1 Cloud Computing

Cloud Computing has been regarded as a new large-scale distributed computing paradigm, where computational power is provided similar to utilities like water, electricity, gas and telephony (Buyya 2009). It involves Grid computing, Distributed computing, parallel computing, utility computing, network storage technology, virtualization and load balance techniques (Kalagiakos and Karampelas 2011). It delivers infrastructure, platform, software, storage as services, which are made available as subscription-based services in a pay-as-you-go model to consumers (Buyya 2009). These services in industry are respectively referred to as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), and Storage as a Service (StaaS) (Wu et al. 2010). Users access services based on their requirements without regard to where the services are hosted (Niyato 2011).

Since the CEO of Google, Eric Schmidt, put forward the concept of cloud computing for the first time in 2006, Cloud Computing develops rapidly and is widely used in Internet Technology applications, for example, BT for IaaS, Amazon EC2 for PaaS, Google apps for SaaS, Amazon S3 for StaaS (Wu et al. 2010).

With the characteristics of service-oriented, loose coupling, scalability, strong fault tolerant, ease use, virtualization and high security (Gong et al. 2010; Tian

et al. 2010), it will make a lot sense to introduce Cloud Computing into the service of oil pipeline's safety monitoring and assessment.

### ***117.2.2 Field Signature Method***

As has been noted, pipelines may be in a severe working condition where manpower can't reach easily. So, we need a practical and effective inspection method to detect and monitor the defects of pipelines on line. Because corrosion is the main defect that results in the failure of pipelines (Zhengjun et al. 2011), the Field Signature Method (FSM) is the best option.

FSM is a nondestructive, on-line, reliable inspection method, which was put forward and developed by the CorrOcean ASA in Norway (Strommen et al. 1998). In case of having metal loss and cracks on the steel object and current flowing through it, the electrical resistance of these regions will rise (Kawakam et al. 2011). According to Ohm's law, the potential difference will rise in proportion to the increase of electrical resistance. FSM detects corrosion and cracks by detecting the changes of voltage measurements of the sensing pins (electrodes) which are distributed in an array over the monitored area.

With the advantages of nonintrusion, accuracy and adaptability in extreme conditions (Kawakam et al. 2011), FSM has been used in oil and gas industry, in petrochemical plants, in refineries, in power plants and in nuclear reactors. With the improvement of FSM technology (Zhengjun et al. 2011), using FSM technology has become an unavoidable trend.

### ***117.2.3 Dynamic Assessment Technology***

There are many methods to assess the security or fitness-for-service and estimate the remaining life of the equipment, such as finite element method (Gibson et al. 2006), linear-elastic fracture mechanics (Jouris and Shaffer 1978), fracture mechanics (Navin et al. 2007), most of which are based on the residual strength of pipelines. With the application of these methods, enormous economic benefits have been gained. However, most of these methods are either too conservative or too restrictive, such as the ANSI/ASME B31G-1991 based on fracture mechanics. And they belong to static assessment methods, that is, they can only gain the security of current working condition and predict the residual life of the condition that is the same as the current condition. It is known to us that the working conditions having a huge influence on the security and residual life may change, so the results we obtained by paying a heavy price sometimes may be inaccurate and impractical. Thus, dynamic assessment method is developed.

Dynamic assessment technology, which was firstly put forward by School of Manufacturing Science and Engineering of SICHUAN UNIVERSITY, is based on

computer technology. Taking the safety assessment of cracks as an example, we often utilize Failure Assessment Diagram (FAD) to judge the security of pipelines by determining whether the assessment point is in the acceptable region or not. For dynamic assessment method, the failure routine and failure rate can be simulated through a system based on dynamic assessment technology. The residual life is found by dividing the failure routine by the failure rate after considering all sensitive factors, such as loads, material properties and temperature.

Undoubtedly, this method is intelligent, the results of which are more intuitive and practical. Because of the powerful data processing ability, it will take less time to obtain the assessment results.

117.3 Analysis of Cloud Service Model

117.3.1 Structure of Cloud Service Model

Given that the traditional service model has many disadvantages and can't meet the need of society, we put forward a new service model, Cloud Service Model, which is mainly based on Cloud Computing, Field Signature Method (FSM) and Dynamic Assessment Technology. In Fig. 117.1, the structure of the new model is displayed.

117.3.2 Characteristics of Cloud Service Model

- 1. *Timeliness* The inspection communication equipment can conduct real-time data acquisition and the Cloud Service Center will deliver the safety information of pipelines to the oil and gas companies in time in a way that is

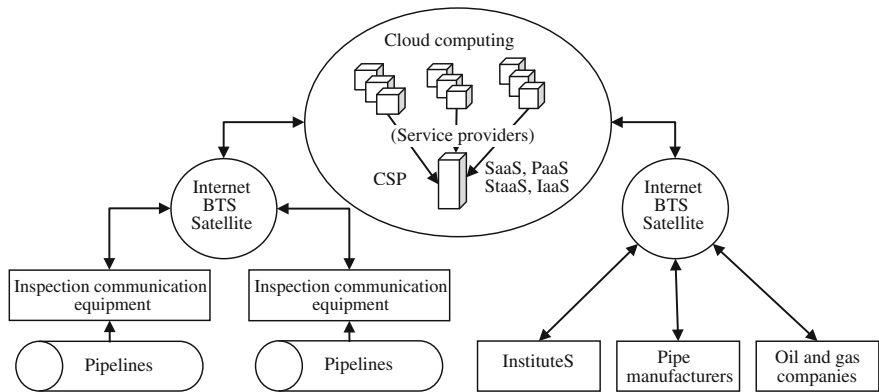
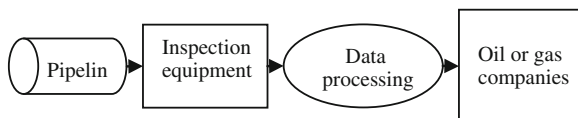


Fig. 117.1 Structure of cloud service mode

**Fig. 117.2** Structure of traditional assessment model



accessible to them. The oil and gas companies can also use Mobile Terminals (MT), such as cell phone, tablet PC and laptop computer, to get the safety information at any place and any time through the Cloud Service Provider (CSP).

2. *High efficiency* Because the amount of inspection data is very large, it may take the processing center of oil and gas companies a lot of time to process it, which is the last thing they want. Cloud Computing can solve this problem very easily and quickly, because of the enormous data processing capacity and system scalability.
3. *Resource sharing* The confidentiality of the inspection data of pipelines which is completely unnecessary impedes the progress of assessment technology. Through the Cloud Service Center (CSC) can we overcome this barrier, and the institutes, Oil and Gas companies and pipe manufacturers take what they need. Because what the institutes are concerned with are the laws behind the inspection data, the oil companies is the safety of pipelines, the pipe manufacturers are the problems resulting from the use of pipelines, through the CSC can the rational allocation of resources be achieved.
4. *Low Cost* Compared with the traditional assessment model, see Fig. 117.2, it will take the oil and gas companies less money to get what they want, because the institutes and pipe manufacturers pay the rest (Wee 2011).

## 117.4 Conclusion

Based on Cloud Computing technology, Field Signature Method and Dynamic Assessment technology, a new service model, Cloud Service Model, is set up.

Compared with the traditional assessment model, we conclude that the Cloud Service Model has many advantages. We can define it as a resource conserving model with a great deal of promise.

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# Chapter 118

## Research of Human–Machine Collaborative Emergency Management in Major Transport Hub of China

Chun-dong Zheng, Hai-xin Qi, Xiao-liang Li and Ya-dong Qiu

**Abstract** In order to enhance the capability of the emergency management of the major transport hub of China, this paper analyses the exiting method of emergency management of major transport hub, and generalizes the mode of emergency management from the theory of “management mode,” then shows a new mode using Synergetics: human–machine collaborative emergency management. Then this paper explains it from the organizational structure, mechanism, human resource, the management of hardware, management information system, training and exercise. If the major transport hub uses this mode of emergency management and makes the people and human to collaborate, the efficiency of emergency management will be increased, the loss will be reduced.

**Keywords** Human–machine collaborative emergency management • Management mode • Transport hub • Synergetics

As the rapid economic development, the integrated traffic system of China has entered a fast developing period, and the Major Transport Hub (hereinafter referred to as MTH) in Large and medium sized cities of China was launched into construction successively, which generally showed a large-scale, integrated and stereoscopic development trend.

In this paper, we will discuss MTH emergency management mode from the perspective of “management mode,” taking the special situation of MTH into consideration, and put forward a new emergency management mode and its realization methods on the basis of the analysis of the existing MTH emergency management modes. Generally speaking, a management mode includes three aspects of contents: the concept, the system, and the methods, from which this paper will study the MTH emergency management mode of China (Guo 2003).

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## 118.1 Introduction

From the burst of “SARS” on, research on emergency management in China has gained huge breakthroughs through learning foreign emergency management theory.

In the 1990s, Zhi-bao Chen et al. put forward two kinds of methods to distinguish hazards sources. Shui-cheng Tian 2001 put forward a third kind of hazards sources by further analyses (Tian 2001). From then on, experts and scholars from all fields conducted further researches of the identification, assessment, and classification of hazards sources in their respective areas, such as Li et al. (2009) and Han and Xu (2009), which constitute to some extent the foundation of the follow-up study of emergency management.

At the same time, domestic researchers began to study foreign emergency management researches. By analyzing the disaster emergency management mode and features of several countries in the world, Yang and Xu (2004) put forward “The conceptualization of disaster modern management mode in China (Yang and Xu 2004).” Guo-zhang Yao further studied each aspect of Japan’s emergency management system, including the government crisis management, the sudden public emergency management, and the emergency management on information management system construction, etc.

Some experts also systematically discussed the emergency management mode according to China’s national conditions. Zhu 2003 discussed the methods to establish emergency management mode under system control from three aspects including strategic capacity, capacity development, and process capability (Zhu 2003). Zhan (2009) put forward the emergency management system research methods on the basis of “scene-impact-vulnerability (Zhan 2009).”

We could conclude that, although various items of our country’s emergency management research have developed very deeply, there’s still a lack of systematic research, even foreign emergency mode researches also stay only in law, policy, system and other aspects.

The systematic study of emergency management has begun abroad. Carver and Turoff (2007) proposed that man-machine synergy should be realized in information management (Carver and Turoff 2007). Heather Wyatt Nichol and Abel (2007) tried to find a suitable comprehensive framework for emergency management of government agencies (Wyatt Nichol and Abel 2007). Kapucu (2008) proposed emergency management based on the combination of organization, prevention and response (Kapucu 2008).

In conclusion, there are much more researches on emergency management than those on MTH emergency management. At the present stage exists only researches on single disaster of single rail transportation way, Zhi-yu Bao, Li Yu, Yu-fen Li, Rui-hua Xu all focused on the study of the fire hazard of single rail transportation way.

This paper will put forward a new MTH emergency management mode, in accordance with the “management mode” theory, combining the characteristics of MTH and “Synergetics Theory.”

## **118.2 Overview of MTH Emergency Management**

MTH emergency management can be defined as the process to ensure the normal operation of MTH and to keep lives and property of the public away from damage by establishing the necessary coping mechanism and taking a series of necessary measures during the process of the prevention, coping, disposition, and the after-care management of MTH emergency events.

MTH are special places which contain relatively large closed structures, high population density, and various personnel types. It has a complex traffic streamline, and runs a 24 h continuous business (Cui and Jia 2007). As a result, MTH needs strictly emergency management.

## **118.3 Analysis of the Current MTH Emergency Management Mode Home and Abroad**

### ***118.3.1 Introduction of MTH Emergency Management Mode Home and Abroad***

Current domestic MTH emergency management relies mainly on the development of the electronic and information technology, introduction of advanced equipment and facilities from overseas, and integration of all kinds of systems. Domestic MTH personnel generally think that the emergency management level could be improved rapidly through mastering the most advanced equipment. This can be defined as the hardware driven mode.

There has been an impeccable theory system for foreign emergency management and relevant personnel have very good emergency management consciousness. But as the railway and subway stations are constructed earlier, equipment and facilities abroad are not advanced. Therefore, foreign MTH management personnel rely mainly on the person’s ability, with the assistance of related equipment and facilities. This can be defined as the person driven mode.

### ***118.3.2 Analysis of MTH Emergency Management Mode Home and Abroad***

The hardware driven mode relies mainly on the equipment and facilities. However purchasing and maintaining equipment will bring certain financial burden to investors and operators. At the same time, as the generation type and manifestation form of emergency events will present a multiplication tendency, there may be an occasion on which the existing equipment and facilities are not able to deal with all kinds of disasters in new forms. The rapid development of electronic information technology has also accelerated the frequency of the renewal of the equipment and facilities, so operators of transport hubs have to upgrade and reform the equipment and facilities passively.

The person driven mode emphasizes the human factors. But the effective solution of some emergency events must rely on advanced equipment and facilities. Such as the subway “sarin” poison gas event in Tokyo Japan, owing to the lack of advanced equipment, the gas is not detected originally which leads to the paralysis of the commander’s thoughts. Moreover, as the randomness of MTH emergency events, personnel must be in standby state for long time, which causes huge pressure and goes against the handling of emergency events of the transport hubs (Carver and Turoff 2007).

From the analysis above, we can draw a conclusion that both hardware and person driven mode have some deficiencies and go against the MTH emergency management.

## **118.4 Proposition of the Human–Machine Collaborative MTH Emergency Management Mode**

### ***118.4.1 Fundamental Concept of the Human–Machine Collaborative MTH Emergency Management Mode***

It is obvious that both the existing emergency management modes have some defects. This paper hopes to realize the synergy between personnel and equipment by combining the hardware with the personnel organically and proposes the man–machine collaborative emergency management mode.

This mode can be defined as realizing high efficiency emergency management with the personnel and equipment achieving effective synergy, when the personnel could use the equipment effectively and reasonably at the premise of their higher own quality.

For this mode, personnel quality is the premise, equipment is a necessary factor, and the cooperation of personnel and equipment is the core.

### ***118.4.2 Feasibility of the Human–Machine Collaborative MTH Emergency Management Mode***

The man–machine collaborative emergency management mode needs not only experienced personnel but also advanced technical infrastructure, so there are certain difficulties for its combination with MTH. Limited by existing devices, foreign MTH can only improve the quality of the staff continuously and rely on the person driven emergency management mode.

Domestic MTH has enough ability to realize this mode. At present, most of China’s MTH are in design planning period, or in part operation period (part under construction), these MTH have already been equipped with or been planned to be equipped with first-class equipment. So it’s possible to realize the man–machine collaborative mode in China just by improving personnel’s ability, and the reasonable assignment of personnel and equipment.

### ***118.4.3 Main Research Contents of the Human–Machine Collaborative MTH Emergency Management Mode***

The idea of the man–machine collaborative emergency management mode has been elaborated above. In human–machine collaborative MTH emergency management mode, “system” refers to the complete theoretical system, while for emergency management mode, it contains only the organization structure, mechanism and plan system. “Methods” contains personnel management, equipment management, information management, and drills and training. “System” is the basis and premise to realize the man–machine coordination, while “method” is the specific approach.

### ***118.4.4 Collaborative Idea of the Human–Machine Collaborative MTH Emergency Management Mode***

The Synergetics focuses on how large numbers of subsystems of complete different natures that constitute various systems could work together to generate space, time or functional structures in a macro scale. Structures that appear as the form of self-organization should be especially focused on, so as to find the general principles that dominate the self-organization process and are irrelevant to the nature of the subsystems (Haken and Guo 1989). The man–machine collaborative emergency management is the application of Synergetics to the field of emergency management, and coordination idea is reflected everywhere in this mode which intends to make emergency management improve continually in aspects of space, time, and function, through the continuous adjusting of the parts of the system and

the constant improvement of methods, in a state where the personnel and the equipment are not balanced. The idea of Synergetics is also used constantly in the specific realization methods of man-machine collaborative emergency management mode and this holistic mode could be realized through the synergy of all the items.

## **118.5 Realization of Man-Machine Collaborative MTH Emergency Management Mode in China**

### ***118.5.1 Organization Structure of the Man-Machine Collaborative Emergency Management Mode***

The organization structure of the MTH emergency management should be divided into three layers: the decision-making layer, the tactics layer and the operating layer. The decision-making layer contains the top management and decision-making departments and the relevant personnel, the tactics layer contains the departments which formulate the emergency plans and the corresponding preparations and the relevant personnel, and the operating layer contains the specific emergency responding departments and the relevant personnel.

MTH usually contains large amounts of companies of the railway, subway, bus, and many other means of transportation (Liu 2010). The strategy layer and the tactics layer should consider the synergy with other companies, such as how to assign the personnel and how to realize synergy when railway emergency events happen and so on.

So the decision-making layer of the MTH emergency management shall set up an emergency committee, while the tactics layer shall set up an integrated command and control center. The emergency committee is a virtual organization, regular meeting should be held to determine the whole emergency strategies of traffic hubs and many other contents. The integrated command and control center that is attached to the tactics layer is the actual action control and leadership organization.

The realization of the synergy between the overall management of the equipment operation and personnel management along with the synergy between equipment assignment and personnel assignment could be reached through the effective management of the strategy and tactics layer.

The operating layer should be divided into four systems, including the disposal system, resource security system, information management system, and decision assistance system. Personnel of disposal system respond to and deal with emergency events depending mainly on the existing equipment and facilities, and are responsible for the equipment maintenance. Personnel of resource security system are mainly responsible for the quantity and quality of the equipment and the equipment assignment when responding to emergency events. Personnel of

information management system are primarily responsible for collecting and processing all kinds of data in emergency management. The decision assistance system primarily provides necessary expert support to the management layer and assesses and evaluates various kinds of MTH emergency decisions and the event disposing processes (Ji 2006).

The clear duty segregation of the four systems and the effective synergy among them work as the essential premise of man–machine collaborative MTH emergency management.

### ***118.5.2 Mechanism and Plan System Construction of the Man–Machine Collaborative Emergency Management Mode***

The emergency management mechanism is the rules that should be followed in the emergency management process. It could be divided into four parts which could be listed successively as monitoring and starting mechanism, disposal and coordination mechanism, termination and compensation mechanism, and evaluation, rewards and punishments mechanism, according to the characteristics of MTH emergency management (Chen 2009).

Through the analysis of the four parts, emergency management personnel should work out treatment processes in allusion to various forms of hazards, according to the actual situation of transport hubs. When generating treatment processes, the current situation of the existing emergency equipment, the emergency organization structure and staff should be rationally analyzed. Finally, the synergy between the equipment and personnel will be realized by adjusting and improving the disposal process and standardizing the disposition of emergency events constantly.

When disposal process is completed, people should consider comprehensively how to deal with all kinds of specific events from multiple dimensions, and then formulate the emergency response plan. To MTH, emergency response plans are options for possible emergency events, and they should arrange the collaboration among different departments reasonably, clear and definite the responsibilities of the personnel, distribute the emergency equipment reasonably, and clarify the emergency treatment steps, so as to reduce the consequences of emergency events, and make MTH back to normal operation as soon as possible.

Both the emergency treatment processes and the emergency response plans should be improved continually. As a result, possible errors could be found and corrected timely through regular check and assessment and concrete practices.

### ***118.5.3 Personnel Management of the Man–Machine Collaborative Emergency Management Mode***

The man–machine collaborative mode emphasizes increasing the emergency management consciousness of all the staff, promoting emergency managers' professional level, and realizing high efficient synergy with equipment.

An impeccable emergency management system can make each layer and personnel of each system cooperate with each other and thus realize the emergency management of traffic hubs effectively, but it can't solve the problems of the emergency management of traffic hubs fundamentally (Sun 2009). We should improve the emergency management consciousness, and the abilities to prevent, respond to, and deal with all kinds of events of all the staff, so that they could prevent and solve all kinds of emergency events effectively under the special environment of MTH.

Professional guidance is essential for emergency management. Experts should be consulted to provide professional emergency treatment suggestions to avoid serious consequences resulted by the lack of professional knowledge.

At the same time, personnel of the MTH disposal system should be proficient in all kinds of emergency treatment equipment and facilities, and should enhance their own professional emergency treatment level continuously.

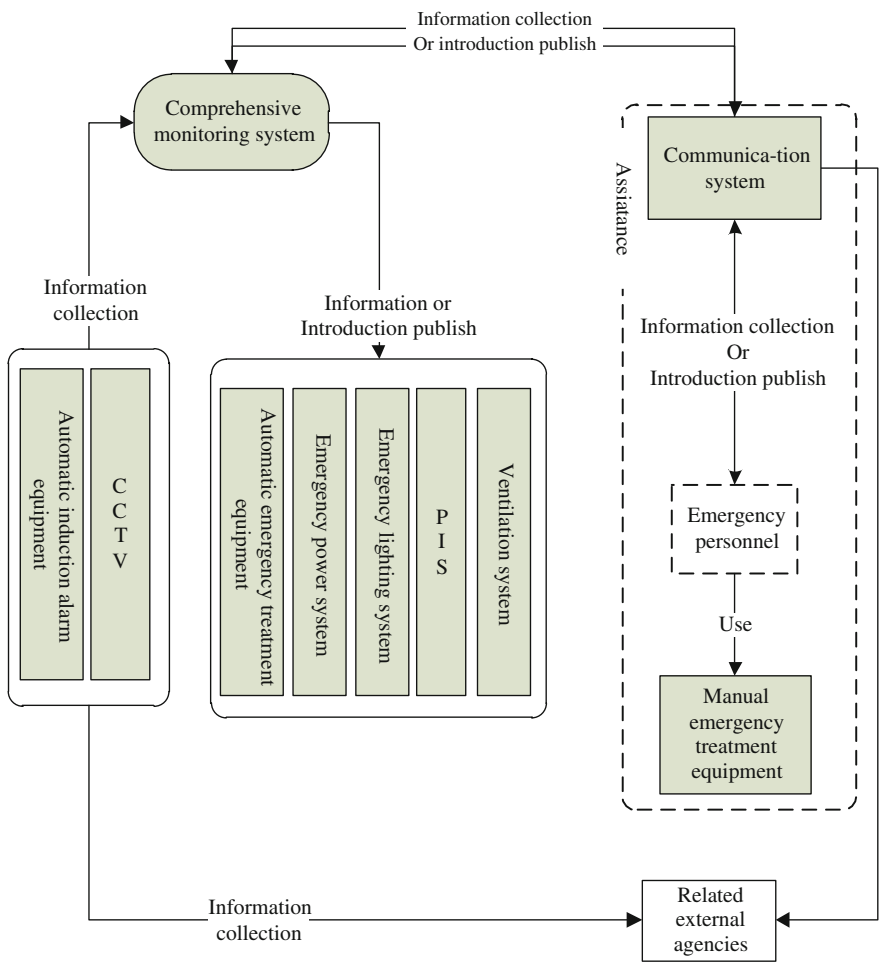
### ***118.5.4 Hardware Management of the Man–Machine Collaborative Emergency Management Mode***

This paper divides MTH emergency management equipment into eight parts as video surveillance system (CCTV), passenger information system (PIS), automatic induction alarm equipment (e.g. fire induction detector), emergency treatment equipment (such as automatic fire extinguishing nozzle), emergency power supply system, emergency lighting system, ventilation system and communication system, according to function logic.

Traditional emergency management mode contains two sets of hardware solutions: integration solution and loose solution.

Integration solution integrates all systems to establish the integrated supervisory control system (ISCS). Once a disaster happens, induction equipment at corresponding sites will send information to ISCS, which will immediately dispose the events automatically depending on specific circumstances, as shown in Fig. 118.1. At the same time, “related external agencies” such as fire stations, police stations and any other can also monitor each area of the hub.

Loose solution realizes emergency management by assistance from limited integrated equipment under the management of “people”. As shown in Fig. 118.2, “central control room” can monitor all the hubs, but can't implement real-time “control”, so instructions need to be issued to sub control rooms or fire prevention

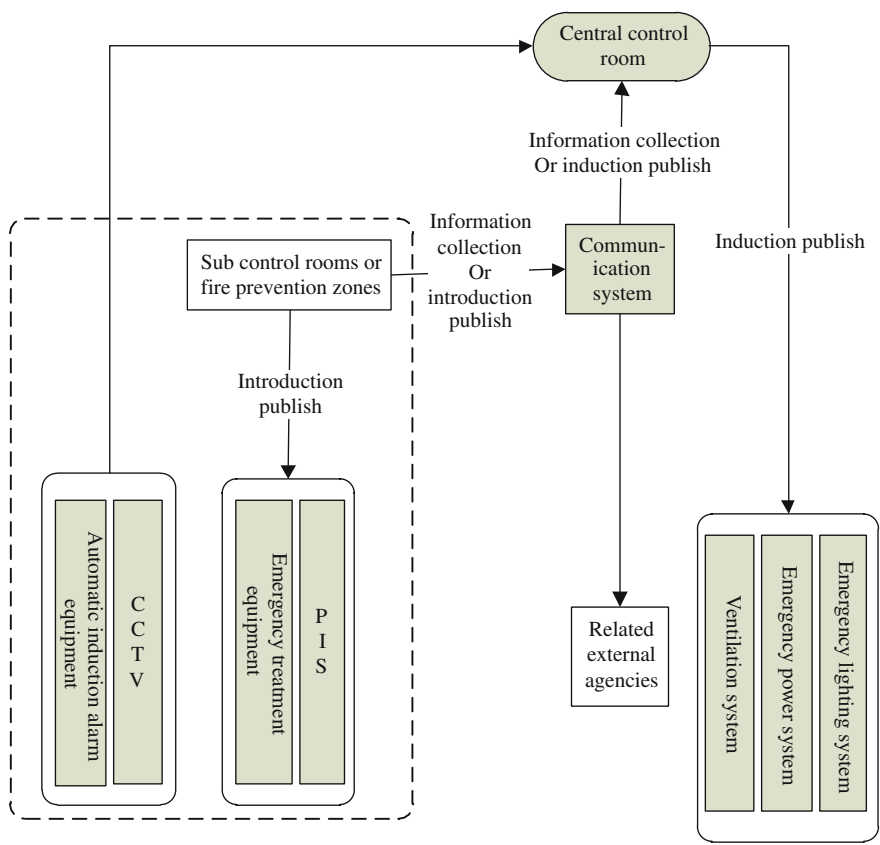


**Fig. 118.1** The logic diagram of integrated solutions

zones by communication system, and then personnel could issue introductions or participate in emergency treatment.

Hardware driven mode emergency management usually adopts integration solution, while person driven mode usually adopts loose solution. The man–machine collaborative emergency management mode pursues the synergy between personnel and equipment, so dynamic hardware solutions should be adapted to this mode.

At the beginning of the MTH operation, loose solution should be given priority to when it comes to hardware construction, the improvement of emergency management personnel quality should be paid attention to, and MTH emergency management system and mechanisms should be improved gradually.



**Fig. 118.2** The logic diagram of loose solution

As the development of MTH, we should upgrade hardware device, integrate each system gradually, and integrate all independent systems into a whole organic one at last.

Although hardware facilities should gradually transit form loose solution to integration solution, personnel should not transit into an auxiliary status. Now there have been advanced equipment, emergency mechanism and system, and the personnel quality of emergency management is much higher. At this stage we should perfect equipment management methods, strengthen the control of the equipment, pay attention to renewal maintenance and supplement of the equipment, establish impeccable equipment using standards and specifications, and enhance equipment using proficiency of personnel.

Only impeccable equipment construction logic and normative equipment operation management can ensure the synergy between equipment and personnel to improve emergency management level.

### ***118.5.5 Information Management of the Man–Machine Collaborative Emergency Management Mode***

Because of the high complexity of MTH emergency management and the diversity of information sources, there must be a series of information management system support, to further enhance the level and efficiency of MTH emergency management.

As an important channel of communication for personnel and equipment, information management system plays a very important role in man–machine collaborative emergency management mode. “Equipment resource management system” can help the emergency management personnel manage all the equipment better and understand the use and maintenance of equipment as soon as possible. “Emergency events database” can record all the events and disposition records, help the emergency management personnel to learn from the past emergency response and events disposition, and enhance emergency consciousness of personnel. “Plan management system” can be used for relevant personnel to access and learn corresponding plans at any time, and can help emergency management personnel to revise emergency plans anytime. When emergency events happen, emergency management personnel can contact with relevant experts and get professional help through the “expert support system”. “Command decision system” that is associated with hardware equipment can realize the man–machine synergy better when handling emergency events, through a more humane way. As a particularity of MTH, emergency drills can bring great inconveniences to the operation of hubs and the passengers’ egresses while it is essential at the same time, so “virtual drill system” is a very ideal alternative tool.

### ***118.5.6 Training and Drills of the Man–Machine Collaborative Emergency Management Mode***

With the improvement of MTH emergency management, emergency management level will be heightened all the time.

The man–machine collaborative emergency management mode shall ensure that emergency personnel enhance their quality constantly and can use all kinds of new equipment proficiently, so personnel training and drills should be organized regularly or irregularly.

Emergency training can be divided into equipment training, system training, plan training from the perspective of training contents; induction training, job training from the perspective of training time; and general staff training, emergency personnel training and labor dispatch training personnel training from the perspective of personnel to be trained.

Drill is a special kind of training which can help personnel master the training contents by practicing and examine the rationality of present emergency

management system and plan. There are three ways for drills, indoor drills, field drills and virtual drills. Representatives from each department of emergency management agencies or personnel from key positions participate in oral drills for indoor drills. Field drills are actual drills assuming real events (Deng 2004). Virtual drills refer to drills that utilize the virtual drill system mentioned above.

## 118.6 Conclusion

MTH emergency management is a very complicated system which cannot be realized singly by person or hardware. And this article proposes man-machine collaborative emergency management mode, as well as some methods to realize balanced human-machine synergy.

The man-machine collaborative emergency management mode emphasizes the application of “Synergetics Theory,” and organic integration between personnel and equipment and then enhances the emergency management level.

This paper proposes a systematic MTH emergency management mode, but doesn’t further analyze the every details of this mode which future researches can focus on. And as the continuous improvement of management idea and means of science and technology, concrete theories and methods of the man-machine collaborative emergency management mode should be improved continuously.

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# Chapter 119

## The Analysis of Parking Problems at Huaxi Hospital

Xue-dong Liang, Chao Ji, Qi-gang Ran and Li Liu

**Abstract** A systematic analysis of factors that affect parking in Huaxi hospital is proposed. The relative importance of improvable factors is ranked by Grey Relevancy Theory. It demonstrates that the parking demand of employees, the efficiency of parking and traffic order are the key factors that limit the hospital's parking capability. Parking demand and supply situation are estimated and different characterization of each crowd of hospital travelers is also analyzed in order to provide valuable information to address the problems.

**Keywords** Hospital · Parking · Grey relational analysis

### 119.1 Introduction

The problem of insufficient parking facilities is a problem that plagues many urban areas in North America, Europe, and Asia (Batabyal and Nijkamp 2008). Due to the fast development of China's economic and the rapid growth of motorization, parking problems at big cities are becoming more acute in China. On one hand, the parking resource do not increase much as time pass by; on the other hand, the demand for parking resource has been continuously growing these years. Between

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8 and 74 % of traffic is generated by cruising for parking and the average time to find a curb space can vary between 3.5 and 14 min (Gallo et al. 2011). The imbalance between supply and demand of parking resource has become distinct. Cars cruising for parking would further exacerbate traffic congestion and noise problems, originate accidents, waste fuel and other resources, pollute the air, degrade the pedestrian environment, and restrain levels of accessibility. This is not only because the distance traveled, but also frequent stopping and starting of cars (Tsai and Chu 2011).

Most Chinese super hospitals are centralized in big cities. And these hospitals were usually developed from their former buildings, whose layout lack of advanced concerning about parking or flow line of cars (Lun and Jingxian 2011). It is common to see cars queuing on the road to park, encumbering traffic around the general hospital in China.

West China Hospital of Sichuan university is a super hospital with 4,300 beds (Tiangui et al. 2008). Although the hospital covers an area of 7.8 million square meters in urban of Chengdu, the road around the hospital seems to be over crowded with both people and cars. Parking has been a headache for patients and visitors of the hospital. The difficulty of parking not only causes the serious traffic jam around hospitals at peak hours, but also damages the experience of patients going to the hospital and gains the risk of traffic accident (Feng 2011). Improving the parking situation has been listed in the agenda of the hospital's administrators.

This paper intends to analysis the parking system of Huaxi hospital and find out the key factors that affect the parking problems. The result may make it possible that some targeted measures can be taken to ease the parking difficulty of the hospital.

## **119.2 Parking Demand and Supply Analysis**

### ***119.2.1 The Supply of Parking Places***

The capacity of parking lots in Huaxi hospital is 2,225 in total, including 269 extended parking places. The extended parking places were planned by taking full use of the road in the parking lots to meet the growing parking demand. The extended parking places often need skill and sufferance to park successfully. Concerning the special need of emergency patients and the ability to response to some emergency situations, an on the ground parking lot with the only access of emergency patients was planed. Besides, the standard of charge for parking in the hospitals was set officially which is lower than parking in other areas of the urban city.

The capacity of different types of parking lots in Huaxi hospital was displayed in Table 119.1. These data show that 34.6 % of the parking places (PA) were planned for employees of the hospital and 60.2 % of the parking places were planned for patients and their visitors.

**Table 119.1** Parking lots of Huaxi hospital

Types	Allocation	Capacity of standard parking places	Capacity of extended parking places	Summary	% of total supply	Objectives to serve
PA	PA1	100	39	770	34.6	Employees
	PA2	88	22			
	PA3	271	46			
	PA4	204	0			
PB	PB1	62	0	62	2.8	Emergency patients only
PC	PB2	182	0	1,340	60.2	Common patients and their visitors
	PB3	317	71			
	PB4	699	71			
PD	PD1	33	20	53	2.4	Others
	Summary	1,956	269	2,225	100	

## ***119.2.2 The Survey of Demand for Parking in Huaxi Hospital***

### **119.2.2.1 Objective**

The aim of the survey is to figure out the characteristics of different crowds of people parking in the hospital. Different arriving time of each crowd of travelers was taken into consideration in the survey.

### **119.2.2.2 Results of the Survey**

The travelers parking in the hospital can be sorted as employees, patients and visitors. The arriving time of different populations is identical. The distribution of each crowd of travelers' parking demand on time was illustrated in Fig. 119.1, based on the data provided by the security section of the hospital.

Characteristics of each crowd parking in the hospital are as follow:

- *Employees* The peak period of staff's parking demand is between 7:00 and 8:00 a.m. Parking places for employees (PA) are likely to be fully occupied between 09:00 and 10:00 and 14:00–15:00. The parking demand of employees is mainly centered between 7:00 and 8:00 a.m. The parking period of employees is always their working time, which is usually fixed. So the turnover rate of employees' parking is low.
- *Common Patients* The peak time of outpatients' parking demand is between 8:00 and 9:00 a.m. Parking places for common patients (PB) are likely to reach the saturation point between 09:00 and 10:00 a.m., which is usually the most jamming period of the day.

**Fig. 119.1** Distribution of parking demand



- *Visitors* There are a considerable portion of cars parking in the hospital to visit the patients. Most of these visitors usually come between 09:00 and 10:00 a.m. The parking demand of visitors should have no significant peak time due to the flexibility of their arriving time.
- *Emergency Patients* There is no regular pattern about the arriving time of emergency patients. But it is definitely troublesome for them to arrive on time when the traffic jam is severe during peak periods.

### 119.2.3 Conclusions of the Supply–Demand Analysis About Parking Places

Although the capacity of parking places in Huaxi hospital is higher than that the existing index system for construction of supporting parking lots for hospital buildings has prescribed, total supply of parking places in Huaxi hospital is not enough to meet the demand in peak hours of the day. The distinct imbalance between supply and demand often leads to serious traffic jam between 09:00 and 11:30 and 14:00–15:00 of the day. The parking demand of patients is usually considered to be “rigid”, which means that if there is no parking place available, they will queue on the road or cruising in the area until they successfully parked (Le 2011). As the hospital is always crowded with people during daytime and drivers of cars trying to park in the area are likely to have an anxiety mood (Lun and Yong 2011), large quantity of cars jamming on the road or cruising in the area could be a big risk for traffic accident. Bad traffic situation of hospitals leads to serious noise and air pollution, which damaged the quiet and harmony atmosphere of the hospital (Qixia et al. 2009).

### 119.3 Factors Affect the Parking Problem in Huaxi Hospital

#### 119.3.1 Introduction About Grey Relational Analysis

Grey relational analysis was pioneered by Deng Julong in 1984, which aims at analyzing the relationships among things, having incomplete running mechanism, lacking of behavior data, devoid of experience in treatment, being naked to inherent connotation (Julong 2005). The basic steps and algorithms of GRA are as follow (Yang and Junqiao 2011):

- Step one, to define data series.  
Assume  $X_0 = \{X_0(k) | k = 1, 2, \dots, n\}$  is a sequence of data representing a system's characteristics, and are comparative series;
- Step two, dimensionless treatment for data series.

$$X_j(k) = \frac{x_j(k)}{x_1(1)}, k = 1, 2, \dots, m \quad (119.1)$$

- Step three, to calculate the grey relational coefficients.  
By taking differences as  $\Delta_i(k) = |x_0(k) - x_1(k)|$ , we thus have the following difference series  $\Delta_i(k)$ . So the grey relational coefficients are:

$$r(x_0(k), x_i(k)) = \frac{\min_i \min_k \Delta_i(k) + \rho \max_i \max_k \Delta_i(k)}{\Delta_i(k) + \rho \max_i \max_k \Delta_i(k)} \quad (119.2)$$

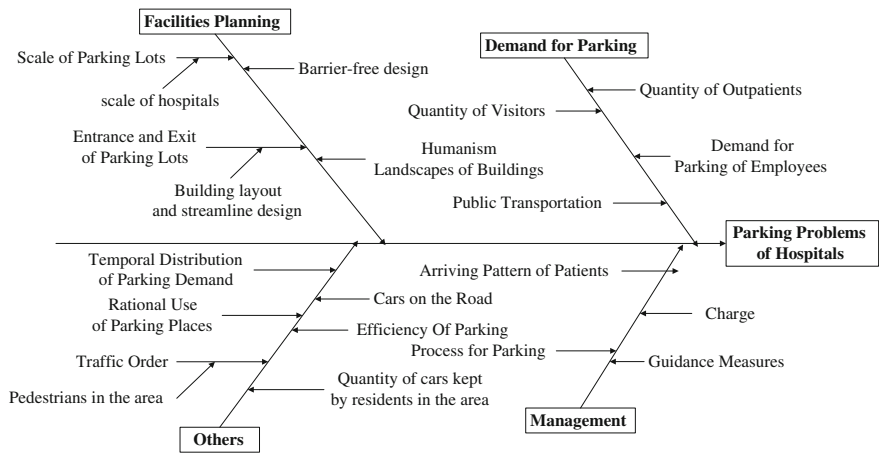
- Step four, to calculate the grey relational grades.

$$r(x_0, x_1) = \frac{1}{n} \sum_{k=1}^n r(x_0(k), x_i(k)), k = 1, 2, \dots, n \quad (119.3)$$

- Step five, to rank grey relational grades basing on the size of  $r(x_0, x_i)$ .

#### 119.3.2 Factors Affect the Parking Problem of Hospital

The construction of supporting parking lots for hospitals was restricted by the available land, cost, and location of the hospital and has to take humanism landscapes into consideration. While continuously increasing the supply of parking resource is not the only or best way to solve the problem (Deliang and Hua 2005). The scale of parking lots of hospitals should be fixed by taking a systematic investigation of the problem and figure out the key factors. Figure 119.2 gives the analysis of the factors concerning the parking problem of hospitals by using fishbone chart (Linhua 2011; Ji and Qing 2005; Lei 2011).



**Fig. 119.2** Factors concerning parking problems of hospitals

Most of these factors should be considered at the building’s planning and construction period to figure out the appropriate capacity of parking places the hospital should provide. According to the actual situation of Huaxi hospital, factors change at the different period of the day are as fellow: x1 parking demand of employees, x2 quantity of outpatients, x3 cars on the road, x4 visitors of patients, x5 parking efficiency, x6 traffic order, x7 level of supply saturation, x8 use turn-over of parking lots.

**119.3.3 Grey Relational Analysis of Parking Problems**

According to the survey in part II and the opinions of the administrators, 7 typical periods of a specific day was selected to analyze the parking problems using GRA.  $T_i$  ( $i = 1, 2, \dots, 7$ ) was defined to represent time period 07:00–08:00, 08:00–09:00, 09:00–10:00, 10:00–11:00, 14:00–15:00, 17:00–19:00, 20:00–21:00. Quantified data was showed in Table 119.2. Row  $x_0$  represents the level of difficulty to park.

**Table 119.2** Raw data of parking issue

	$T_1$	$T_2$	$T_3$	$T_4$	$T_5$	$T_6$	$T_7$
$x_0$	1	0.8	0.6	0.4	0.8	1	1
$x_1$	1	0.8	0.6	0.4	0.8	0.4	0.4
$x_2$	0.4	1	1	1	1	0.8	0.4
$x_3$	0.8	0.8	1	1	0.8	0.6	0.4
$x_4$	0.2	0.4	1	0.8	0.8	0.4	0.2
$x_5$	1	0.8	0.6	0.6	0.8	1	1
$x_6$	1	1	0.6	0.2	1	1	1
$x_7$	0.57	0.85	0.97	1	0.95	0.31	0.19
$x_8$	0.5	0.5	0.8	1	0.8	0.5	0.5

**Table 119.3** Grey relational grades

$x_0$	$x_1$	$x_2$	$x_3$	$x_4$	$x_5$	$x_6$	$x_7$	$x_8$
$r(x_0, x_i)$	0.880	0.494	0.499	0.602	0.676	0.658	0.591	0.629
Ranking	1	8	7	5	2	3	6	4

The results of the calculation were listed in Table 119.3, including the ranking.

## 119.4 Conclusions and Discussion

Because of the centralization and overlapping of parking demand, the supply of parking places in Huaxi hospital cannot meet the demand in peak hours. The characteristics of different kinds of parkers are not identical.

According to the calculation in part III, the most significant factor affecting the parking issue of Huaxi hospital is  $x_1$  (parking demand of employees), following with  $x_5$  (parking efficiency) and  $x_6$  (traffic order). The results of this paper may help administrators take some targeted actions to make an optimization of the hospital's traffic situation. The affecting factors listed in the fishbone chart may also provide a reference for architects when they planning parking places of hospital buildings.

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# Chapter 120

## A Comparative Study on Industrial Promoting Policies of China's Service Outsourcing Model Cities

Jun-wu Dong and Wei-jin He

**Abstract** This paper summarized industrial promoting policies of China's 21 service outsourcing model cities, and found that the policies focused on the following key areas—distinctive managerial mechanism and financing policies, established intellectual property protection system, multilevel policies in educational training and talent attraction, conditionally developing headquarters economy. With the reference to the advanced experience from abroad, this paper came up with the suggestions for the service outsourcing model cities to further optimizing the industrial policies, which including to develop the model cities' industrial parks in differential way based on comparative advantages, to form strategic alliance among outsourcing companies, to establish a dominated association at national level or among the model cities, to further improve intellectual property protection systems and educational training and talent attraction mechanisms.

**Keywords** Model cities · Optimal suggestions · Promoting policies · Service outsourcing

### 120.1 Introduction

Service outsourcing is about a kind of economic activity in which enterprise completes its IT business by stripping out and outsourcing it to external professional service providers. The IT business including basic non-core business which originally should be done within the value chain and others based on IT process which outsource to the external providers. In the mainstream of service

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outsourcing study, service outsourcing is divided into information technology outsourcing (ITO), business process outsourcing (BPO) and knowledge process outsourcing (KPO). Service outsourcing developed rapidly thanks to the deepening of economic globalization and the extensive application of information technology, which plays an important role in accelerating the transition of the mode of China's economic development, manifested in promoting industry upgrading, particularly on speeding up the transition from traditional manufacturing industries to high value-added producer service industries. Undertaking service outsourcing does help in improving the vendor countries' industrial structure, increasing its export earnings and creating jobs. Staff get benefits from wage increased and skill levels improved (Wang and Wang 2010).

As the most attractive outsourcing undertaken country, India has made good use of globalization and informatization to drive the rapid development of its domestic industries such as software and information service industry (Yang 2010). Although service outsourcing industry in China hasn't developed for a long time, China still has its unique advantages and it is thought to be an emerging outsourcing service center (Xu 2008). In 2010, Chinese offshore service outsourcing business has amounted to 14.45 billion USD, increased by 43 % than last year. At present, China has 21 service outsourcing model cities, where a series of policies have been put forward to support and cultivate the service outsourcing industry.

## 120.2 The Principal Policies in Model Cities

In order to implement both the Eleventh Five-Year Plan and the "Thousand-Hundred-Ten" program promoted by the Ministry of Commerce, the relevant ministries of State Council successively identified several groups of service outsourcing model cities and demonstration plots. On August 4, 2006, the Ministry of Commerce and the Ministry of Information Technology held an awarding ceremony in Dalian Software Zone, making it the first service outsourcing demonstration plot. Also, several zones and cities were awarded the title of "Chinese Service Outsourcing Demonstration Plot" or "Chinese Service Outsourcing Model city" from 2007 to 2008. In 2009 and 2010, the General Office of the State Council identified 21 cities as China's service outsourcing model cities.

In light of the experience in the development of service outsourcing from abroad, the role that government played cannot be ignored. From the aspect of resource allocation, government plays an important role in advocacy and platform construction in addition to market regulation (Fu and Lu 2010). The State Council also introduced a series of documents and policies to promote the development of service outsourcing industry when identifying the 21 model cities. Then the local governments established relevant detailed policies on that basis, which shows three main features: firstly, efforts has been made to implement the national policies strongly; secondly, to support national policies in detail; thirdly, new trails were brazen in service outsourcing policies to suit local circumstances, such as managerial

**Table 120.1** The main contents of principal policies in 21 model cities

Principal policies	Main problems	Methods	Representative cities	Notes
Managerial mechanism	Lack of institutionalized management	Set up service outsourcing leading groups or joint conference systems	All of the model cities	All of 21 model cities had set up similar managerial mechanisms
Financing policy	Start-ups and small medium enterprises have difficulties in getting loan	Offer “green channel” which simplifies procedures and offers discounts on loaning rates	Beijing, Wuhan, Harbin	Only part of the model cities have special financing policies like Beijing
Intellectual property system	Insufficient protection for intellectual property	Formulate local regulations and intellectual property trade fair	Dalian, Hangzhou	Dalian and Hangzhou have advanced experience in intellectual property system
Educational training and talent attraction	Shortage of senior technical and managerial talents	Establish students’ training bases and offer subsidies	Tianjin, Chengdu, Chongqing	All of the model cities have similar policies, but differentiated in some details
Headquarter economy	The quality of the enterprises set up by foreign investment	Offer financial rewards to both companies and senior managers	Beijing, Shanghai, Guangzhou, Nanjing	Only developed large cities have corresponding conditions such as Beijing and Guangzhou

mechanism and financing policies, intellectual property protection, educational training and talent attraction policies (China Outsourcing Institute 2009). Table 120.1 describes the main contents of principal policies in 21 model cities.

### ***120.2.1 Distinctive Managerial Mechanism and Financing Policies***

By 2009, all service outsourcing model cities had set up service outsourcing leading groups, established joint conference systems or long term working mechanisms of service outsourcing, in accordance with the relevant policies put forward by the State Council. Many cities had made particular provisions that special administration will be provided, which are respectively responsible for personnel incentives, funds management, intellectual property protection and so on.

Start-ups and small medium enterprises (SMEs) usually faced the problem of low capital turnover and difficulties in getting loan. In order to solve these problems, some cities provided them with preferential loan interest subsidy and “green channel”. In Beijing, “A notification on promoting service outsourcing industry issued by the Municipal Commission of Commerce” issued in 2009 had asked the banks, guarantee and re-guarantee institutions to offer favorable guarantee business to service outsourcing corporations. For instance, Beijing Zhongguancun Sic-tech Guaranty Co., Ltd provided eligible software corporations with loan guarantee for their outsourcing business through the “green channel”, which simplified procedures and offered discounts on loaning rates. In addition, Wuhan established the SME Technology Loans and Financing Platform, where the administrative committee cooperated with Science and Technology Bureau and financial institutions to give financial priority to service outsourcing corporations. Besides, Harbin innovated on its loan financing mechanism by providing service outsourcing corporations a financing portfolio: capital contributions made jointly by corporations and the government, who share both benefits and risks.

### ***120.2.2 Established Intellectual Property System***

Dalian formulated the “The regulations for Protecting Personal Information of the Dalian Software and Information Service Industry” in 2006, which is the first a set of industry regulations for personal information protection among the 21 model cities (China Outsourcing Institute 2007). The regulation put forward a Personal Information Protection Assessment (PIPA) for the software and information service industry, which achieved mutual recognition with Japan’s P-MARK (Personal Information Protection and Certification System) since June 2008. Moreover, Hangzhou is the first city which standardized the intellectual property of service outsourcing in a way of legislation.

In terms of the creation of intellectual property, Dalian enhanced the originality of its scientific researches with the help of its universities and research institutes, turning the resource advantages into intellectual property advantages. Also, enterprises' awareness of intellectual property has increased, and working mechanism of intellectual property is established and improved gradually. In terms of the application of intellectual property, a platform was established to display intellectual property trading; and the internationally well-known brand of China International Patent Fair and China International Software and Information Service Fair have expanded the influence on intellectual property trading and enabled the establishment of a long-term intellectual property trading market. Finally, in terms of the protection of intellectual property, Hangzhou has further improved its intellectual property protection system, which combined the government regulation, industry self-regulation, public opinion, and mass participation.

In the management of intellectual property, Hangzhou set up a leading group responsible for making rules on the protection of service outsourcing as well as dealing with relevant major events. Other measures were taken including the integration of intellectual property information resources, the establishment of the city's intellectual property information service platform and the city's intellectual property talent supply and demand information database.

### ***120.2.3 Multilevel Policies in Educational Training and Talent Attraction***

In order to support the development of service outsourcing, it is quite common that model cities carried out the policies like establishing panels of the demand for talents, constructing training bases and carrying out talent attraction policies. Tianjin formulated the "Incentives to accelerate the development of software and service outsourcing in Tianjin Hi-tech Zone" in 2007, which encouraged enterprises and organizations to establish students' training bases and offer subsidies; set up Tianjin service outsourcing talent training center which helped enterprises to train talents through cooperative agreements; utilized the teaching resources to increase the proportion of service outsourcing knowledge taught in college curriculums. What's more, senior talents were contained in the range of main attractive talents policy in Tianjin, so that they would be provided some convenience in household management.

The management of software talents in Chengdu is comparatively systematic and comprehensive. Firstly, with regard to mechanisms, Chengdu has its own joint conference system for investigation of demand for software talents and training capacity assessment. Secondly, with regard to encouraging employees to receive further training, Bureau of Education in Chengdu allocates special funds for training potential software talents, which reduces their cost of entry. Thirdly, with regard to encouraging enterprises to introduce talents outside, the government set

up the specialized administrative department for talent introduction. A software talent market has been built through publishing software talent supply and demand report and relative conference system.

#### ***120.2.4 Conditionally Developing the Headquarter Economy***

Some regional central cities rely on their powerful economic strength and locational advantages to attract and encourage service outsourcing enterprises to set up headquarters or regional headquarters in the city, which radiated its surrounding provinces and cities, seeking to the win-win situation.

Multinational corporations or individuals which set up their headquarters in the capital are encouraged according to the policies of Beijing. First of all, enterprises which headquarters set up in Beijing can receive different grades of financial subsidies in accordance with their registered capital level, government will give them one-time grant to purchase or to rent office; senior managers not only can get incentives, they and their relatives are also given a convenient living way (immigration and other living facilities). In Guangzhou, several kinds of foreign investment in establishment of headquarters or regional headquarter are welcomed including organizations such as investment companies, managerial companies, R&D centers or productive enterprises. The government offered a reward of up to 5 million RMB to the identified enterprises. It also contained the basic housing purchase or rent concessions, Chinese or foreign senior managers and their family members were given a convenient way of dealing with immigration, residence and school affairs. In addition, raw materials which processing with imported materials could be exempted from Value Added Tax; to set up purchasing center or logistics center in the city could obtain export rights and export tax rebate; infrastructure rental costs were given a certain discount; what's more, the government also offered the convenience to the enterprises in foreign exchange management.

### **120.3 Effects on Promoting Policies in Industry Level**

In the first half of 2010, it has increased about 1,548 new enterprises and 272 thousand employees in this industry, which including about 183 thousand new graduated students and made up 67.2 % of the total new employees. The contract executed amounts reached to 6.76 billion USD, increased by 105.8 %. The general situation represented in Table 120.2. According to the sampling survey in 2010 conducted by China Outsourcing Institute, half of the enterprises' orders are from inland. According to the data from 388 representative enterprises in the model cities, the service outsourcing offshore customers are still concentrated in the United States and Japanese market, but most of the customers still from inland,

**Table 120.2** The situation of china's service outsourcing industry

Period	The numbers of the service outsourcing enterprises	Employees (thousand people)	Contract executed amounts (billion USD)
2007	1,731	427	2.094
2008	3,301	527	4.69
2009	8,950	1,547	13.84
2010 (1-6)	10,498	1,819	6.76

**Table 120.3** The distribution of business customers of key enterprises in service outsourcing model cities

	China	U.S.	Japan	Europe	South Korea	others
Number of enterprise (2008)	140	114	96	86	32	77
Number of enterprise (2009)	284	214	151	134	46	141

which accounted for 73.2 %. Table 120.3 describes distribution of business customers of key enterprise in service outsourcing model cities in 2008 and 2009.

The central or the local governments have paid much attention to the talent training of service outsourcing. The policies such as “Reply on Issues of Encouraging Service Outsourcing Industry” by The State Council, “Opinions on Enhancing Service Outsourcing Talents Training and on Promoting the Placement of College Graduate Students” by the Ministry of Education and the Ministry of Commerce, and “Management Methods of the Shanghai Service Outsourcing Talents Training Center (Trial)” have further specified the details of the talents training of service outsourcing. Different training methods are applied to different trainees. An effective training pattern was formed by the active participation of different education institutions, training institutions, service outsourcing companies and institutes.

There are many difficulties in conducting statistical research on service outsourcing industry, as it is a kind of emergent and burgeoning service type with the characteristics of cross-industries and cross-fields, and also because of no consensus on an exact classification of service outsourcing among all parties. Thus, the Ministry of Commerce issued “Service Outsourcing Statistical Reporting System” based on existing relevant regulations in the third industry in 2008. The regulations will be implemented initially in the model cities, marking an initial establishment of China's service outsourcing statistical system. Additionally, relevant statistical work on service outsourcing has been conducted by Ministry of Industry and Information Technology and various industrial zones. Service outsourcing zone acts as an undertaking, hatching and promoting carrier for the service outsourcing enterprise, and gradually to be a key point to build up a multi-level industrial system for the development of service outsourcing. The construction of service outsourcing zone all over the country has been boosted, for example, the enterprises and staff in the past 5 years scale up nearly 20 times in Zhongguancun software zone. Since 2009, the model cities have successively

introduced service outsourcing zone identification and assessment managerial practices, and intensified the policies for supporting facilities and construction.

## **120.4 The Optimal Suggestions for Industrial Policies**

### ***120.4.1 To Develop the Model Cities' Industrial Parks in Differential Way Based on Comparative Advantages***

Since 2006, the development of China's service outsourcing industry has come to the stage of exploration; most of the zones have similar policies, goals and positioning. Homogeneity of competition leads to a fact that only several industrial zones in developed districts are able to achieve their development goals (Tao 2011). During the period of implementing the Twelfth Five-Year Plan, the industrial zones should utilize their unique competitive advantages to specialize themselves and create professional zones. Besides, the soft environment becomes a more essential key factor for competition and development, that is to say, the zones need to be more multifunctional, characteristic on improving the information platform and service system.

Since the model cities have their distinct location features and characteristics of differentiation, policy guidance should give full play to them. For instance, Dalian has obvious advantages to do business with its Japanese clients, such as convenient traffic condition, mutual trading frequently, lots of Japanese talents. Therefore, Dalian became the first one to positioning on "the strategic gateway of China-Japan software cooperation" and come up with the idea that to be the "outsourcing center of north-east Asia", which made it the first choice for Japanese clients (Cao 2010). Although there are differences in the empirical studies on the competitiveness of the model cities, some model cities still contact closely because of the location (Wang et al. 2011).

Suzhou and Wuxi are big cities located near Shanghai with a good manufacturing base, and as pioneers of China's private economy, they have a more efficient administrative system and superior financial capacity to ensure the successful implementation of supporting policies for service outsourcing industry. For the reasons of costs, Shanghai's service outsourcing enterprises have built up a mode called "a shop in front (Shanghai) and a factory behind (neighboring cities)" or transfer its business to the neighboring cities. In this way, these cities are going to share benefits. Shenzhen is also a good example to show the vitality of "a shop in front (Hong Kong/Macau) and a factory behind", the "Hong Kong Packets, Shenzhen Services" mode helps it to develop offshore outsourcing business vigorously. Preferential policies are easy to be imitated because of the cruel competition. If several cities compete for one project, then it will lead to the vicious competition, and becomes difficult to acquire the expected benefits (Zhou 2010).

Therefore, each city should make their respective advantages complementary to each other.

#### ***120.4.2 To Form Strategic Alliance Among Outsourcing Companies***

Apart from physical resources, service outsourcing enterprises also require tacit knowledge like technology and patents. With the continuous development of modern science and technology and the ever-changing demands of markets, service outsourcing industry emerges as a large and complex project, which has an increasingly high demand for strategic resources like capital, technology, knowledge and professional engineers. Service outsourcing strategic alliance is a kind of horizontal cooperation among service outsourcing enterprises to provide a certain outsourcing service through a way of sharing resources, complementing advantages, and sharing risks and R&D (Qu et al. 2011). The research shows that, over 30 % of service outsourcing enterprises have established for 8 years, 35 % have established for 5–8 years, 10 % have established for 3–5 years, and the rest have established for less than 3 years. What's more, the companies enjoying an annual sales volume of more than 100 million RMB are those with a history of at least 7 years (Yang and Yin 2009). The competitiveness of a service outsourcing enterprise is closely related to its history, the massive accumulation of competence and reputation can help to win recognition in the market for an enterprise. The service outsourcing strategic alliance helps each enterprise with respective expertise to be in charge of corresponding parts of the whole work and totally offer an integrated solution to the client, just after those enterprises with good reputations receive orders.

Since the different enterprises have heterogeneous resources and different competence, then service outsourcing strategic alliance can help them to integrate those differentiated skills and knowledge. The overall competitiveness can be increased, if favorable policies can provide a good platform for enterprises to learn from each other.

#### ***120.4.3 To Establish a Dominated Association at National Level or Among the Model Cities***

The advanced service outsourcing countries like India and Ireland have their corresponding service outsourcing industrial associations. India National Association of Software and Services Companies (NASSCOM), provides favorable conditions for the service outsourcing industry through protecting intellectual property within the country, making industrial database, and helping Indian

enterprises to exploit the external market (Wang and Wang 2008). Irish Software Association (ISA) represents the interests of the majority of Irish software developers, and to be on behalf of them to negotiate with government, provides latest information for the industry, and sponsors Irish software industry meetings as well as software sales projects (Yu 2010). In contrast, most industrial associations of our country belong to the government or institution with relatively weak influence. We should learn from abroad to set up industrial association which is clearly positioning in providing service for enterprise.

According to the research from home and abroad, the clients always follow the principles that consider about the country or region first and then pick up outsourcing companies, when they are choosing offshore outsourcing providers. Because there is different production efficiency, economic development and social environment among different countries, the enterprise seeks to outsource some business will have a comprehensive consideration of each aspect such as the macro environment of vendors' country (Shao 2010). Service outsourcing industry in our country is still at the primary stage of development, under such circumstances, it is necessary to establish a broadly representative industry association. Generally speaking, the association at least should contain several important functions. First of all, to build China's outsourcing brand and represent domestic enterprises to exploit international market. Secondly, to establish professional service outsourcing platform aims to introduce the trend of international outsourcing and strengthen the cooperation and sharing of information. To act as a role of intermediary organization, offering services like market research, legal consultation, and information management for the service outsourcing enterprises.

#### ***120.4.4 To Further Improve the Intellectual Property Protection Systems and Educational Training and Talent Attraction Mechanisms***

At present, the legislation of intellectual property protection is still not specifically used for service outsourcing, the policies and regulations that applied are mostly appeared in the third industry, which are lack of executive maneuverability (Liu 2010). With reference to the advanced experience of foreign intellectual property protection, the policy needs to be improved from three aspects. At the national level, the largest enlightenment from India service outsourcing development is that, we can build an intellectual property protection system in the industrial level which under the premise of avoiding conflict with international obligations, instead of setting all types of intellectual property protection standards. So we can formulate intellectual property protection regulations just in outsourcing field. On the one hand, it can help to reassure the outsourcing companies; on the other hand, it won't involve other industries' complicated problems. At the industry level, to set up a cooperation mechanism between industrial association and law enforcing

departments to reduce intellectual property infringement. At the enterprise level, to establish a more specific intellectual property protection mechanism inside the company, for example, to make the staff sign a confidentiality agreement aims to protect the internal intellectual property. Sometimes, some big enterprise can also customize the intellectual property protection regulations for the outsourcing companies (Shui-jing and Xiang 2009).

In order to conduct the talent construction, it's common for the governments from home or abroad to adopt some experience, like adjust the personnel structure and improve the cultivation mode, actively attract and hire senior personnel from abroad, encourage overseas students to come back (Qin-xue and Wang 2009). From the aspect of talent training, many model cities have already made a good demonstration, but China still faces the problem of shortage of high quality talents. In order to alleviate this problem, policies can be put forward from two aspects. For fulfilling high quality talents in demand, it should encourage enterprise to send their senior engineers or managers to universities or research institutions even abroad to learn latest technological or managerial practice. Secondly, it should formulate preferential policies to attract and hire overseas senior talents, especially those who are familiar with offshore market and international business process and can communicate with foreign clients directly.

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# Chapter 121

## A Study on the Continuous Improvement of Hotel Service Quality Based on the PDCA Cycle

Guo-xia Sun

**Abstract** The quality is the lifeline of enterprise. The intangibility and tangibility of the hotel's products makes the hotel service quality to show its great comprehensiveness. In this article, PDCA cycle is applied to the management of hotel service quality, analyzes its main problems and their reasons, and develops the corresponding countermeasures in order to achieve the continuous improvement of the hotel service quality and increases hotel's vitality and competitive advantage.

**Keywords** Continuous improvement · Hotel management · PDCA cycle · Service quality

### 121.1 Introduction

As early as the 1970s, the issues of service quality management had got the attentions of scholars who worked in the western developed countries. "Management of Service Operation", which is written by W. Earl Sasser, Richard Paul Olsen, D. Daryl Wyckoff and published in 1978, is one of earliest books. It makes systematic expositions of the service product, the service quality and the service quality management. Thereafter, the Nordic School, as the representatives of Christian Gronroos, makes a lot of pioneering research on it (Gronroos 1982). Someone, such as Berry, Zeithmal, Parasuraman, makes a more in-depth systematic research on this issue (Parasuraman et al. 1985). But the research of service quality in our country is still in the stage of drawing lessons from foreign research results. And we also need to constantly improve in terms of theoretical foundation and research methods etc.

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Based on the PDCA cycle theory, this article discusses how to improve the hotel service quality.

121.2 PDCA Cycle Theory

PDCA cycle theory (Dong Wenyao et al. 2010) is co-founded by Walter A. Shewhart and William Edwards Deming, who are the American quality experts. It is one of effective methods to improve the quality management activities, especially has been widely applied in quality continuous improvement.

121.2.1 The Four Phases and Eight Steps of PDCA Cycle

The four phases of PDCA cycle: the Planning phase, the Do phase, the Check phase and the Action phase. These four phases form a loop, and continue the cycle, so that make the target to continual improvement, as shown in Fig. 121.1.

- 1. *The Planning phase:* the plan is the first stage of the quality management. Through the plan, we can determine the policies and objectives of quality management, and the action plans and measures for achieving these policies and objectives. The Planning phase includes the following four steps.

The first step, to analyze the current situations, to find out the quality problems;  
The second step, according to the quality problems which we find out, to analyze the causes and the influencing factors;  
The third step, to find out the major causes and the main influencing factors;

standardized and institutionalized, it would be impossible to make PDCA cycle to move forward.

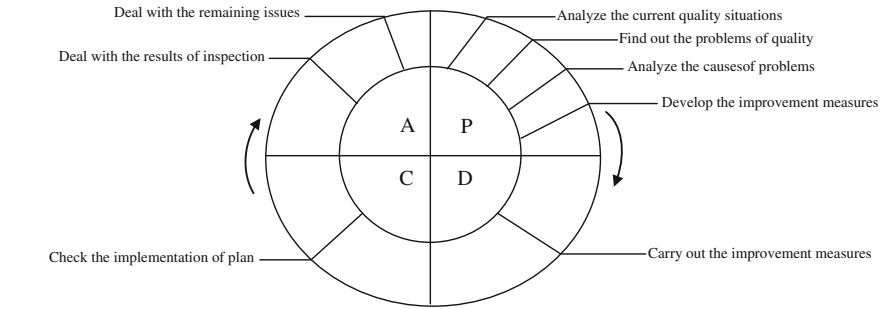


Fig. 121.1 Picture of PDCA cycle

The fourth step, we should develop the measures for improving the quality, to propose the action plan, and to expect the results. The action plan mainly includes the cause, purpose, place, time, executor and method, also known as 5 W1H.

2. *The Do phase*: this phase is only one step.

The fifth step, is in accordance with the plans, objectives and measures to implement specifically.

3. *The Check phase*: this phase also includes only one step.

The sixth step, check the effect of the plan implementation. By doing a self-inspection, mutual inspection, process handover inspection, full-time inspection etc., we will contrast to the implement results and the predetermined targets, to carefully check the implementation results of the plan.

4. *The Action phase*: the Action phase includes two concrete steps.

The seventh step, sum up the experiences. To deal with the various problems which we check out, to approve those correct ones, to summarize to the written, and to set the standards.

The eighth step, put forward the unresolved issues. According to the inspections, we can list the remaining issues and transfer them into the next cycle, such as the effect is not obvious, the effect of measures is not yet in line with the requirements, and the quality problems are not been solved.

The Action phase is a critical phase of the PDCA cycle. The mission of this phase is to solve the problems, sum up experiences and learn lessons. The focus of this phase also is to revise the standards, including the technical standards and the management systems. No standardized and institutionalized, it would be impossible to make PDCA cycle to move forward.

### ***121.2.2 The Characteristics of PDCA Cycle***

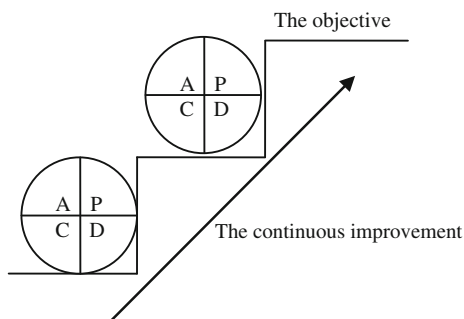
The main features of the PDCA cycle are the cycle, large ring with a small ring, ladder rise, the use of statistical tools (Biyani 2010).

The cycle refers to the four processes of PDCA cycle is not only run once, but to carry out again and again;

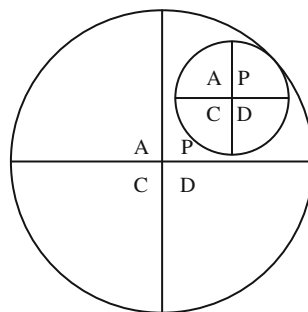
The large ring with a small ring refers to the organic and logical combination of organizing the overall operation and its various sub-sectors;

The ladder rise refers to the PDCA cycle is not stuck in the same level cycle, but continues to solve the problems, and it is the gradually increasing process on the level of the quality management, as shown in Figs. 121.2 and 121.3.

**Fig. 121.2** Picture of the continuous improvement in the PDCA cycle



**Fig. 121.3** Picture of the large ring with a small ring in the PDCA cycle

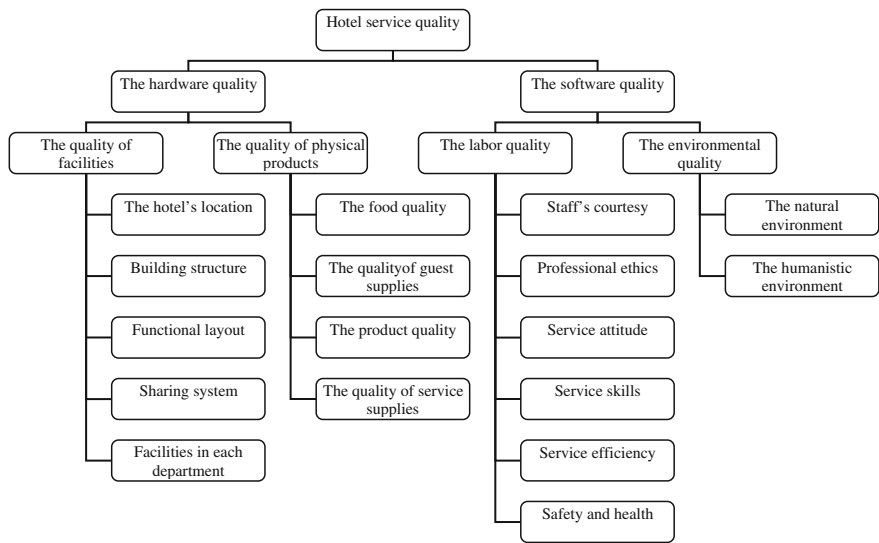


## 121.3 The Meaning and Structure of Hotel Service Quality

From the broad sense, the hotel service quality including the hardware quality and software quality; from the narrow sense, it only means the software quality. The article uses the generalized meaning of hotel service quality. The hotel service quality refers to the ability and extent that the service activities can meet the standard requirements and the needs of guests, its essence is the unity of the quality of tangible products and the quality of intangible services in hotel (Mai-hong 2005). Its connotation is rich and its structure is complex, as shown in Fig. 121.4.

### 121.3.1 The Hardware Quality

1. *The quality of facilities and equipments*: the facilities and equipments are the foundation for the hotel's existence, are the support of the labor service in hotel. The configuration and operation condition of equipment is an important content of hotel service quality, mainly refers to the hotel's location, building structure, functional layout, sharing system, facilities in each department.
2. *The quality of physical products*: the physical products can satisfy the needs of customer's material consumption, its quality level is also an important factor to



**Fig. 121.4** Picture of the structure of hotel service quality

affect the service quality. It mainly included the food quality, the quality of guest supplies, the product quality and the quality of service supplies (Ding Lin et al. 2009).

**121.3.2 The Software Quality**

- 1. *The labor quality*: the labor quality is the quality of various services which are provided by the hotel staff. It mainly included staff’s courtesy, professional ethics, service attitude, service skills, service efficiency, safety and health, and so on.
- 2. *The environmental quality*: the hotel environment refers to the natural environment and the humanistic environment where the hotel is located (Wenjun et al. 2008). The quality of natural environment includes the hotel’s natural scenery

Whether inside or outside, the situation of green layout, and whether has the artistic charm. The humanistic environment refers to the relationship during the hotel staff, the managers and the customers is whether friendly, harmonious, understanding and mutual aid or not.

121.4 The Application Example

This article selects the main problems in one hotel service quality issues to systematically expound the application of the PDCA cycle.

121.4.1 The Plan Phase (P)

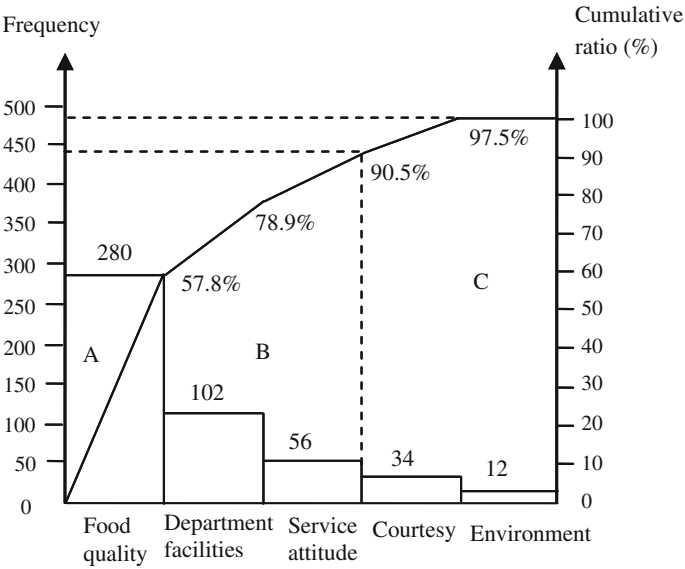
1. *Analyze the situation, identify the main quality problems:* using the ABC analysis, we try to identify the main quality problems. The ABC analysis is a method that the problems are divided into three categories. Class A is a pivotal problem, which is characterized by a small number, but more frequently, the cumulative frequency percentage in the range from 0 to 70 %, accounting for 70 % of the total number of complaints; Class B is a general problem, which is characterized by the general number and less frequently, the cumulative frequency percentage in the range from 70 to 90 %, accounting for 20–25 % of the total number of complaints; Class C is a minor problem, which is characterized by a large quantities, but less frequently, the cumulative frequency percentage about 90–100 %, accounting for the proportion of complaints about 10 % (Hong 2007).

By the questionnaire of service quality to the guest, the guest complaint records and inspection records of various departments to collect the problems of hotel service quality in one hotel which is located in Changchun city in 2011, and to classify into a chart, as shown Table 121.1, Fig. 121.5.

From the chart shows, the cumulative ratio, about the problems of food quality in this hotel, is 57.8 % that between 0 and 70 %, so it belong to Class A; the cumulative ratio about the problems of department facilities and service attitude are 78.9 and 90.5 % that between 70 and 90 %, so they belong to Class B; the cumulative ratio about the problems of staff’s courtesy and environment are respectively 97.5 and 100 %, classified as Class C in the rang of 90–100 %. Therefore, this hotel must solve the food quality problems immediately.

Table 121.1 The statistics on the problems of hotel service quality

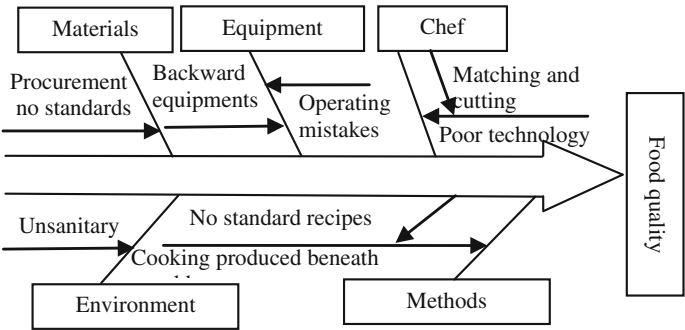
The structures of quality	Quantity	Ratio (%)	Cumulative ratio (%)
Food quality	280	57.8	57.8
Department facilities	102	21.1	78.9
Service attitude	56	11.6	90.5
Courtesy	34	7.0	97.5
Environment	12	2.5	100.0
Total	484	100.0	100.0



**Fig. 121.5** Pareto diagram of the problems of hotel service

2. *Analysis on the causes of quality problems:* from the Pareto diagram shows, the problem of food quality in this hotel is the main quality problem. We can analyze the reasons that affect food quality by the method of cause and effect diagram, in terms of personnel, equipment, raw materials, methods and environment etc., and make the cause and effect analysis diagram with these reasons, as shown in Fig. 121.6.

From the diagram of cause and effect analysis, we can find out the main reasons of affecting the food quality: the cook's poor technology; no standard recipes as references for producing the dishes; kitchen equipments are backward relatively;



**Fig. 121.6** The diagram of cause and effect for food quality

staff's mistakes during operating; the procurement specification of raw materials is inadequate; the bad environment in the kitchen and so on (Wang 2007).

3. *Formulate the improvement measures*: in view of the above reasons of food quality problems, combined with the fourth step of Plan phase, we can develop the action plan for improving the food quality (Jiang 2009), as shown in Table 121.2.

#### ***121.4.2 The Do Phase (D)***

The Do phase is the implementation of above action plan of improving the food quality (Bojanic and Rosen 1994). This hotel has made the procurement specifications, monitoring system, sanitation rules, etc. from January 1st to 5th; it trains the chef's skills of operating kitchen equipment and the chef's skills of processing and cutting from January 5th to 10th; from January 10th to 20th, it makes the strengthen management for the inspection and inventory of raw materials; it introduces advanced equipment for kitchen during January 15th–30th; this hotel makes the standard recipes during January 20th–30th. We should be noted that the Do phase is not isolated. When the staff is amending the plan, as the same time they are discovering the problems.

#### ***121.4.3 The Check Phase (C)***

The Check phase is to check the action plans of improving food quality if on schedules, to confirm one by one, to contrast the collected completion data to the standards', to see whether they have reached the predetermined target. According to the checking the contrasts, we find out the following problems, as shown in Table 121.3.

#### ***121.4.4 The Action Phase (A)***

The Action phase is a critical stage for solving the food quality issues. According to the checklist, we know that the problems are solved, such as the problem of processing and cutting food, the degree of advance equipment, the staff's proficiency, the value and freshness of raw materials. These standards will be summarized and written into the specification of food quality.

From the table, we can know these problems that the color of the dishes are monotonous, the chef of using materials are not inaccurate, and the situations of

**Table 121.2** The action plan for improving the food quality

No.	Situations	Standards	Countermeasures	Dept.	Person in charge	Schedule
						January 2012
						5
						10
						15
						20
						25
1	Processing and cutting with non-standard monotone colors	Uniform shapes various colors	1. Skills training for the chef 2. Carry out the external technical exchanges to the chef	Training F&B	LI xx ZHAO xx	
2	Backward equipments, staff's mistakes during operating	The operation of equipment is normal, operation is trouble-free	1. Equipment operation training 2. Introduces advanced equipment for kitchen	Engineering F&B, Purchasing	WANG xx LI xx	
3	The procurement specification of raw materials is inadequate.	The raw materials' edible value, maturity, sanitation, and freshness meet the standards	1. Develop the procurement specifications 2. Strengthen the inspection and inventory management	Purchasing F&B	LIU xx GAO xx	
4	The cooking produced beneath the standard	Color, smell, taste, shape, cooking time, ingredients, accessories, processing and cost meet the standards	1. Makes the standard recipes	F&B	HU xx	
5	The bad environment in the kitchen	Location, size, ventilation, lighting, microclimate, daily sanitation meet the standards	1. Make the check rules of sanitation 2. Establish the monitoring system	Inspection F&B	MENG xx CUI xx	

**Table 121.3** The checking form for improving the food quality

No.	The content of inspection	The inspector	The result of inspection
1	The food's processing and cutting	The kitchen helper	Uniform shapes
2	The degree of equipment, the usage of staff	The engineering dept	Advance equipment, skilled staff
3	Purchase draw materials	The purchasing dept.'s inspector	High edible value, high freshness
4	The whole process of cooking	The head chef	The ratio of raw materials is not accurate
5	The environment and sanitation	The manager of F&B, the head chef	Poor situations of ventilation and lighting

ventilation and lighting in kitchen are still poor, etc. These problems will be listed as the leftover problems and shift to the next PDCA cycle, to continue to be resolved, in order to achieve the continuous improvement of food quality.

## 121.5 Conclusion

This paper reviews the PDCA cycle theory and the structure of hotel service quality management, and illustrates the application of the PDCA cycle with examples.

At present, the PDCA cycle has been used more and more in the enterprise management, which allows manager's thinking, methods, working procedures to be principled, systematic, graphic and scientific, is an effective method to enhance the service quality and continuous improvement. But in the course of using, it also exist certain problems, because it is used in accordance with predetermined framework, that maybe lead to some manager's inertial thinking, lack of inspiration and innovation method (Li 2007). Therefore, in the process of using, managers should foster its strengths and avoid the weaknesses, use the new ideas and ways to find out the solutions of quality problems, so that the quality will be to improve continuously.

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Finally, my special thanks go to my classmate Chun-yan Wang and colleagues Wei Meng for guidance in English translation.

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# Chapter 122

## Implementation of Six Sigma to Service Quality Management in Auto After-Sale

Xiang-ping Bo, Yi-yi Wang and Jun-fang Zou

**Abstract** Based on the characteristics of service industry, this paper constructs an implementation model for automobile service quality management and achieves excellent results in the service quality improvement project in after-sale maintenance center. It proves that Six Sigma can be applied in automobile service industry, and some suggestions for Six Sigma implementation in service industry are proposed: firstly, making some necessary adjustments according to the specified situation in the enterprises; secondly, gaining support from the executives; lastly, paying close attention to the customer demands and making decisions on the basis of data and facts.

**Keywords** Six sigma · Auto after-sale service · Service quality management · Process improvement

### 122.1 Introduction

With the speedy improvement of domestic auto manufacturing technology and the maturity of the consumption concept of customers, auto brand competition has transferred from internal factors such as product technology and price to after-sale services. So far, auto after-sale service quality has remained to be improved, scientific management and analysis methods are desperately needed for management guidance.

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Six Sigma is a good management method to improve quality management in processes intensively and effectively. Since Six Sigma lays much on processes, people think that it is not suitable for service enterprises because its processes and products are intangible, mutable and perishable. But this research has shown that Six Sigma is suitable to the auto after-sale service processes. It has proved that Six Sigma is effective for the service industry and can be taken as a reference for other service sectors.

## **122.2 Literature Review**

### ***122.2.1 Six Sigma***

Many researchers have studied Six Sigma programs and identified many critical decisions of these programs. Six Sigma is a management system for achieving and maintaining success by concerning customers, process improvement as well as effective using data and facts (Pande et al. 2011). The key idea in Six Sigma is through the process improvement to improve customer satisfaction and increases the firms profits (Banuelas et al. 2008), with main features including the real focusing on customers, the management and improvement based on facts and data driven, active management and no boundary cooperation.

### ***122.2.2 Implementation Model***

As discussed before, a model for effectively guiding the implementation of Six Sigma is not available. Mortimer (2006) considered the DMAIC methodology to be essential to six sigma programs and appropriate for delivering business improvements (Mortimer 2006). Bis considered DMAIC as the scientific method in Six Sigma programs. According to Franza, DMADV was central to a product development experience. But there are great improvement demands and opportunities in service areas. So four steps model of Six Sigma and five steps model are put forward and they have played an effective role beside the factory scope in nonwoven field (Pande et al. 2011).

### ***122.2.3 Critical Success Factors of Six Sigma***

Snee and Hoerl (2007) think that the success factors of Six Sigma are leadership support and participation, outstanding talents, and basic support systems three elements (Snee and Hoerl 2007). Through the questionnaire surveys, Ho and

Chuang have found out that the senior managers participation and support, the Six Sigma team, education and training and considering customers as the center etc. are the key factors to successfully implement Six Sigma (Ho and Chuang 2006). Schroeder et al. (2010) conclude five important factors, namely, senior managers support and participation, experts of Six Sigma, a Six Sigma team, according to the DMAIC system in Six Sigma implementation (Schroeder et al. 2010). The other scholars argue that understanding Six Sigma and incentives, project choosing and management experience, concentrating and communicating with customers, outstanding talents, connecting with strategic and suppliers, clear standards of performance will also have the effect on the implementation of Six Sigma (Kumar and Haritha 2009; Shanmugam 2007; Antony and Banuelas 2004; Johnson et al. 2007; Ayon and Kay 2009).

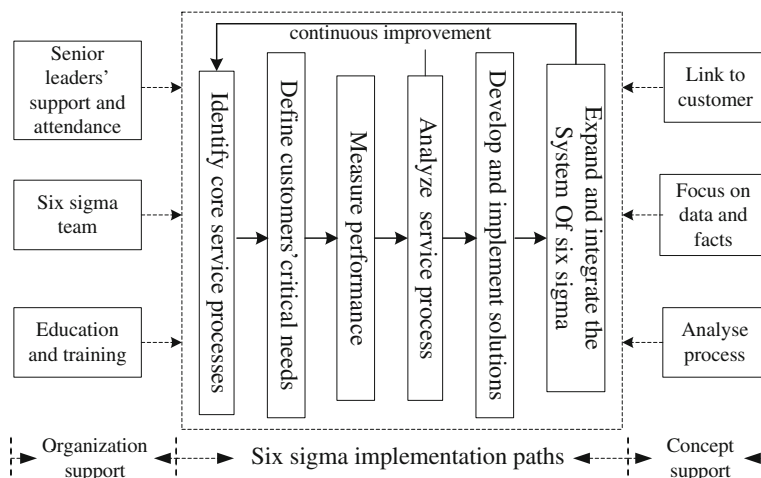
#### ***122.2.4 Suggestions to the Implementation of Six Sigma***

Scholars have put forward many suggestions to the implementation of Six Sigma. Kwak and Anbari (Kwak and Anbari 2008) view that when the enterprises implement Six Sigma, they must regard customers as the center (Kwak and Anbari 2008). Satya (Chakravorty 2009) points out that enterprises should pay more attention to the training and education of the workers to make the employees understand the Six Sigma, change the enterprise culture, and establish an effective incentive mechanism (Chakravorty 2009). But (Zhao 2004) emphasizes that implementing Six Sigma in China, the companies must pay attention to the Chinese cultural characteristics, and can not copy the foreign methods mechanically (Zhao 2004). Pande et al. (2011) argues that carrying out Six Sigma in the service industry should note the following four points: starting from the beginning, regulating the process carefully, using the facts and data well, not over-emphasizing statistical analysis (Pande et al. 2011).

### **122.3 Six Sigma Implementation Model in Service Quality Management**

The implementation of Six Sigma in the service quality management can not follow the Six Sigma system in manufacturing quality management because of the service characteristics. In this paper, the implementation model is based on Pande's five steps model by adjusting the model combined with the service process characteristics (Fig. 122.1).

As shown in Fig. 122.1, the model includes Six Sigma implementation paths and support systems. There are six implementation paths, including identifying the core service process, defining the customer critical needs, measuring the



**Fig. 122.1** Six Sigma implementation model in service quality management

performance, analyzing the service processes, designing and implement solutions, expanding and integrating the system of Six Sigma. The support system includes organization support and concept support.

1. *Identifying the Core Service Processes.* The core processes are the most important part of the link to creating value and affecting customer satisfaction directly. Since service process is intangible, drawing the diagram of core processes can help the project members to understand the whole process better.
2. *Defining the Customer Critical Needs.* Critical needs are the needs that can not be fully satisfied but important to customer satisfaction. They should be found out and defined firstly in the project.
3. *Measuring the Performance.* Measuring performance is to measure the quality characteristics of critical demands to set up an improvement goal.
4. *Analyzing the Service Processes.* Analyzing the service processes is to find out the problems in the processes, especially the poor performance processes, and the possible causes by drawing detailed service flow chart.
5. *Putting forward the Solutions.* Put forward several improvement solutions to the main problems firstly and then adjust the process or design a new process based on the most feasible solutions. A continuous assessment on the improvement effect to the implementation of the new solutions should be operated and the implementation of the new solutions should be controlled.
6. *Expanding and Integrating the System of Six Sigma.* Expand the range of the improved processes to push over the improvement efforts continually and implement the closed loop management.
7. *Organization Support.* The implementation of Six Sigma must gain the support and attendance from the senior leaders. It also depends on an effective organization team to promote the continuous improvement. The education and

training of the employees are necessary to improve service consciousness and quality improvement skills and increase the possibility of success.

8. *Concept Support.* The implementation of Six Sigma must concentrate on customer demands, communicate with customers effectively and design products and services based on customers' demands in order to improve customer satisfaction. The decisions are made based on the data and facts not on the feelings and experience. The Six Sigma in service quality management must analyze the service processes to find out the improvement chances and improve service quality by improving the service process ultimately.

## **122.4 Implementation Case: Service Quality Improvement Project in Auto After-Sale**

As the competition becomes intensively, TC Auto Sales and Service Co. Ltd. decide to implement the Six Sigma model in auto after-sale service center to improve service quality and increase customer satisfaction.

### ***122.4.1 Preparatory of the Implementation***

In order to promote the implementation smoothly, TC has done lots of preparatory work:

#### *1. Setting up a six sigma team*

The general manager is the advocate who is responsible for the overall project. The other members are responsible for the cooperation and communication in different departments.

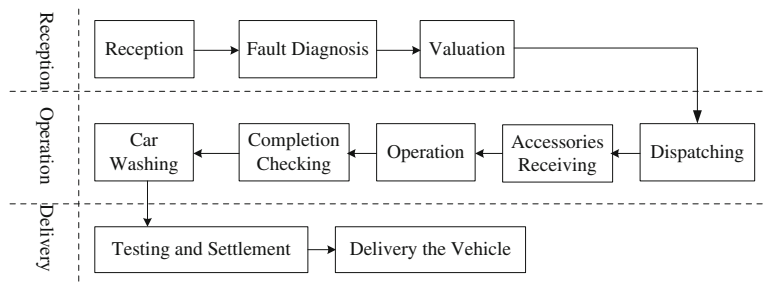
#### *2. Education and training*

The training includes the service awareness training and the training of quality improvement methods and tools.

### ***122.4.2 Implementation of the Model***

#### *1. Identifying the core processes*

The core process of the auto after-sale is the maintenance service, which includes reception, operation and delivery processes (Shown in Fig. 122.2).



**Fig. 122.2** Core service process of after-sale service center

2. Defining the critical needs of customers

The critical needs of customers are defined by the investigation the service quality of the after-sale service center which is the gap between the perceived quality and expected quality and the importance of customer needs. The quality questionnaire is adopted Likert 5 point scale and divided into three parts of the importance of quality factors, the expected quality and perceived quality. We regained 131 valid questionnaires and established the matrix of service quality-importance, the plot is divided into four quadrants by the average of scores of service quality and importance (Shown in Fig. 122.3).

It can be seen that the critical needs are maintenance cost and service time consuming in Fig. 122.3 and these two quality elements should be improved firstly. The maintenance cost is uniform priced by the manufacturer. So shortening service time-consuming is the preferred improvement project.



**Fig. 122.3** The matrix of service quality-importance

3. Measuring performance

According to the core process in after-sale service, the time spending in the center includes the reception, operation and delivery time. The dispatching time is listed separately because of its long time. The vehicle arrival time ( $t_0$ ), billing time ( $t_1$ ), dispatching time ( $t_2$ ), completion time ( $t_3$ ) and delivery time ( $t_4$ ) are taken as the measure nodes. The reception time ( $T_1$ ), dispatching time ( $T_2$ ), operating time ( $T_3$ ) and settlement time ( $T_4$ ) according to  $T_n = t_n - t_{n-1} (n = 1, 2, 3, 4)$  and the total time ( $T$ ) can be calculated (Shown in Fig. 122.4).

140 maintenance vehicles are selected to be recorded for the service time-consumption and 131 effective samples are collected finally. The results are shown in Table 122.1.

According to Table 122.1, the operating time is about 84 min, more than 60 % of the total time. Therefore, it is the key to shortening customers' waiting time to improve the operational efficiency and eliminate unnecessary operation process. The sum of dispatching and settlement time is more than 47 min and accounts for 35 % of the total time which is very short. It shows that the problem is very prominent and the processes need to be improved urgently.

4. Analyzing the service process

The detailed service flow chart is drawn out based on the actual situation in the after-sale service centers. The problems are found out by identifying the coherent processes, bottlenecks, redundancy, rework links etc. They are the fault diagnosis, valuation, dispatching, parts supply, operation, settlement etc. The fault diagnosis, careless checking may cause incomplete fault diagnosis. And some new faults in the operation process may be found by the maintenance technicians. All these would waste lot of maintenance time and lengthen the operation time.

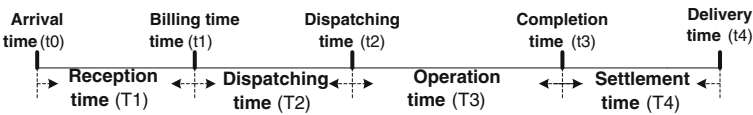


Fig. 122.4 The diagram of time measurement program

Table 122.1 Time-consuming statistical analysis table

	Before improvement		After improvement	
	Mean (m)	Percent (%)	Mean (m)	Percent (%)
Reception time	6.26	4.47	11.05	10.14
Dispatching time	19.95	14.58	12.33	11.31
Operating time	83.68	61.11	69.73	63.96
Settlement time	27.01	19.74	15.91	14.59
Total time	136.90	100	109.02	100

**Table 122.2** Independent samples test

		Levene's test for equality of variances		<i>t</i> test for equality of means		
		F	Sig.	t	df	Sig.
T	Equal variances assumed	15.276	0.000	2.019	195	0.045
	Equal variances not assumed			2.462	194.98	0.015

## 5. Putting forward the solutions

The improvement solutions are put forward according to the problems which are found out by process diagnosis individually. For example, the feasible improvement solution for fault diagnosis process is to divide the fault diagnosis process into reception station diagnosis and diagnostic station diagnosis. The six position checking is implemented strictly to confirm the fault and the cause of the malfunction on the reception diagnosis station. A further diagnosis is needed on the diagnosis station for those can't be determined the malfunction cause on the first diagnosis station.

To verify the effectiveness of the process improvement, 66 repaired vehicles for the service time consumption are selected to do the independent samples T test at significant level before and after the improvement. The result is shown in Tables 122.1 and 122.2.

From the Tables 122.1 and 122.2, it is seen that the P value is  $0.015 < 0.05$ , which certifies that the total time before and after the improvement are different significantly and the vehicle maintenance total time consumption is 109.09 min. It has been shortened 17.88 min. And the dispatching, operating and settlement time are shortened 7.62, 11.1 and 13.95 min separately. It shows that the process improvement makes successful result in the after-sale service center.

## 6. Expanding and integrating the six sigma system

Expand the range of improved process to push over the improvement efforts continually. Firstly, publicizing the improvement achievement to the managers and employees in order to reduce the resistance. Secondly, developing solutions in advance to the potential problems. Thirdly, assigning process manager and clarifying the responsibility. Finally, implementing the closed-loop management in the other field.

## 122.5 Conclusions

Considering the specific characteristics of service industry, this paper constructs a Six Sigma implementation model in service quality management and is applied in service quality improvement project in an auto after-sale service center. Conclusions and suggestions are as follows:

1. *Six Sigma can be applied to service industry.* Six Sigma is not only the methodology concentrated on processes but also a strategic way of improvement to all processes and products. Six Sigma management method is also suitable for service enterprises because the service is made up of processes. This article has shown the successful result.
2. *It needs necessary adjustment according to the present situations of the enterprise before applying Six Sigma to service industry.* Service processes and products are intangible and perishable, which are not easy to measure. The priority of the implementation of Six Sigma is how to visualize the service processes and quantify the service products. Six Sigma model of service industry must start with the service processes, analyze processes and improve service processes.
3. *The service enterprises should note in the implementation of Six Sigma.* Firstly, support and participation from senior leaders can help remove obstacles of implementing Six Sigma but also guarantee the cooperation among different departments. Secondly, pay more attention to customer demands. Thirdly, make decisions on the basis of the data and facts instead of feeling and experience.

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# Chapter 123

## Trust Evaluation in Cloud Manufacturing Environment

Lu Gao, Quan Liu and Ping Lou

**Abstract** As a new manufacturing paradigm, cloud manufacturing transforms the traditional manufacturing business model, in which distributed resources belonged to different enterprises are encapsulated into cloud services. Clients can use cloud services according to their requirements, viz., clients can build up their own on-demand production service networks. However, it is quite difficult for clients to select reliable and high-quality service nodes to organize the production service network because of the existence of malicious, fake, untrue, and dynamic service nodes in the cloud manufacturing environment. The trustworthy cloud manufacturing environment is a prerequisite to implementation of cloud manufacturing. The reliable evaluation for trust works as a compass for building the trustworthy cloud manufacturing environment. In this paper, the trust measurement is discussed in cloud manufacturing environment and the trustworthy environment will be built up with this evaluation mechanism.

**Keywords** Cloud computing · Cloud manufacturing · Trust · Reputation · Trust evaluation

### 123.1 Introduction

Internet have been changing the way communication happens between people and trades occur between enterprises. With the advent of cloud computing, it is changing the way industries and enterprises do their businesses in that various virtualized resources treated as various services are dynamically and scalably provided on-demand over the Internet. In recent years, the philosophy of “Design Anywhere, Manufacture Anywhere (DAMA)” has emerged in manufacturing

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industries Heinrichs (2005). The DAMA idea requests enterprises to take full advantage of geographically dispersive manufacturing resources. So far a couple of new manufacturing paradigms supported by Internet, including collaborative manufacturing, networked manufacturing, grid manufacturing, and etc. have been emerging. With the advent of Cloud Computing and Internet of things (IoT), both of them will surely create a new horizon of opportunity for manufacturing industry together. Cloud Computing has emerged as a model in support of “everything-as-a-service” (XaaS) Lenk et al. (2009), which delivers infrastructure, platform, and software (application) as services and are made available as subscription-based services in a pay-as-you-go model to consumers, viz., Cloud represents the infrastructure in which businesses and users are able to access applications from anywhere in the world on demand Buyya (2010). The IoT makes computing truly ubiquitous, in which the Internet extends into the real world and provides a standardized way for the cyber-space to understand the real world Mattern and Floerkemeier (2010). Hence, by linking manufacturing resources and items with the IoT, it becomes a reality to monitor and optimize the production processes and the entire lifecycle of objects from production to disposal (Internet of Things—Strategic Research Roadmap 2009). And both tangible and intangible manufacturing resources which are encapsulated as smart items are organized in terms of the distributed paradigm of Cloud Computing and provide services for users on demand. Under the support of Cloud Computing and IoT, an innovative manufacturing paradigm named Cloud Manufacturing is incubated, where dynamically scalable and elastical manufacturing resources are connected over the IoT and provided as a service over the Internet. In addition, Cloud Manufacturing is also a kind of networked, service-oriented intelligent manufacturing paradigm through which manufacturing enterprises are to obtain better resource utilization, availability and collaboration on demand. The most significant merit of this new manufacturing paradigm is that enterprises can quickly expand their capabilities and get new services to expedite time-to-market with a low cost. It has immense potential without doubt, and scholars and practitioners are starting to realize it. Fujitsu has just announced its “Engineering Cloud” which will bring cloud-based computer-aided design (CAD) and computer-aided manufacturing (CAM) tools to the cloud. Of course, Cloud Manufacturing is, admittedly, in its infancy, and there are a lot of problems to be solved if it becomes mature.

Like all forms of online transactions, such as e-commerce, P2P networks, and multi-agent systems all are based on mutual trust. Trust and reputation management helps transacting peers to steer away uncertainties and risks inherent in these environments. So far, the trust evaluation and management technology have been studied and developed in many fields, such as P2P, Ad hoc networks, GRID, E-commerce, and web services. Likewise, in cloud manufacturing environment, as a kind of distributed manufacturing environment, the trust issue is prominently important for interactions between unfamiliar service providers and customers.

The remainder of this paper is broken into three sections. In [Sect. 123.2](#) the trust concept and evaluation methods are introduced. The [Sect. 123.3](#) give a trust definition and a evaluation method in cloud manufacturing. At last the conclusions are drawn in [Sect. 123.4](#).

## 123.2 Trust and Trust Evaluation

### *123.2.1 Trust Concept*

Trust plays an important role in our social life, especially in business environments, or when financial issues are involved Yan (2010). Apparently, trust is a key enabler of cooperative human actions. However what is trust? In human society, due to widely differing conceptual definition of trust for multiple disciplines ranging from economics to psychology, from sociology to medicine, and to information science, it is difficult to provide a common definition because of the multidimension, multi-discipline and multifacet of trust concept (McKnight and Chervany 2000; McKnight et al. 2003). For example, from the sociologists' point of view, it is related to social structure; from the psychologists', it concerns personal trait; from the economists', it is a mechanism of economic choice and risk management. The definitions of trust can be classified based on the consideration of structural, disposition, attitude, feeling, expectancy, belief, intention, and behavior. Thereby various definitions of trust is found in the literature (Hinde and Groebel 1991; Gambetta 1990; Mayer et al. 1995). As we have seen, several definitions of the human notion of trust proposed may even changing because of facing the different fields. Networks are revolutionizing the way we conduct our personal and organizational business, and the human notion of trust has been extended into the digital world. In digital world or virtual societies the goal of the research on trust is to increase the reliability and performance of electronic communities Longo et al. (2007).

### *123.2.2 Trust Evaluation Methods*

Actually trust and reputation management systems are essential parts of open networks (Sacan 2009). There is a demand for trust evaluation from Peer-to-Peer (P2P) networks, ad hoc networks, e-commerce applications, service oriented computing, and multi-agent systems which have different focuses. Therefore it is not realistic to look for one all-round perfect solution that fits all fields. There are different trust evaluation methods for different types of applications.

1. *For E-commerce:* With the popularity of e-commerce, an effective trust evaluation system become more and more important, and has also become a critical guarantee for further popularity. For example one of the most successful online

business model, eBay uses a kind of binary reputation system to rank the characteristics of parties (Dellarocas 2001). This trust evaluation method is easy to maintain and cheap to run but it doesn't provide enough information about the seller for many buyers. Of course, some need more evaluation systems to provide more detailed and more accurate information about users, such as amount of satisfaction, delivery time, number of transactions, source party credibility, transaction context, community context Xiong and Liu (2004).

2. *For P2P*: P2P information sharing networks are mostly open to public, are big in scale and have no central authorities. They are typically distributed networks. Because of this structure, the requesting party doesn't have any experience with majority of serving peers. Most trust evaluation systems use polling algorithms to collect information about a peer. In Yu et al. (1995), a trust evaluation method is proposed, in which a peer combines testimonies from several witnesses to determine the trustworthiness of another peer. And other people use the idea of 'risk management'. Wang and Varadharajan present an trust evaluating approach to unfamiliar peers which calculates the probability of achieving a successful transaction according to the feedbacks given by other peers Wang and Vassileva (2003). And in Wang and Varadharajan (2004), a naïve Bayesian network is used to represent the trust of a target peer. And a peer can infer the trustworthiness of a target peer according to a Bayesian network.
3. *For Multi-Agent Systems (MAS)*: Trust and reputation are a key issue to effective interaction in open multi-agent systems. In Huynh (2006), FIRE was developed based on a number of potential sources of trust information, including direct experiences of an agent from its interaction (interaction trust), witness reports (witness reputation), third-party references (certified reputation), and rules provided by end users encoding beliefs or knowledge about the environment (role based trust). Josang et al. (2006) have regarded the relationship among the agents as trust networks, and use subjective logic to analyze trust networks.

## 123.3 Trust in Cloud Manufacturing

### 123.3.1 Trust Evaluation Requirements

In cloud manufacturing environment, both manufacturing service providers and manufacturing service customers are regarded as independent decision makers (respectively named as agents and target agents). Manufacturing service customers search credible manufacturing services to meet the needs in cloud manufacturing environment. And manufacturing service providers may also sign the agreement with trustworthy customers and obtain their payment after finishing services. Without trust, service providers and customers can not collaborate effectively in cloud manufacturing environment. Without collaboration, cloud manufacturing

paradigm can not be made a reality. Therefore, trust evaluation and management pays a crucial role in cloud manufacturing. Trust in cloud manufacturing environment can simply be defined as ‘a particular level of credibility of the information on a service from a manufacturing service provider or a requirement from a manufacturing service customers, and the subjective probability of a commitment which a manufacturing service provider or a manufacturing customer makes to be abided by’. The definition of trust has three properties: context, subjectiveness and evolution. To make the cloud manufacturing true, a trust evaluation mechanism must operate without the need for users to intervene, viz., a trust evaluation mechanism may be employed as automatically managing trust between service providers and service users.

### 123.3.2 Trust Evaluation Model

In the cloud manufacturing environment service customers are willing to search and select those potential trustworthy providers whose functions can satisfy the requirements of users. Likewise service providers are willing to provide services to credible customers. Trust evaluation are used to help service customers to decide if it is worth or not to obtain services from a certain service provider, and also help service providers to decide if or not to cooperate with other providers or to provide services to a certain customers. Trust evaluation is based on the information obtaining from direct and indirect experiences. Before an agent contemplates whether to cooperate with a target agent, it has to access the target agent's trustworthiness.

#### 1. Indirect Experiences

In the cloud manufacturing environment, interactions occur between agents and target agents. This kind of interactions is the direct experience for an agent  $A$ , but the indirect experience for the other agents. Each agent will give a rating after the completion of a interaction. These ratings are collected, processed, and finally give evaluating value (named reputation value  $R$ ) for each agent by the cloud manufacturing system and are processed

**Proposal 1**  $f_{ij}(s_k, t)$  denotes that an agent  $i$  gives a rating on a target agent  $j$  about service  $s$  on time  $t_k$  after agent  $j$  serves agent  $i$ .

$$f_{ij}(s_k, t) = \begin{cases} -2, \text{very untrustworthy} \\ -1, \text{untrustworthy} \\ 1, \text{trustworthy} \\ 2, \text{very trustworthy} \end{cases}$$

**Proposal 2**  $F_{ij}(s, T_i)$  denotes the rating about service  $s$  after the multi-interaction between agent  $i$  and agent  $j$  during a period  $T$ ,

$$F_{ij}(s, T_l) = \sum_{k=1}^H \frac{1}{H} \mu(k) f_{ij}(s, t_k)$$

where  $H$  denotes the number of interaction during the period  $T_l$  ( $l = 1, 2, \dots$  denotes the  $l$ th period  $T$ ), and denotes the attenuation function defined as follows.

$$\mu(k) = \frac{1}{H} \sum_{m=1}^k \mu(m)$$

**Proposal 3**  $R_j(s, T_l)$  denotes the reputation value of agent  $j$  that interact with agent  $j$  during a period  $T$

$$R_j(s, T_l) = \sum_{i \in \Omega} \frac{R_i(s, T)}{\sum_{m \in \Omega} R_m(s, T)} F_{ij}(s, T_l)$$

where  $\Omega$  denotes an agent set in which all agents have already interacted with agent  $j$  and make an evaluation to it. If the target agent  $j$  is the first time to provide services,

$$R_j(s, T) = 0$$

This reputation value is public information which can be utilized by all agents before it judges whether a target agent is worth cooperating or not.

## 2. Direct Experiences

There are two types of direct experiences of service customers/providers (trusting agents/trusted agents): The first is the experience based on the direct interaction between trusting agents and trusted agents; the second is the experience based on the observed interaction of other trusting agents and trusted agents. The information obtaining from these experiences are the basis of agents rating the trustworthy level of trusted agents in a cloud manufacturing environment. Hence  $F_{ij}(s, T)$  can be also use to denote the evaluation of agent  $i$  on agent  $j$  after agent  $i$  directly interact with agent  $j$  or agent  $i$  observes the interaction between agent  $j$  and the other agent. For the agent  $i$  the computing rating  $F_{ij}(s, T)$  is local information. Because sometimes some agents maybe publish the untruth rating value, the published rating value is sometimes same as the local rating value.

## 3. Overall Trust Evaluation

Trust evaluation will be made before a service customer (agent) decides whether to cooperate with a service provider (target agent) or not, viz. decide whether a target agent is worth cooperating. Not only does a service customer consider reputation value but also local rating value when it makes evaluation. Hence the overall trust of a service customer combines local rating value from his direct experiences and reputation value from his indirect experiences.

**Proposal 4**  $E_{ij}(s, T)$  denotes the overall trust evaluation of agent  $i$  on agent  $j$  about service  $s$  during a period  $T$ .

$$E_{ij}(s, T_l) = w_{ij}(s, T_l)F_{ij}(s, T_l) + (1 - w_{ij}(s, T_l))R_j(s, T_l)$$

$$w_{ij}(s, T_l) = \begin{cases} \frac{f_{ij}(s, T_l) - R_j(s, T_{l-1})}{F_{ij}(s, T_{l-1}) - R_j(s, T_{l-1})}, j \in \Phi \\ w(s, T_{l-1}), j \notin \Phi \\ w(s, T_0) = \frac{1}{2} \end{cases}$$

where  $w_{ij}(s, T_l) \in [0, 1]$  denotes the weight of local rating value  $F_{ij}(s, T_l)$  and the set  $\Phi$  denotes all agents that directly cooperate with agent  $i$  during the period  $T$ .

## 123.4 Conclusion

Cloud Manufacturing treats as a new way to organize manufacturing activities, we can be much more flexible and effective in sharing and utilizing elastic manufacturing resources over Internet. However Some scholars and practitioners commence on researching on manufacturing service in cloud, and it is, admittedly, in its infancy. The potential of cloud manufacturing is huge without doubt, but it is a long way to go before it becomes mature. The trustworthy service environment for cloud manufacturing is one of key issues needed to be resolved. In this paper a trust evaluation mechanism is presented.

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# Chapter 124

## The Exploration of the Influencing Factors of Impulsive Purchasing and the Construction of the Model: On the Basis of the Researches of Cultural Difference and Mental Accounting

Jun-feng Liao, Xun-qi Liu and Xi-chen Dong

**Abstract** Impulsive purchasing is a special irrational purchasing behavior, the factors of which have been always the spotlight of the researches from the scholars and the merchants Rook and Fisher (Normative influence on impulsive buying behavior. *J Consum Res* 22(3):305–313, 1995). Because of the Internet, the shopping environment has changed and broken the limitation of space and time, many new characteristics has emerged in the impulsive purchasing, even some traditional factors has gotten changeover. This article has collected the research literature of the influencing factors of impulsive purchase, and had further researches of the mechanism, process, personal traits and the psychological change of consumers. Therefore, it proposes the new factors that affect impulsive purchasing, and build purchasing models of impulsive purchasing based on mental accounting, and the frame models of impulsive purchasing based on cultural difference and mental accounting.

**Keywords** Impulsive purchasing · Influencing factors · Cultural difference · Mental accounting

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## **124.1 The Background of Research**

### ***124.1.1 The Cause of Impulsive Purchasing***

Impulsive purchasing is of high proportion in people's daily life (Stern 1962). It even amounts 80 % for some types of products. The factors affecting the impulsive purchase of consumers include: the type of commodity, (Kollat and Ronald 1967), the sale strategies (Lili Wang, Wei lv, Jing Huang, Lin Jiang), the emotional state of consumers when they are buying (Xiucheng Fan, Yunlai Zhang), the self-regulating and self-building of the customers (Fengjie Jing, Suhong Xiong) and the purchasing environment (West 1951) etc. David and Eillett (1996).

### ***124.1.2 The Drawback of the Current Research***

The current research has based on theories of the impulsive purchasing, online shopping, mental accounting, cultural difference, but there are still three parts in need of improvement.

1. Have not taken these as pre-conditions: the emotions of income source, the psychological store frame and the beforehand operational program.
2. Ignore the reasons of impulsive purchasing and the subtle psychological change of consumers.
3. Have not concerned on the implicit and moderate Chinese culture, the conservative consumption concept brought by the culture, the change of the mental

Accounting caused by the consumption concept, and the influence on making impulsive purchasing decision.

### ***124.1.3 The Propose of Research Topic***

In the research of mental accounting and the consumption decision, Aimei Li proposed the relations between the mental accounting and the irrational consumption. Though, to certain degree, there are intersections of irrational consumption and impulsive purchase, there is still difference. Therefore, Li's research makes us doubted whether the impulsive purchase could be triggered by the change of the mental accounting, since the irrational consumption could be caused by that. Besides, Daqiang Sun gave another point of view. In his research of mental accounting and cultural difference, he proposed that the mental accounting has distinguished cultural characteristic, moreover, it should be defined as a

decision behavior based on “limited ration” or “ecologic rationality”, rather than “unreason” or “irrationality”.

That is to say, Sun’s research has pointed out the drawback of the Li’s, and not clearly given the inter relations of the mental accounting, cultural difference and impulsive purchasing, which has given direction for academic researches, also left room for the latter ones.

## **124.2 The Theoretical Frame of the Research**

### ***124.2.1 The Research Statement of Impulsive Purchasing in Real and Virtual World***

#### **1. The Theories of the Impulsive Purchasing**

Since 1950s, the researches on impulsive purchasing, conducted by scholars from home and abroad, could be divided into four phases:

The 1st phase: equals impulsive purchasing as non-planned purchasing (DuPontStudies 1945–1965).

The 2nd phase: the researches of impulsive purchasing focusing on the product categorizing (Stern 1962; West 1951).

The 3rd phase: scholars starting concentrating on the stimulation of the sale environment (Katona and Muller 1995; Piron 1991; Peck and Childers 2006), the personal characteristics of the consumers (Dube et al. 1995; Rook and Hoch 1985; Beatty and Elizabeth Ferrell 1998; Piron 1991) and the psychological change (Rook and Hoch 1985; Weinberg and Gottwald 1982).

The 4th phase: the cross-cultural and cross-channel researches. The cross-cultural research was first proposed by the South Korean scholar Lee and the American scholar Lee and Aaker (2004). They pointed out the difference in the impulsive purchasing behavior of Asians, Europeans, and Americans. Meanwhile, the researches based on the on-line consumption were also hot among the academics. The impulsivity in online shopping is higher than that through traditional channels.

#### **2. The Process and Influencing Factors of Impulsive Purchasing.**

After putting together the beforehand researches, Dholakia proposed the integration model of the causes and process of the impulsive purchasing in 2000. He summarized the causes of impulsive consumption: the stimulation of the market, the characteristic of impulsivity, the situational factors, and the psychological reaction of the consumers after stimulation. The reaction includes: limiting factors, recognition assessments, and resistance strategies, which could eventually form or resist the impulsive consumption.

### ***124.2.2 The Theory of Mental Accounting***

Mental accounting is the psychological process of coding, categorizing, and assessing the results, especially the economic results. (Thaler and Johnson 1990; Tversky and Kahneman 1991; Kahneman and Tversky 1979).

Shefrin and Thaler (1988) and had conducted researches on mental accounting respectively in different regions, and they drew totally opposite conclusion, but they did not continue further researches on the portraits of the mental accounting with various cultural background.

Aimei and Wenquan (2004) and Sun (2008) has respectively explored the field of mental accounting targeted on Chinese, and proposed cultural difference existing in the recognition mechanism of Chinese mental accounting.

### ***124.2.3 The Theory of Cultural Difference***

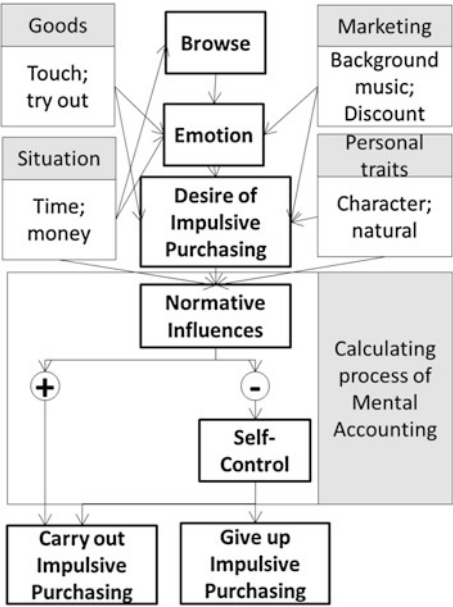
In the research field of cultural difference, many scholars have made excellent achievements, among which Hofstede's theory of cultural value factors is most representative.

Hofstede published *Culture Consequences* in 1980, in which he summarized the four dimensions of comparative cultural difference: (1). Individualism/Collectivism; (2). Power Distance; (3). Uncertainty Avoidance; (4). Femininity/Masculinity (Hofstede 1991).

### ***124.2.4 Mental Accounting, Cultural Difference and Impulsive Purchasing***

Now there is still a few researches conducted for impulsive consumption in the view of mental accounting and cultural difference, however certain progress has been made in the influence of cultural difference on impulsive purchase, and it's said that consumers from individual cultural background is easier to buy impulsively than those from collective ones Aker and Keller (1990). Kacen and Lee (2002) besides, scholars from home and abroad have proposed the effect of mental accounting on the impulsive purchase many times (Aimei and Wenquan 2004; Sun 2008). Nowadays no scholars explore the influence of mental accounting on impulsive purchasing. Mental accounting, however, affects irrational decision a lot, when we combine the theory of mental accounting and the consuming field, we could reasonably conclude that the mental accounting adjusts the behavior of impulsive purchasing.

**Fig. 124.1** The impulsive purchasing model based on mental accounting

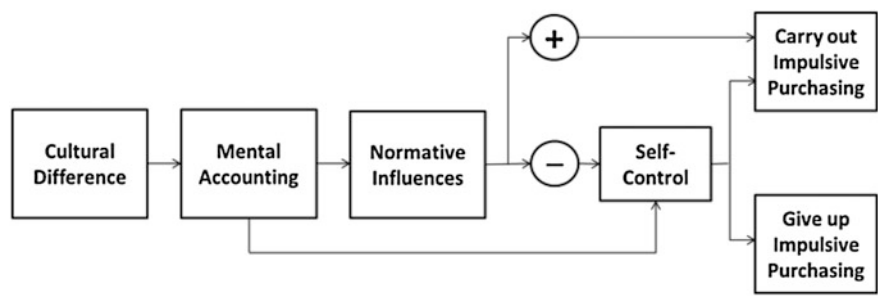


### 124.3 The Propose of the Model

Based on the model of Dholakia (2000), Fengjie Jing, Suhong Xiong, we integrated the current theoretical model of impulsive purchasing, and combined the theory of mental accounting, then concluded the basic research frame (Park et al. 2006) (See Fig. 124.1).

On the basis of summarizing the beforehand researches Peck and Childers (2003), this model has added the adjustment of mental accounting to the online impulsive purchasing, which includes the income resources of mental accounting, the structure of mental accounting, the expense difference varied from different structures. The mental accounting is a way of regulating and controlling to the individual deciding behavior. Through the researches of the effects of the mental accounting to the standard assessment and the traits of self-control (Bayley and Nancarrow 1998), we investigated the effect of the mental accounting to the online impulsive purchasing, enriched and perfected the research frame of impulsive purchase (Kivetz 1990; Henderson et al. 1992) (Fig. 124.2).

With different cultural background, the tendency of impulsive purchasing in online shopping varies. The cultural difference is one of the individual traits of consumers, therefore the consumers with different cultural background are varied in the structure of mental accounting and the tendency of impulsive purchasing. Through the research on the cultural difference, we could find out the effect of the cultural difference on the people's mental accounting in respective regions, and further investigate in the influence of it on the online impulsive purchasing.



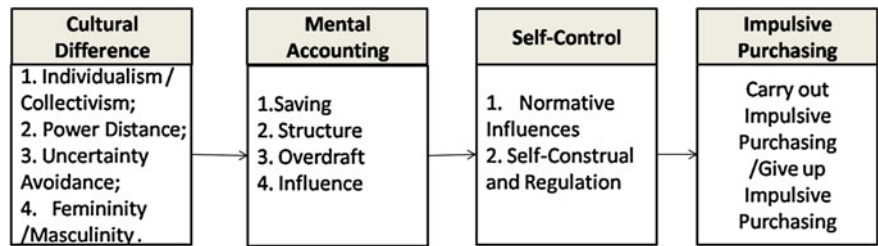
**Fig. 124.2** The impulsive purchasing model frame based on the cultural difference and mental accounting

This model has based on the mental accounting theory and the cultural difference to explore the impulsive purchasing in online shopping. The research includes that whether these factors would have significant effect on triggering the impulsive purchasing, and date back to its causes, processes, results and impacts.

On the basis of the summary of the beforehand researches, the lessons learnt from the drawback of them, through the introduction of the metal accounting theory and the cultural difference, we find out the individual traits and the mediator variable that influence on the standard assessment and the self-control, which helps further explore in the theories of on-line impulsive purchasing, and give guidelines for the practice in the on-line marketing (Fig. 124.3).

124.4 The Conclusion and Direction for Future Researches

Through the analysis of the influencing factors of impulsive purchasing, this article, on the basis the already known influencing factors of the impulsive purchasing and the model, comprehensively analyzes the impact of cultural difference and mental accounting on the impulsive purchasing, and build the model of impulsive purchasing based on mental accounting and the frame model of impulsive purchasing based on cultural difference and mental accounting.



**Fig. 124.3** The tendency model of impulsive purchasing on the basis of cultural difference and mental accounting

Through the analysis of the current researches, certain progresses have been made in the research of cultural difference and impulsive purchasing. Besides, consumers from individual cultural are easier to shop impulsively than those from collective culture. (Kacen and Lee 2002) in the field of psychology, scholars has proposed many times that the cultural difference has impact on the mental accounting (Aimei and Wenquan 2004; Sun 2008).

Therefore, on the basis of the current researches and the construction of the models, we could propose:

1. The theory of mental accounting has impact on the standard assessment and the self-control trait, and adjustment on the impulsive purchasing.
2. The mental accounting has distinguished cultural characteristics. In other words, consumers with different cultural background are varied in their mental accounting structure and the tendency of impulsive purchase, which further influence the impulsive purchasing in shopping.
3. The impulsive purchasing is not absolutely “irrational”. It is more of “limited rationality” or “ecological rationality”.

In the future researches, first of all, the theory of mental accounting borrowed from the psychology could be further applied in the researches of the impulsive purchasing. Some scholars have used the mental accounting theory in studying the irrational consumption before, but the other researches have proved that the behavior influenced by the mental accounting is not irrational, but limitedly rational.

Second, there are researches of the cross-cultural mental accounting and impulsive purchasing. On the cutting-edge research in the impulsive purchasing is the cross-cultural research. The mental accounting has distinct cultural characteristics. Besides, the cross-cultural mental accounting has adjustment on the behavior of impulsive purchasing.

Third, the impulsive purchasing is in the circumstance of Internet. Thought some scholars have conducted researches in the field, which is still on the exploring phase without enough researches on the forming mechanism of the online impulsive purchasing, this field is still belong to the cutting-edge of the academic researches.

Innovations, specially, have been made in the impulsive purchasing model and its variables. The research starts from a new perspective to study the consumers' behavior on the online impulsive purchasing.

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# Chapter 125

## Study on Airport CRM Strategy and Tactics in Detainment

Qing-song Zhang, Yi-nan Yang and Li Li

**Abstract** The profits of passengers, airlines and airports are certainly harmed by air detainment. From the point of airport to avoid this, its two main customer types, airlines and passengers, are divided by customer subdivision based on their behavior. Study the decision of CRM strategy and tactics of airport aiming at airlines and passengers in air detainment and present the decision should be made based on CRM theory and distinguished from different customer types. Through the implement of these strategy and tactics, passengers' rights and benefits are guaranteed, airlines loss are declined and extra profits are obtained by airport.

**Keywords** Detainment · Airport · Customer relationship · CRM strategy and tactics

### 125.1 Introduction

Every time when flights delay or emergencies occur in airport, the detainment harms the benefits of passengers, airport and airlines together. Detained passengers may be driven into ill mood; some may even obstruct the airport operating order in

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ultra-behavior. Moreover when airlines take a negative attitude to dispose detainment, passengers will surely have fights with them, which do nothing good with detainment but hurt company's profit and business credit. While time, airport's operation can be disturbed by the bad attitude held by airlines and other well-operating flights are not able to take off for orderliness lack which shall be kept by the airport. Since this, only can the airport ensure both airlines and passengers' interests can its loss bottom out. Strategy and tactics based on the theory of customer relation management (CRM) can reduce the loss mostly and gain added profit through helping airlines dispose detainment by providing additional service.

Among the study on detainment control, the existing works include study on airlines flight delay management, air passenger demand and detainment scale prediction, air detained passengers' compensation policy by government. IBM Travel and Transportation Industry Solution Unit uses information technology help airline avoid delay (Medeiros et al. 1998). Neural model are developed for air passenger demand prediction (Alekseev and Seixas 2002). The Detailed Policy Assessment Tool models the delay propagation throughout airports system (Schaefer and Millner 2001). China set up air passenger consumer right protection in emergency as a universal compensation standard. European Union also published general provision on compensation and help when flights refuse to carry passengers or are canceled and delayed (Ping 2003).

In conclusion, though some government department did try to solve the detainment, which mostly from the point of airlines, there is a lack of research from airport's point on detainment strategy and tactics. Thus this paper studies on strategy and tactics decision making of airport aiming at airlines and passengers in detainment based on CRM theory and guarantees the passengers, airlines and airport' profit maximum together through this.

## 125.2 Airport CRM Analysis in Detainment

When detainment happens, the airport itself and both of its main customer groups, air passengers and airlines suffer interests damage differently. Air passengers may be discontentment towards airlines and airport because they cannot continue their trip and their profits are hurt, while the airlines suffer the economic loss for the flights delay and give their passengers compensation. Because of this, the airports do not only have to face the angry passengers in every detainment but also have to work the detainment out together with the airlines whose profit suffers a lot. As the medium between passengers and airlines dealing with interests balance, airports should calm down passengers' anger and help airlines out of trouble at the same time.

### ***125.2.1 Detainment Events Analysis***

Flights delay can be caused by six reasons, including weather, maintenance, air traffic management, airline plan, passenger, and checking. Weather causes detainment by affecting airport, line and aircraft. Detainment also can be caused by the unfinished maintenance work or aviation material lack. When there is a flow rate control for crowd airspace, a temporary avoidance to air force secret task or a priority to special aircraft for the fatal disaster, air traffic management will cause detainment. Reasons of airline plan are crewman or flight plan variation and a dispatcher error. Passengers' personal issues or guarantee to aircraft having VIP in will yield detainment.

Though the possibility of airport emergency is lower than others, its result is extremely serious, which shall be regarded. Detainment can be caused by emergencies, like operation system failure, flight ground disqualification, terminal disorder and freight operation error. Disorder, terror, food public incidents and accidents in airport or temporary area all can cause detainment, when situation goes worse the airport may even be closed temporarily.

### ***125.2.2 Status and Problem of Airport Detainment Disposal***

Based on the national aviation law and international tradition and combined its actual situation, every airport establishes its own detainment plan, includes *Abnormal Flight Scheme* and *Front Area Operation Procedure*. Those are just focused on the special situation not aiming at general detainment treatment, the loss of economic and business reputation caused by the imperfection is common. On May 7th, 2010 vast flights delay in Guangzhou Airport caused over 20 events of passengers destroying the airport facilities. Even worse, in April, 2012 both of the extensive detainment in Guangzhou and Shanghai airport results in angry passengers obstructing flying-off aircraft. Therefore, the aviation administration informs the disposal of these accidents to all the aviation units and suspends involved flight's operation for the improper disposal of the long-time detainment taken by Shenzhen Airline.

Among the above accidents, airport's loss is mainly caused by improper disposal of relation among passengers, airlines and airport. To improve status, the airport should bring in CRM theory and deal its customer relationship in detainment scientifically. The problems in implement of CRM for airport detainment disposal are as follow.

1. Just take CRM as work software, do not combine the CRM ideology with detainment disposal. That is to say the customer, the most important resource are not satisfied by customer analysis and service.
2. Ignore that the supreme goal is achieving profit maximum but not just fulfill the customers' need simply. That is implement CRM don't just aim on helping airlines decline their loss or fulfill the customers but on achieving profit maximum.

### ***125.2.3 Goals of Implement CRM for Airport Detainment***

Combine the detainment disposal's ideology with the CRM theory. Obtain the types of passengers and airlines through customer subdivision and make different CRM strategy and tactics varying different types. Provide extra service to airlines of detainment, replace the airlines to serve and comfort passengers and help them decline loss but gain airport's profit at the same time. Though at the forefront of implement CRM the profit is negative, the speed of attract client is fast enough to reach the balance point in a very short time and in a long term afterwards CRM can bring in a continual and steady profit for the airport (Shao and Wang 2004). Consequently goals for implement CRM of airport detainment shall include setting up CRM strategy for achieving profit maximum, putting in CRM tactics based on customer subdivision on their behavior, and establishing proper CRM system and structure.

## **125.3 Detained Passengers Behavior Study**

It is easy to study customer subdivision by statistics character, while it is hard to reflect the customers' need or relationship and guide the corporation to fulfill customer and achieve profit maximum. In Frederick Reichheld's opinion, whether customer would buy more products and service is depended on their behavior (Reichheld 1996). Many firms have adopted customer subdivision according to the attribute of customer behavior, for example airlines divide customers depending on their flights mileage into platinum customer, gold customer and silver customer. So airport detainment CRM should be constituted by the customer subdivision of customer behavior on passengers and airlines, the CRM strategy establishment varying different customer groups and CRM tactics implement.

### ***125.3.1 Airlines Customer Subdivision of Behavior Analysis***

Through the investigation on the passengers' view to airlines, detainment disposal patterns taken by airlines can be divided into these types thereafter.

1. Extensive Form Care nothing for the detainment instance and reject all their questioning and requiring.
2. Stylization Form Dispose the detainment stylized, walk through passengers' asking and excuse themselves from passengers' need.
3. Active Form Regard passengers' need, cooperate with air traffic management unit and airport, inform state process and satisfy passengers' rational needs.

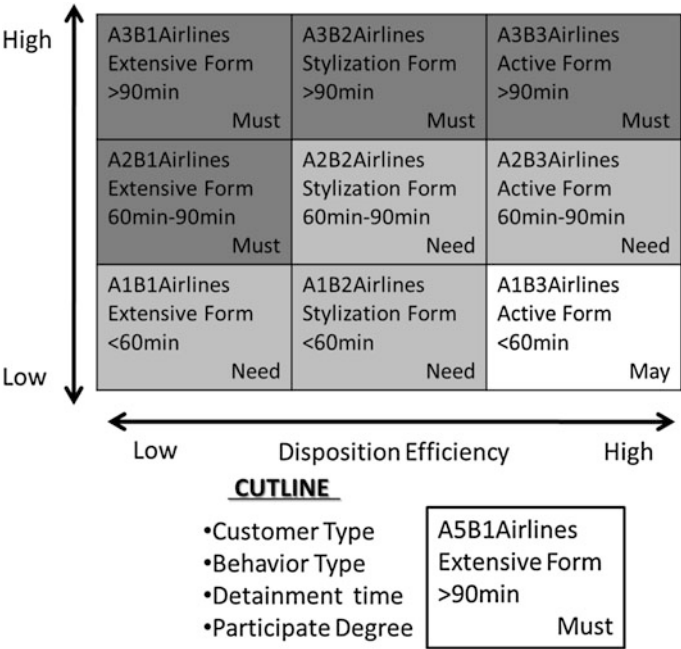


Fig. 125.1 Airlines customer types' matrix chart

Airlines customer types' matrix chart (Fig. 125.1) shows 9 customer groups, which arrange each group with matrix compositor method as  $A_iB_k$ . Abscissa is the efficiency of airlines detainment disposal while y-axis is detainment time extent (degree of detainment). The darkness of every module's color represents airport's participation extent, like must, need and may.

### 125.3.2 Passengers Customer Subdivision Based on Behavior

To comprehend air detained passengers' behavior, we use questionnaire to do research. The questionnaire is designed according to the passengers' need, investigating under 5 kinds of detainment time extent their collectivity behavior trend as follow, which based on Demand Phase theory and safety psychology (Lan 2009).

1. Physiological Need.
2. Respect Need (An 2010).
3. Do things what others do effected by fluster (Jin 1992).
4. Detainment time.
5. Passengers scheduling.
6. Awareness of aviation industry.

**Table 125.1** 14 categories of passengers' behaviors

Level	Behavior description		
1	1.1 Understand and waiting	1.2 Just unsatisfied	1.3 Flow others
2	2.1 Know the detainment reason and waiting time		
3	3.1 Restroom	3.2 Free food	
4	4.1 Change	4.2 Cancel	4.3 Complain to superior
	4.4 Compensation	4.5 Must send me to destination	
5	5.1 Argue with staff	5.2 Demonstrate and protest	5.3 No More bear react fiercely

7. Passengers' character.

8. Nearby environment (Tian 2008).

The 14 passengers' behavior modes are divided into 5 levels by how the passengers reacting to detainment. Details are in the follow Table 125.1.

200 questionnaires were sent out and 195 receded by field survey in airports, professional forum research and online survey during March to May, 2010. Through the investigation detainment time is found as first factor of passengers' behavior, combined with the results passenger customer types' matrix chart are obtained (Fig. 125.2).

25 customer groups are arranged with matrix ranking method as  $A_iB_k$ , abscissa represent passenger behavior extent while y-axis is detainment time extent (degree of detainment), and the darkness of every module's color is first three behavior level in each detainment time extent.

1. Detained within 30 min, most passengers concentrate on Level 1, 2 and 3. Whether passengers who understand this detainment or not react as waiting in peace.
2. Detained for 60 min, more passengers want to 'Know detainment reason and waiting time'; while time passengers need 'Restroom and free food' get big increase.
3. Detained for 90 min is a turning point. Over half passengers transmit to choose Level 3, while people choose Level 4 and 5 increase steadily from 20 to 40 %.
4. Detained for 120 min, behavior trend turns to Level 3 and 4, which is 2/3 passengers' choices.
5. Detained over 120 min is beyond everyone's patience limit. There is a big increase of people cancelling flight, over 30 % thinking must send them to destination, 20 % in Level 3 and only 20 % people in Level 1 and 2.

## 125.4 Airport CRM Strategy and Tactics in Detainment

Survey shows nearly 90 % interviewees had been in detainment often or once, over 60 % have no awareness of detainment fact, acceptable detainment time is within 90 min, over 90 % were ever harmed and one quarter was harmed

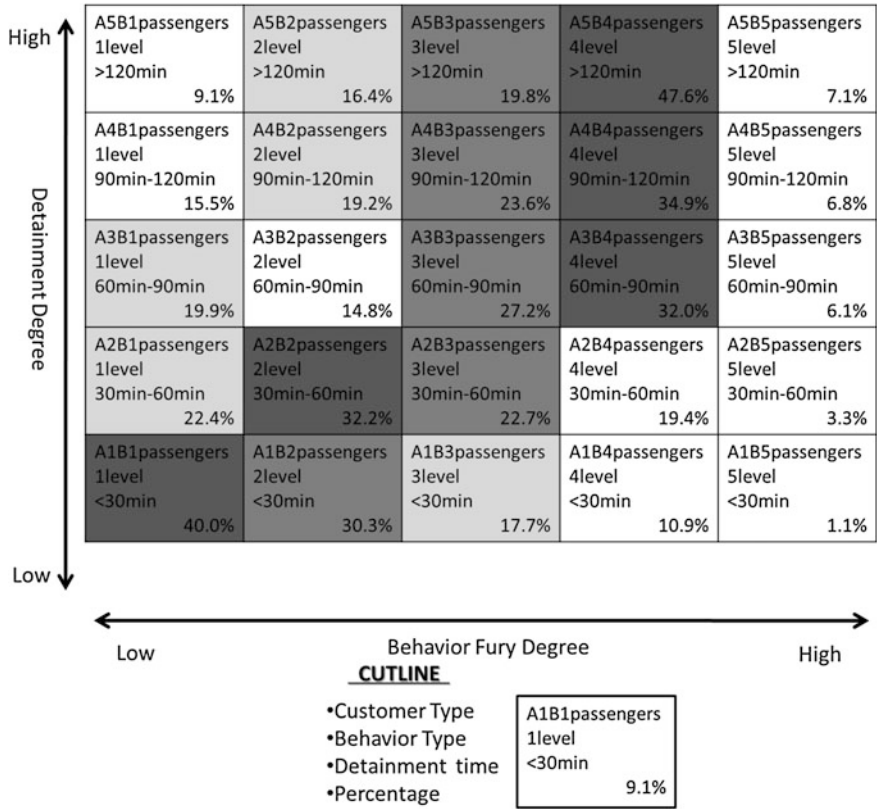
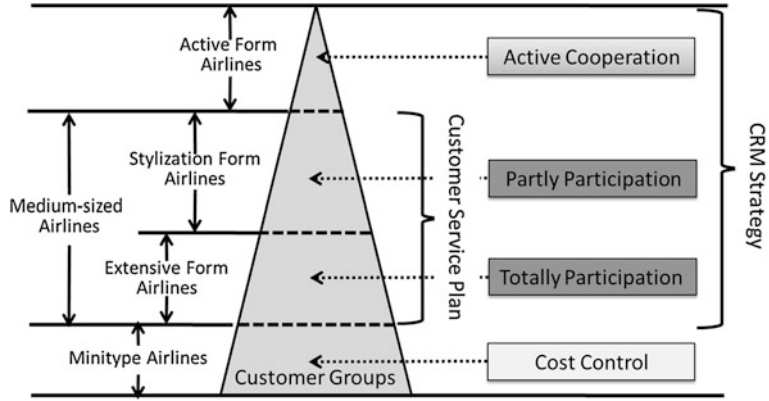


Fig. 125.2 Passenger customer types' matrix chart

seriously, 60 % were unsatisfied with the airport measures while over 80 % think government effort make difference to detainment. Above results make it exigent for airport to take own advantages, ensure passengers and airlines' interest, decline its own loss and achieve profit maximum under CRM theory in detainment. Since this, in detainment airport should make CRM strategy of airlines to help control state and decline loss while execute CRM tactics of detained passengers to comfort their emotion, ensure their rights and profits, help them reach agreement with airlines and continue their trip.

125.5 CRM Strategy of Airlines in Detainment

CRM strategy of airlines in detainment should lean on providing extra service scheme (Fig. 125.3) to airlines, which vary different customer groups. By executing CRM tactics of detained passengers, the goals of implement CRM for airport detainment are achieved.



**Fig. 125.3** CRM service scheme of different airlines customer groups

Take strategy of cost control to minitype airlines, like provide consulting service to decline this cost part as much as possible. Transfer the un-payoff state of this customer group to payoff state and commend choosing extra service scheme to keep the potential customer.

Take strategy of participation to medium-sized airlines, like provide proper extra service scheme to extensive and stylization form to choose. Devote most resource of detainment disposal to this group and increase the airport’s payoff level of them in product return term.

Take strategy of cooperation to active airlines. Fulfill their demand as much as possible. Maintain and develop this customer group.

**125.5.1 CRM Tactics of Passengers in Detainment**

The CRM tactics of passengers must depend on different detainment time. The CRM tactics schemes for airlines can be achieved through strengthen corresponding CRM tactics measures to passengers’ behavior trend in different detainment time (Fig. 125.4).

**125.5.1.1 Measures on Within 30 min**

Passenger behavior trend is Level 2, so staff should inform detainment reason and waiting time firstly then arrange restroom. For 10 % choose change or cancel, staff should transact as usual. Watch anger in case of accident.

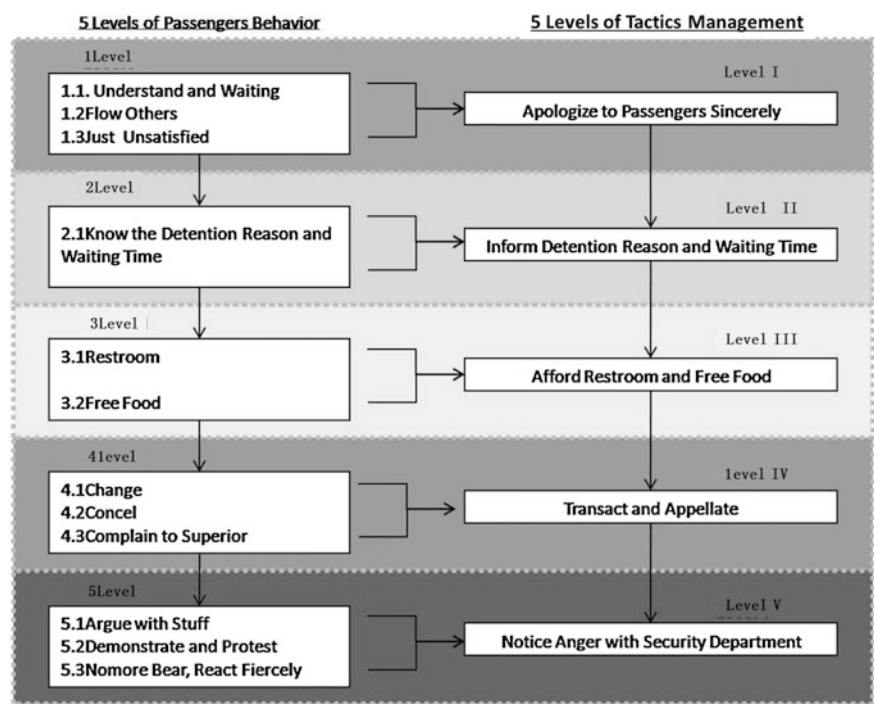


Fig. 125.4 Relationship between behavior levels and measure levels

125.5.1.2 Measures on Within 60 min

Since trends still on Level 2 but Level 3 increasing simultaneously, staff should afford detainment reason, time and food. While people on Level 4 increasing to 20 %, service windows and comfort staff should be added and leaflet on aviation knowledge should be served around passengers. Still watch anger in case of accident.

125.5.1.3 Measures on Within 90 min

Since over half on Level 3, staff must inform reason and time every 30 min and after 1 h every 15- min. Then afford restroom and food. For Level 4 and 5 increasing to 40 %, service windows and comfort staff should be added and leaflet on aviation knowledge should be sent to passengers. Watch anger in case of accident and contact police station every 15 min. Moreover, change comfort teams every 30 min to avoid work burnout.

#### **125.5.1.4 Measures on Within 120 min**

Since passengers getting tired, 2/3 is on Level 3 and 4. Restroom and food are must. In former hour inform waiting time every 30 min and send leaflet, in the left time cut the interval to every 15 min and change leaflet to literature. Add security department into comfort and contact police station every 15 min. Moreover, change comfort teams every 30 min to avoid work burnout.

#### **125.5.1.5 Measures on Over 120 min**

Since detainment time beyond acceptance and over half on Level 4, strengthen transaction and appellation. In former hour inform time every 30 min and send leaflet, cut the interval to every 15 min and change leaflet to literature. Add the security department into comfort and contact police station every 15 min. Moreover, change comfort teams every 30 min to avoid work burnout.

### **125.6 Conclusions**

The issues of passengers detained in airport caused by emergencies happen constantly and harm passengers, airlines and airports' profit together. Since this, this paper subdivides airports' main customer through the survey of passengers and airlines' behavior in detainment, brings CRM theory into detainment disposal for airport, makes proper CRM strategy and tactics, and ensure passengers installed appropriately, decline airlines' loss and keep airport orderliness. The main conclusions are as follow.

1. Since airlines' detainment disposal varies, CRM strategy of airlines should be established depending on their behavior. Under this strategy's guidance, airport can help them disposal detainment and serve passengers by providing extra service and achieve profit maximum.
2. Detained passengers' behavior varies from time, so their tactics should be set up according to both their behavior and behavior trend in different time.
3. Bring CRM theory into airport detainment disposal can ensure passengers' rights and profits, decline airlines' loss and achieve the airport's profit maximum.

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# Chapter 126

## Research into Consumers' User Acceptance Willingness of Mobile Advertising

Zhong He, Xia Chen and Ting-jie Lv

**Abstract** Mobile internet is being used by countless people. But how to design the applications after all can make customers accept it more easily? In various mobile internet applications, mobile advertisement is facing rapid development trends and various inevitable problems, and becomes a typical mobile internet application. So it is necessary to carry out a deep research into its user acceptance willingness. Based on the discussion of definition, characteristics, types and business model of mobile advertisements, this paper establishes a consumer acceptance model with UTAUT as the base model, and an empirical study is given as well.

**Keywords** Mobile internet · Mobile advertising · UTAUT · SEM

### 126.1 Introduction

With the maturity of 3G network and smart phones, china mobile internet subscribers grow explosively, and subscribers have strong demands for various kinds of mobile Internet application. Therefore, it is just the best time for the development of China's mobile internet. However, to be success in the mobile internet industry is not easy. Among the mass mobile internet applications, some are very successful and spread widely in short time, but some other are unsuccessful and disappear quickly. There are many factors influencing the acceptance extent of an application, so the thorough knowledge of each influencing factor will contribute to the spread of mobile internet applications. As a mobile internet business, mobile

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advertising is no exception. Therefore, this paper will mainly focus on the spread of mobile advertisement.

TAM is the classical model to research the influencing factors of consumer's acceptance of an innovation. In 1989, the Technology Acceptance Model (TAM) is put forward by Davis when he studied the customers' acceptability to the information system via the use of theory of reasoned action, with initial purpose being make an explanation on the decisive factor for the general acceptability to computer (Davis 1989; Davis et al. 1989). Venkatesh made a second improvement on the TAM Theory. Targeted at the discussion about factors affecting the customers' recognition and on the basis of the research on basic structure of theory of reasoned behavior, theory of planned behavior, technology acceptance model, motivation theory, theory of social recognition and computer use model, they put forward the unified model covering elements included in the major models- Unified Theory of Acceptance and Use of Technology/UTAUT via the verified comparison for the major models. And this model notes that variables such as sex, age, experience and voluntary control variable can have significant influence on the dimensionality of performance expectancy, effort expectancy, social effects and factors of fulfillment. Besides, the four relations will directly affect the intention to use and the cooperation dimensionality will directly affect the actual system use. Through differently demonstration analysis of enterprises from different industries, UTAUT model have a higher reliability and validity. UTAUT model can explain 70 % technology acceptance behavior, equaling with the previous 40 % explanations, so UTAUT improves a lot (Venkatesh et al. 2003; Ha et al. 2007; Thompson et al. 1991).

## 126.2 Mobile Advertisement

### 126.2.1 Definition of Mobile Advertisement

Mobile advertisement arose along with the development of mobile data services. It is one of the mobile value-added services, starting as an extension of the combination of mobile location services (LBS) and advertising services. Mobile advertisement is actually a kind of interactive network advertisement, which is carried by mobile communication network, possesses all the characteristics of network media, and at the same time has more advantages than the internet, for mobility can make users receive information anytime anywhere. Mobile advertisement is regarded as the best stage to carry out precision marketing based on the user database in the future commercial advertisement and for the advertisers to select appropriate people on purpose to spread targeted business information. The biggest highlight is to combine mobile phone with advertisement, forming the situation in which the three sides of customers, merchants and operators all benefit from it (Jing 2008; Taifen 2009).

### ***126.2.2 Characteristics of Mobile Advertisement***

As a firenew advertisement form, compared with other media advertisements, mobile advertisement mainly has the following major characteristics:

(1) Accuracy: mobile phone advertisement can send advertisements directly to the users' mobile phones according to the users' practical and real-time situation, really achieving "accurate dissemination". (2) Instantaneity: the instantaneity of mobile phone advertisement comes from its mobility, mobile phone advertisement has broken through the constraints of time and regions, users can receive advertisement information quickly anytime and anywhere, and such a spread velocity is incomparable with any previous media. (3) Interaction characteristic: as the perfect combination of internet technology and mobile communication technology, 3G mobile phone media can give full play to the advantage of interactive function, and integrate interactive elements into the originality of mobile phone advertisement, making users carry out the feedback interaction after receiving advertisements anytime and anywhere; (4) Diffusibility: mobile phone advertisement's diffusibility is also can be said to be the characteristic of being transmitted, which means users can transmit the advertisements that they think to be useful to their relatives and friends, diffusing information or spread advertisements to the people around; (5) Integrity: the integrity advantage of mobile phone benefits from the rapid development of 3G technology. Mobile phone advertisements can be shown in different forms of characters, sounds, images and moving pictures, etc.; (6) Measurability: the advertisers can cooperate with mobile communication operators actively and trace and monitor the advertising effectiveness periodically and directionally; (7) Low cost: as a kind of advertisement media, 3G mobile phone has the strong characteristics of separating people and personalization, and it can realize market segments, providing corresponding advertisements and information for the potential target audience. Therefore, compared with traditional media advertisements, mobile phone advertisement has prominent cost advantage, and maybe it can turn the CPA charge method into reality (Guo 2005; Chuansan 2008).

### ***126.2.3 Types of Mobile Advertising***

Mobile advertisements can be classified according to different standards, such as carrying ways, content format, type model and push ways, etc (Xiang 2008; Zhijiang and Haitian 2009).

According to content formats: mobile advertisements are divided into text advertisement, image advertisement, video advertisement, audio advertisement and hybrid form advertisement, etc.; according to push ways: mobile advertisements are divided into push advertisement and pull advertisement; according to release form: mobile advertisements are divided into information advertisement,

terminal embedded advertisement, voice advertisement, video advertisement, WAP advertisement, mobile search advertisement and wireless location advertisement, etc.

### ***126.2.4 Business Model of Mobile Advertisement***

The business model of mobile advertisement in 3G times shall take meeting users' individual needs as its centre, provide more value-added services for users, realize exact marketing and develop user active advertisement, thus achieving a victory for many sides in the whole industry chain of mobile advertisement. Specifically, there are 3 main business models of mobile advertisement: mobile search advertisement model, implanted advertisement model, scene push advertisement model. The business model of mobile search advertisement is similar to that of the internet search, that is, to provide free search services for the users and charge the trade company according to the pay-per-click keywords. Nowadays, there are two common forms of mobile search advertisement as follows: Mobile phone real name search advertisement; Local search advertisement. There are two common forms of implanted advertisement model as follows: terminal implanted; contents implanted. And there are two common forms of scene push advertisement model as follows: Scene push advertisement model combined with major events or activities; Scene push advertisement model based on location (Shouxing 2009; Zhengshu 2010).

## **126.3 The UTAUT Model**

### ***126.3.1 Research Variables***

After many investigations and analysis, UTAUT model can explain acceptance behavior of mobile data business. Therefore, based on this, the model's main body will be designed and studied.

The model's main body holds four dimensionalities of UTAUT model, which are performance expectancy, effort expectancy, social impact and promotion condition. Performance expectancy means that mobile advertising can provide the needed services for users, thus improve users' life, study and work. Effort expectancy means whether the individual thinks mobile advertising service is easy to use the system. Social impact means social and surrounding people's opinions and views on mobile advertising can easily affect users' acceptance.

The youth is the main force of developing mobile advertising, so young people are the main respondents. In addition, mobile phone has been popularized in recently years. And at the same time, the mobile advertising is still at the early

development in the market, which is new concept and business form for users. Therefore, there are no problems about experiences and voluntariness. Based on the analysis above, study model in the dissertation does not take age, gender, experience and voluntariness into account.

According to the development and characteristics of mobile advertising and based on the UTAUT model, we added three variables, they are perceived cost, perceived playfulness, perceived risk. Perceived cost means that the customers need to pay more cost on equipment change and payment of flow fee on the characteristics of mobile advertising business. Perceived playfulness means that users focus on a mobile advertisement and are willing to interact to satisfy their need for a product and service. In the meanwhile, when used mobile advertisement, speedy, accuracy and delicate pictures of advertisement will bring pleasure. Perceived risk means customers' any purchasing behavior can not ensure the correctness of expected results, yet some results may cause customers' unpleasure and then affect users' acceptances.

126.3.2 Research Model and Research Assumption

Based on the above analysis and research, this section introduces the general concept model of mobile advertising users' acceptable behavior shown in the following Fig. 126.1. The research tries to study mobile advertising users' acceptable behavior for mobile advertising business from the perspective of users' recognition. According to research purpose and literature study, the research hypothesis is established shown in the following Table 126.1.

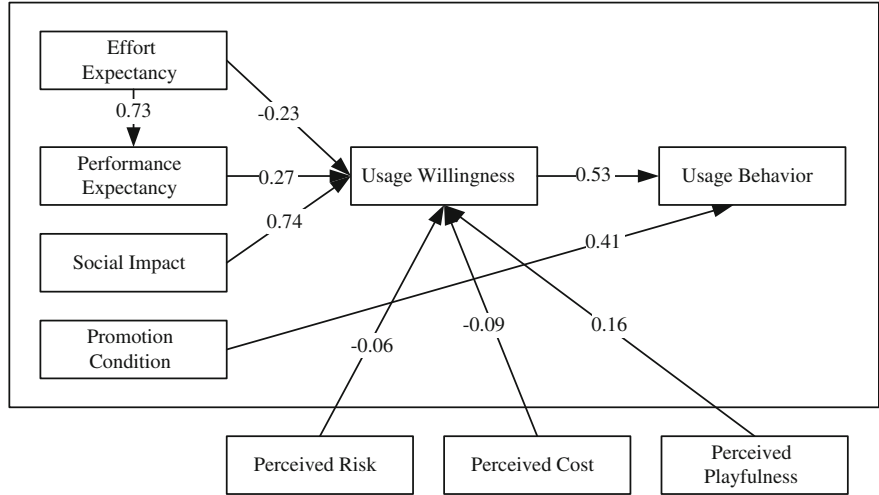


Fig. 126.1 Conception model and the results

**Table 126.1** Assumption verification of acceptance behavior research of mobile advertising

No.	Assumption content	Result
H1	Users' efforts expectation in mobile advertising have an active influence on performance expectation	Yes
H2	Users' efforts expectation in mobile advertising have an active influence on performance expectation	No
H3	Users' social influence on mobile advertising is active to use willingness	Yes
H4	Users' perceived cost to mobile advertising is negative to use willingness	Yes
H5	Users' perceived entertainment to mobile advertising is active to use willingness	Yes
H6	Users' perceived risk to mobile advertising is negative to use willingness	Yes
H7	Users' performance expectation to mobile advertising is active to use willingness	Yes
H8	Users' promotion conditions to mobile advertising is active to use behavior	Yes
H9	Users' use willingness to mobile advertising is active to use behavior	Yes

**126.3.3 Questionnaire Design and Data Collected**

Questionnaire is an important instrument to investigate and study the collected data. Likert's five-scale is adopted in this paper to design the questionnaire. This questionnaire consists of three parts. At the beginning, it presents the objectives and purposes of this research and then gives the definitions of mobile advertising and classifications. The second part in the questionnaire deals with personal information with five items, including gender, age, education and incomes, together with the monthly communication expenditures according to the characteristics of value-added service. In order to know users' opinions about mobile advertising, part three contains thirty questions to investigate their acceptability and intentions to use it.

As the mobile advertising is still at the early development in the market, young people from eighteen to twenty-nine are the main respondents. 325 questionnaires were sent out, 319 were returned and 310 were valid.

**126.3.4 Empirical Study**

Reliability coefficient is commonly used to show the degree of test reliability. The reliability of all problems of the questionnaire is 0.925 according to Cronbach's Alpha' reliability standard; it belongs to high reliability standard. Cronbach's Alpha's value of various models are all larger than 0.500 which reaches reliability requirement, namely the test result reliability of problem can be accepted. Validity refers to the close degree between test result and expectation and assesses bias and systematic difference. All factor loads are all larger than 0.45. As mentioned above, if factor load is larger than 0.45, question options may not be deleted (Min 2009).

The research adopts Lisrel8.7 to handle and analyze the model. We built on the research base of UTAUT model and works out standard regression coefficient to

**Table 126.2** Assessment of conception model of acceptance behavior of mobile advertising

Index	Assessment standard		Model value
	Acceptable	Good	
Chi square/d.f.	<3.0		2.42
Goodness-of-fit index, GFI	[0.70, 0.9)	>0.9	0.83
Adjust goodness-of-fit index, AGFI	[0.70, 0.9)	>0.9	0.79
Comparative fit index, CFI	[0.70, 0.9)	>0.9	0.96
Root mean square error of approximation, RMSEA	<0.01	<0.08	0.068
Non-normed fit index, NNFI	>0.8	>0.9	0.96

know the relation among various variables and verify the truth of relevant research and assumption so as to conclude final route relation chart (Qi et al. 2004). The results can be seen in Fig. 126.1 and Table 126.2.

According to route coefficients of various variables, direct effect and indirect effect of use behavior of mobile advertising business from various variables. According to the degree of influence on effect, from big to little such as social influence (0.74), efforts expectancy (0.73), using willingness (0.53), promotion condition (0.41), performance expectancy (0.27), perceived playfulness (0.16), perceived risk (−0.06), perceived cost (−0.09), effort expectancy (−0.23).

Based on the analysising and processing results of the structural equation, the initial research hypotheses in this study are to be verified, of which the results are shown as in Table 126.2.

### 126.4 Strategies and Advices

Through the research on users' acception willingness upon mobile advertising above, we have strategies and proposals upon mobile advertising development.

- Taking user's feature into consideration, excavate user's individual demands deeply and provide services according to user's individual demands;
- Protect the consumers' privacy by reasonable marketing;
- Expand the present ways of mobile advertisement actively, and enhance the cooperation with other members in the industrial chain, such as terminal manufacturers and application developers.

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# Chapter 127

## Does Organizational Injustice Lead to Unethical Behavior in Workplace? The Moderating Effect of Guanxi

Ya-li Tan

**Abstract** This study examines the relationship between distributive injustice and unethical behavioral intention in workplace under Chinese culture background. According to literatures of organizational injustice, unethical behavior and guanxi, we hypothesize that distributive injustice will positively relate to unethical behavioral intention of individuals, and guanxi status of individuals will play a moderating role in the relationship. Study results generally supported our hypotheses listed above. Firstly, level of perceived injustice was positively predicted individuals' unethical behavioral intention. Secondly, the positive relationship of injustice and unethical behavioral intention was reinforced when individuals maintained estranged guanxi status to the leader in organizations.

**Keywords** Unethical behavior • Distributive injustice • Guanxi

### 127.1 Introduction

As the accounting scandals of Enron was disclosed at the beginning of this century, the role of business ethics in modern industries has been attracted attention from academic scholars and business world in recent years (Kish-Gephart et al. 2010). Unethical behaviors of employees in organizations have been proved to have negative impact on the economic landscape. Unethical behavior in workplace occurs in variety of organizations and it could take many forms, for example, employees break the rules in organizations, workplace sabotage, workplace theft and cheat, etc. Unethical behavior in the workplace is defined as behavior in organizations violates generally accepted moral norms of behavior (Jones 2009),

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and it does great harm to organizations' ethic climate, erode organizational performance and increase organizational cost, even wreck economic systems (Gino et al. 2009). However, workplace unethical behaviors widely exist in all kinds of organizations. There have been empirical studies found that unethical behaviors impair long-run performance and sustainable development of organizations, as well as increase the risk of organizational corruption (Kulik et al. 2008).

Some researchers argue that unethical organizational behaviors in the workplace are partly due to organizational injustice (Bennett and Robinson 2003). The serious the employees perceive unfairness in organizations, the more they tend to react unethically. However, little is known about whether the relationship of organizational injustice and unethical behavior in workplace is moderated by relational status of employees. In China, *guanxi* plays an important role in various social activities. The meaning of *guanxi* is beyond personal social ties in the West, it is rooted in differential pattern of traditional Chinese culture, and involves personal favors to achieve some particular benefit. Employees in various relational status react differently in behavior and psychology to organization environment (Lee et al. 2001). However, how different employees react unethically to organizational injustice is remain unrevealed.

This paper is to explore the impact of injustice perception of employees on unethical behavior. Furthermore, this paper is trying to reveal the moderator role of employees' relational status in Chinese differentiate pattern of culture. The left part of this paper contains four sections. The first section is to describe the theoretical relationship among organizational injustice, relational status and unethical behavioral intention. The second section is to describe method and result of empirical study. The third section discusses the results and describes the flow of this study.

## **127.2 Literature Review**

### ***127.2.1 Organizational Injustice***

Research on organizational justice has focused on three main domains: distributive, procedural, and interactional justice. Distributive justice means employees' response to the outcomes they receive. Procedural justice means employees' reaction to the process of fairness. Interactive justice focuses on employees' reaction to the treatment from people important (Greenberg 1990). Some researchers argue that procedure is more important because it determine a particular outcome (Martin and Bennett 1996). However, outcome of payment contributes significantly to individuals' perceptions of organizational fairness, and thus explains their behaviors effectively (Hegtvedt et al. 2003).

Despite the significant difference of behavioral responses of individuals caused by justice and injustice, research on responses to distributive injustice is

insufficient. Individuals' reactions may differ depending on the extent to the degree of unfairness they perceived. According to equity theory, the serious they evaluate their distributive outcomes unfair, the more intention of them behaving reactively to eliminate injustice. Studies on distributive injustice in organizations have shown that employees who have perceived greater unfairness about the outcomes they received tended to engage in more deviance behaviors in organizations. One possible cause is that individuals who feel unfairly treated may reduce their positive prosocial behaviors so as to avoid possible exploitation (Lind 2001).

### ***127.2.2 Unethical Behavior in Workplace***

Employees often cross ethical boundaries in workplace to cheat, sabotage, steal, etc. Scholars interested in business ethics have contesting opinions on the reason of unethical behavior. Some of them attribute unethical work behavior as result of character flaws, for example, bad apples approach. Others who insist bad barrel approach consider that dishonesty behavior is the result of situation, for instance, institution, circumstance, and situations [for a review, see Kish-Gephart et al. (2010)]. In recent, scholars have paid more attention to situational variations for their overwhelming impact on (un)ethical decision making. Rest (1986) considered that (un)ethical decision making process which includes four steps (awareness, judgment, intention, and behavior) is influenced by situational factors (Rest 1986). Plenty of empirical studies have shown that unethical behavior is explained by situational factors rather than by character traits (Gino et al. 2009; Gino and Pierce 2009).

There exists positive correlation between organizational injustice and unethical work behavior. Based on social exchange principles, it can be easily concluded that individuals tend to response correspondingly toward the source of fair or unfair treatment. The individuals who believe they are treated fairly by their organizations feel obligated to reciprocate through contribution, cooperation, and proactive behavior in organizations. On the other hand, those who believe they are treated unfairly may reciprocate through kinds of negative actions, such as unethical behaviors (Jones 2009). A number of studies imply that employees' unethical work behavior is influenced by job context, incentive institution, and organizational culture (Trevino 1986). Particularly, employees who perceive injustice in organizations have more intention in engaging in unethical behavior in workplace (Jones 2009). Therefore,

**Hypothesis 1** Perception of organizational injustice is positively related to employees' unethical behavior in workplace.

However, the relation between organizational injustice and unethical behavior is moderated by some variables. Just as Aquino et al. (2006) noted, employees with lower status engaged in more revenge behaviors when the climate for justice was low (Aquino et al. 2006). In china, guanxi plays an important role in all hierarchies of Chinese societies.

### **127.2.3 Guanxi**

Chinese people have the tendency of treating people differently according to distant and close relationship between themselves and target persons. Guanxi includes three main types: personal ties, instrumental ties, and mixed ties. Personal ties mean connections of families, classmates or fellow-villagers. Instrumental ties mean connections of colleagues. Mixed ties mean personal and instrumental ties together developed through social interactions. Persons who have close connections with powerful key managers will possibly have more resources and possess more opportunities to achieve success. Therefore, they should more sensitive to distributive injustice. While those who have distant connections with powerful key managers will get used to estrangement and negligence from the leaders. Thus, they should not sensitive to distributive injustice. Hence:

**Hypothesis 2** Guanxi status to the managers positively related to unethical behavior.

In China, for those who have close guanxi with organization leaders, they rely more on social connections and private interactions to rationally deal with injustice in serious unjust environment. However, for those who have distant guanxi with organization leaders, they rely more on themselves to independently response to unfair distributive outcomes. And they are more likely to react unethically and irrationally in serious unjust situation. Hence:

**Hypothesis 3** Guanxi status to the managers negatively moderates the relationship between distributive injustice and unethical behavior.

## **127.3 Method**

Research hypotheses of this study will be examined using empirical method which includes quasi-experiment and questionnaire investigation.

### **127.3.1 Participants**

Participants were 236 senior college students and MBA students of a comprehensive university in the central of China. Participants voluntarily took part in our experiment without any payment. 193 participants returned qualified questionnaire with a response rate of 81.7 %. Average age of these 193 participants was 24.4. 125 of them were males, and 68 were females.

### ***127.3.2 Procedures***

Firstly, 236 participants were divided into two groups randomly. One group members were told they could imagine themselves as the protagonist who was a henchman of the organization leader, and he was close to leaders both in workplace and privately. The other group members were told they imagined themselves as the protagonist who was a sidelined person to the organization leader. He only had working contacts to the leader, and hardly shared any private time with leaders. Then, secondly both groups were presented a series of scenarios. The protagonist in four scenarios was about an employee who was treated unfairly on his payment in workplace (distributive injustice), and from scenario first to fourth the degree of unfairness increased in turn. At the end of each scenario, each participant was asked to complete a questionnaire on intention of unethical behavior.

### ***127.3.3 Measures***

The focal employees were asked to provide information on their intention to act unethically to the injustice in workplace. The questionnaire of intention of unethical behavior was a 5-point Likert Scale that consisted of five items developed by the authors. From 1 to 5 meant very disagree to very agree. Demographic information were manipulated as control variables in analysis.

### ***127.3.4 Analysis Methods***

After collecting data, we used SPSS 16.0 for analyzing. Descriptive statistics, ANOVA and linear regression method were employed for testing the Hypotheses.

## ***127.4 Results***

In this section, analysis results and findings to the data were presented. This study was a 4\*2 quasi experiment study. Before formal analysis, cronbach's Alpha Consistency Reliability is used to examine items' consistent of intention of unethical behavior. Cronbach coefficient alpha coefficient, which implies internal consistency reliability among a group of items of the scale of unethical behavioral intention, was 0.94 in this study. The result meant acceptable internal consistency of the instrument used.

**Table 127.1** Main and interact effects of injustice and guanxi status on unethical behavior

Group		Unethical behavior		<i>F</i> of guanxi
		Mean (n)	SD	
Close guanxi	No unfair	10.53	6.06	<i>F</i> = 2.26 ( <i>df</i> = 1) <i>p</i> = 0.134
	Low unfair	11.15	7.68	
	Middle unfair	11.50	4.89	
	High unfair	10.90	6.29	
Distant guanxi	No unfair	6.56	4.37	<i>F</i> of interaction <i>F</i> = 2.62 ( <i>df</i> = 3), <i>p</i> = 0.052
	Low unfair	7.02	4.66	
	Middle unfair	10.12	5.64	
	High unfair	13.44	6.89	
<i>F</i> of injustice		<i>F</i> = 5.74 ( <i>df</i> = 3), <i>p</i> = 0.001		

**127.4.1 Effects of Injustice and Guanxi Status**

ANOVA was employed to examine the main and interactive effect of organizational injustice and guanxi status. The result of ANOVA analysis was shown in Table 127.1.

The result of ANOVA implied that the main effect of organizational injustice on unethical behavioral intention was significant, while the main effect of guanxi status of individual was non-significant. However, the interactive effect of injustice and guanxi status was significant in explaining the variance of unethical behavioral intention. Therefore, Hypothesis 1 was supported while Hypothesis 2 was rejected.

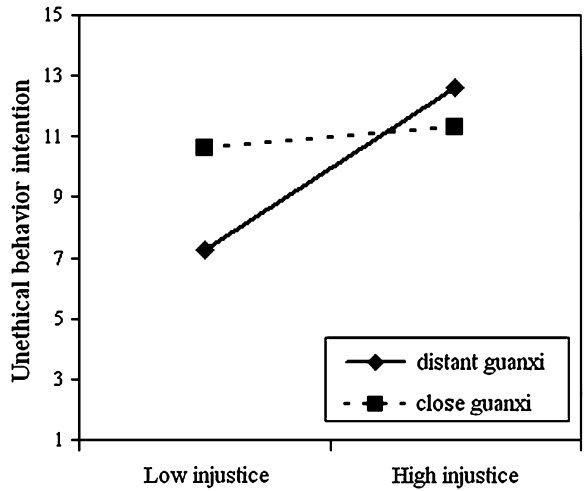
**127.4.2 Moderating Role of Guanxi Status**

In order to further analyze the moderating role of guanxi status, we conducted linear regression of unethical behavioral intention. Before regression analysis, we created three dummy variables to illustrate level of perceived injustice, and compared this regression model to the model that take perceived injustice as continuous variable. However, the results made no difference. Then we created an interactive variables (injustice\*guanxi) after centralization.

The regression result showed that standard coefficient of interactive variable was significant after controlled demographic variables (*Beta* = −0.40, *t* = −2.81, *p* = 0.006), which implied guanxi status of individuals to their leaders played a negative moderating role in the relationship between organizational injustice and unethical behavioral intention. The regression model explained 13 % (*p* = 0.00) variation of overall variation of unethical behavioral intention of individuals. Figure 127.1 shows the interacting effect of guanxi status.

From Fig. 127.1, it can be seen that those who have distant guanxi with organizational leaders are more sensitive to organizational injustice. They vary

**Fig. 127.1** Moderating effect of guanxi status



their unethical behavioral intention according to level of injustice perceived, the serious they perceive injustice, the more likely they engage in unethical behavior in workplace. However, those keep close guanxi with the leaders react slowly to injustice, they almost keep constant as perceived workplace unfair varied. Therefore, Hypothesis 3 was fully supported by this data.

127.5 Discussion

In this section, the research findings and conclusion are represented.

The purposes of this study were to explored how organizational distributive injustice perceived by individuals and their guanxi status to the leaders predict their unethical behavioral intention. Results show that the serious individuals perceive unfair about distributive outcomes, the more possibly they engage in unethical behavior. This result is consistent with findings of Jones (2009) and Gino et al. (2009). Our findings of positive relation of injustice and unethical behavior give further evidences to the opinion that justice are widely accepted and most desired social context (Ambrose et al. 2002). Pursuit of justice is a basic social motivation that drives an individual reacts unethically to regain sense of justice.

There exists no difference on the overall unethical behavioral intentions between individuals of close and distant guanxi status. Moreover, we extend previous work by examining the moderating role guanxi plays in the relation between injustice and unethical behavior. According to the theories of social psychology, individuals react differently in order to in accord with their specified social status. Especially for the Chinese, the first thing they should take into consideration before response to environment is evaluating their social status in the group. Echoing this opinion, this study highlights the value of guanxi status of an

individual, and verifies its moderating effect. Those persons possess close relation with key persons are not so sensitive to distributive injustice and their unethical behavioral intention almost keep constant. But those who are alienated from the key person are much more sensitive to injustice, their unethical behavioral intention increases more steeply as unfairness increases.

Despite some limitation, this study contributes on understanding the relationship between injustice and unethical behavior in Chinese culture context. We believe some conclusions of this study are useful to improve effectiveness of regulating and reducing unethical behaviors of employees in various organizations.

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# Chapter 128

## The Empirical Research about the Effects of Consumption Experience on Word-of-Mouth Intention

Bao-ku Li and Jin-zhi Jiang

**Abstract** Which factors influence Word-of-Mouth (WOM) Intention? How do they influence WOM Intention? These are a focus of the researches about WOM intention. This paper utilizes the demonstration methods of factor analysis, multivariate linear regression to analyze the satisfaction data by investigating some students whose have computer. Through empirical analysis, we get the dimensions of Consumption Experience. All four dimension of the Consumption Experience have positive on WOM Intention. Furthermore, the degree to which different consumption experience influences customer satisfaction varies. This study has some practical significance on the rich WOM marketing theory and to help enterprises better implement of WOM marketing strategy.

**Keywords** WOM · Consumption experience · WOM intention · WOM marketing

### 128.1 Introduction

With the development of market economy. Consumer's product knowledge is increasing and consumption gradually experienced. Consumer behavior is becoming more rational. WOM has become the most frequently used when people make purchasing decisions of information resources. To provide consumers with a good consumption experience, encourage and guide them to spread the reputation

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information that is conducive to business. Gain a sustainable competitive advantage.

This paper will be on the basis of fully drawn on the related Research and combined with the status Research quo in WOM marketing and consumption experience. To build a reasonable consumption experience measurement scale. To clear consumption experience dimension structure and proposed research model and hypotheses. To explore the impact of the relationship between customers consumption experience praise WOM intention.

## 128.2 Review of the Literature

### *128.2.1 The Basic Connotation of Consumer Experience*

Consumption experience can be divided into functional consumption experience and experiential consumption experience. Functional consumption refers to general merchandise, consumer content in pursuit of the functions and attributes of goods to meet consumer demand for the consumption patterns of the target. Experiential consumption for consumer content refers to the experience goods to an exciting, memorable consumer experience as the goal consumption patterns. Visible, there is a clear difference between these two types of consumption experience. Functional consumption experience is the focus of this paper.

Consumption experience began in Holbrook and Hirschman (1982) focus on the consumption experience. In the book “consumption experience: fantasy, feeling, and entertainment”, the author points out that the experience consumption to the historical arena, marketers should pay close attention to customers in the consumption experience in experiential consumption.

Terblanche and Boshoff (2001a) pointed out, only concerned about the experiential consumption experience and neglect of the functional consumption experience is not appropriate. Functional consumption to bring customers the consumption experience also can influence customer psychology and behavior. Thus it is worth trying that to explore around the consumption experience to the related marketing issues.

Terblanche and Boshoff (2001b) believe that the consumption experience is the profound memory and subjective experience of customer personal consumption of a product obtained. Berman and Evans (1998) believe that retail consumption experience is all the incentive or constraint elements of the customer contact with retailers. Comprehensive these two viewpoints, this article believe that the consumption experience is all the incentive or constraint elements of the customers in order to consume a product with the sellers of contact in the transaction process and the profound memory and subjective experience.

### ***128.2.2 WOM and WOM Spread***

For the reputation of the research originated in the study of Arndt (1967). He confirmed the important role of Word-of-Mouth on new product diffusion and adoption. In this study, we integrated in Arndt (1967) and Westbrook (1987) defined on WOM: WOM is the interpersonal communication of between the consumer and the consumer about the product or service features, brand, and business information and consumption experience oral forms of interpersonal communication.

A concept closely related to WOM is WOM Spread. Arndt (1967) defines the WOM Spread: face-to-face verbal communication behaviors between the information sender and information recipient. Chan believes that WOM Spread is the sender on the elaboration of product-related information as well as spread to other consumer (receiver). In addition, he also believes that the WOM Spread by the combined effects of many factors, such as product, emotional, personal factors and so on.

Huang and Xu (2004) believe that WOM Spread is a perception of non-commercial information disseminators and receivers on a product, brand, organization and informal interpersonal communication.

### ***128.2.3 WOM Intention Factors Affecting Willingness to Study***

Arndt (1967) and Dichter have been researched the antecedent of the WOM Spread. Their research shows the antecedent of consumers to participate in WOM Spread is reduce the purchase dissonance, product involvement, self-improvement, concern for others, and the use of WOM Spread to upgrade their status in interpersonal communication.

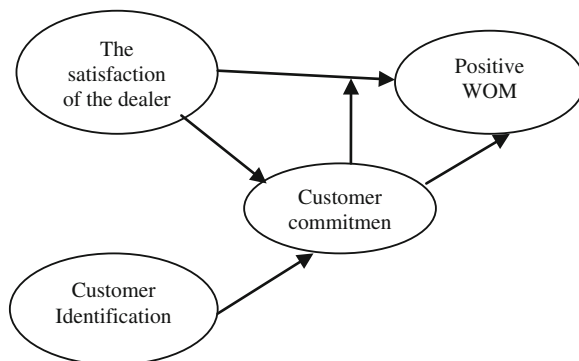
Brown et al. (2005) developed a comprehensive model of the antecedents of positive WOM intention (Fig. 128.1).

Mee-Shew extends the previous studies. They specialize research the factors affect the willingness of WOM intention in the cultural context. Also have did research about consumer WOM motives of China and the U.S. Explained the different cultural backgrounds of the two countries led to the motive of consumer WOM Spread was different and they have put forward different views about WOM Spread process (Cheung et al. 2007).

In summary, concluded that the theoretical studies of WOM prior to contact with the customer consumption experience. In fact, Westbrook (1987) pointed out that customer purchase behavior include WOM Spread behavior. The customer experience has a very important effect of WOM.

According to the literature findings and results above, this paper starts from a specific consumption experience. Directly test the role of the consumption experience on the willingness of consumer WOM intention.

**Fig. 128.1** Model of antecedents of positive WOM intention



### 128.3 Theoretical Foundation and Research Hypotheses

Sundaram et al. (1998) believe that the consumption experience includes four aspects: product performance experience, complaint handling capacity, price and value perception, the employee's performance. Further refinement of these several dimensions, we selected 18 sub-factors that student customers may experience in the consumption process. In order to ensure the scientific nature of the selected variables, we conducted customer interview and consultation with relevant experts. Selected variables were modified based on feedback, finalize the 15 sub-elements: unique, physical properties, performance and compatibility, answer purchased doubt, careful handling of complaints, upgrades, updates, trouble-shooting, value for money, reasonable price, reasonable price, value for money, to provide fast service, willing to help, polite, with interest to solve the problem.

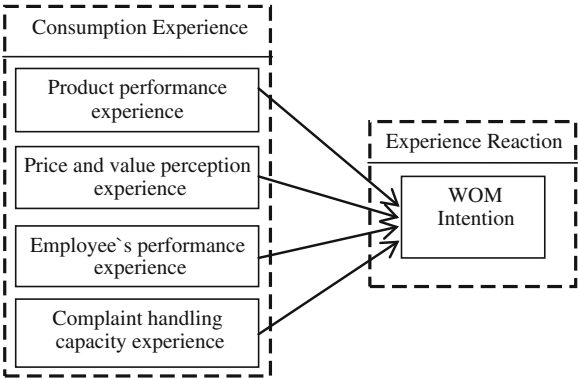
The part of WOM intention, we learn from the previous measure and grouped into a few: the recommended degree, to encourage the purchase, to talk about the advantage of four dimensions.

On the basis in reference to relevant research, we are put forward four hypotheses in this paper:

- H<sub>1</sub> The product performance experience has a positive significant impact on the WOM intention.
- H<sub>2</sub> The price and value perception experience has a positive significant impact on the WOM intention.
- H<sub>3</sub> The employee's performance experience has a positive significant impact on the WOM intention.
- H<sub>4</sub> The complaint handling capacity experience has a positive significant impact on the WOM intention.

In summary, this study proposed a conceptual model (Fig. 128.2):

**Fig. 128.2** The effects of consumption experience on WOM intention



**128.4 Data Collection**

The subjects selected the college students whose have brand computer as subjects. In the actual research methods, On the one hand distributed part of the questionnaire in Liaoning Technical University campus. The other hand, over the network forwards the electronic version of the questionnaire to the students or friends. Commissioned them to fill, release, and also achieved good recovery.

In this study, issued a total of 300 questionnaires and recovery of 243, have 207 valid samples, the effective rate was 69 %. Use SPSS 17.0 statistical software for data analysis. Men accounted for 54 % of those surveyed, women accounted for 46 %. From the age structure of the sample of this research concentrated between 18 and 35 years of age. All are college students. This part of customers most in work or study phase, active thinking, more human, they are regarded as the backbone of the WOM Spread. They are having higher motivation of WOM intention and the influence of WOM is relatively large.

**128.5 Data Analysis**

***128.5.1 Analysis of the Reliability and Validity of the Consumption Experience***

As shown in the above Table 128.1, the level of each factor ‘s alpha coefficients are above 0.7. So the high reliability of the consumption experience scale. It can be seen from the scale development process of this study, every issues rose with reference to literature and monographs. Combined with the actual integration and sublimation, and completed under the guidance of experts. Therefore, the scale has high content validity. In addition, through factor analysis of the consumption experience extracted four common factors can explain the total variance of

**Table 128.1** Reliability analysis results of consumption experience

Factor	$\alpha$	Item abbreviations	Item and factor correlation coefficient	The term after removing the alpha coefficient
Factor A	0.7953	Physical property	0.5297	0.7831
		Uniqueness	0.6633	0.7147
		Performance satisfaction	0.7336	0.6821
		Compatibility	0.5121	0.7886
Factor B	0.848	Good value for money	0.8199	0.7158
		Reasonable price	0.7487	0.7853
		Price is far less than its value	0.7045	0.8433
Factor C	0.8737	To provide fast service	0.7682	0.8224
		Willing to help	0.749	0.8303
		Refined and courteous	0.747	0.832
		To solve the problem with interest	0.6555	0.8667
Factor D	0.8597	Answer the usage question	0.7703	0.8165
		Upgrade, repair	0.7117	0.8404
		Carefully deal with complaints	0.6959	0.844
		Troubleshooting	0.7225	0.8334

The total table of alpha coefficient = 0.8826

74.949 % (>40 %). Each factor loading greater than 0.4, indicating that the scale has good construct validity.

### 128.5.2 WOM Intention of Reliability and Validity Analysis

Questionnaire contains four projects to measure WOM intention. Do factor analysis of these four measurements, the results shown in Tables 128.2 and 128.3. It can be seen from Table 128.2, the sample of the KMO value is 0.764 and can do factor analysis. It can be seen from Table 128.3, four measurements of the WOM intention produce to a factor: “WOM Intention”. This factor explained 82.641 % of the overall variance. The results coincide with the original idea. So the WOM scale has good construct validity.

The following Table 128.4 shows: The Cronbach alpha coefficient is 0.907 of the WOM intention. It shows that the scale of the WOM intention has a high degree of consistency and internal structure. In other words, reliability is very high.

**Table 128.2** KMO and BTS results of WOM intention

KMO and BTS results of WOM intention		0.764
Bartlett's test of sphericity	Approx.Chi Square	524.61
	df	6.00
	sig.	0.00

**Table 128.3** The factor loading of WOM intention

Measuring project	Factor loading
If my friends and relatives is buying computers, I would like to recommend this brand for him	0.918
If I was helping relatives and friends to buy computers for the decision, I would like to recommend this brand for him	0.912
If my friends or relatives are interested in the computer products, I will tell him the brand advantages	0.907
If I talk about the topic of computer with others, I told him this brand advantages	0.90
Cumulative total variance explained	82.64 %

**Table 128.4** Reliability analyst of WOM Intention

Measuring project	Project number	Cronbach $\alpha$ coefficient
WOM intention	4	0.907

### 128.5.3 Model Checking

The main test of this section: test the relationship between the consumption experience of the four dimensions and the WOM intention. That is to verify the assumptions  $H_1$ ,  $H_2$ ,  $H_3$  and  $H_4$ .

In order to clear the role of experience effect of WOM intention. We are use the Regression analysis method. In order to ensure the stability of the results, it has used forced regression and stepwise regression for verification.

Prior to regression analysis, the first response to the model applicable to the conditions tested. By plotting the residuals histograms, founded that the standard residuals of WOM intention follow a normal distribution assumptions. It meets the assumptions of regression analysis.

Next, we use of multiple regression analysis “forced regression”. The analysis showed that the regression equation F value of 64.970. Adjusted R2 of 0.645, the D.W test value of 2.015 which means there is no indication from the relevant circumstances. In order to test the stability of the regression results, we then use multiple regression analysis “stepwise regression”. Again do regression analysis for the four dimensions of consumption experience. The results showed that the F value of 64.970. Adjusted R2 of 0.645, twice regression analysis results was consistent.

**Table 128.5** Results of regression analysis

Consumption experience dimensions	Standardized regression coefficient	T	P
Product performance experience	0.455	-1.135	0.024
Price and value perception experience	0.376	2.552	0.016
Employee's performance experience	0.294	5.895	0.007
Complaint handling capacity experience	0.458	9.201	0.000

Integrated twice the results of regression analysis (Table 128.5) we can see that the consumption experience four dimensions of the *T* test results of *P* reached significantly ( $p < 0.05$ ). And the regression coefficients are positive. As a result, the four dimensions of consumption experience have a positive significant effect on the WOM intention. It means that the assumptions  $H_1$ ,  $H_2$ ,  $H_3$  and  $H_4$  to get support. The effect sizes of each dimension of consumption experience on WOM intention are different.

**128.6 Conclusions and Managerial Implications**

The subjects selected the college students whose have brand computer survey data. To analysis the effect of consumption experience on WOM intention. The results show that: the four dimensions of consumption experience have a positive significant impact on WOM intention. The degree of this positive impact in the order of: complaint handling capacity to experience (0.458), product performance experience (0.455), sensory experiences in the price and value (0.376), the employee's performance experience (0.294).

From the research findings and combined with the basic idea of experiential marketing. We propose the following recommendations for enterprises to implement WOM marketing:

- a. Based on internal marketing, to establish a good relationship between the customer and the enterprise.
- b. Provide extraordinary function experience design, win a good reputation.
- c. Create and deliver high-value experience to enhance the WOM intention.
- d. Build customer communication platform to guide customer to participate in WOM marketing.

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# Chapter 129

## A Systematic Analysis on the Sustainable Development of Tourism Industry Cluster: Take Hainan Province as an Example

Xiao-mei Qi and Li-jun Hu

**Abstract** This article mainly analyzes the composition and structure of tourism industry cluster and makes a quantitative judgment of the formation of Hainan's tourism industry cluster. Firstly, it explores the connotation of sustainable development of tourism industry cluster both from the harmonious management theory and self-organization theory. Secondly, it puts forward the system framework to study the sustainable development of tourism industry cluster. Thirdly, it carries out a systematic analysis on Hainan tourism industry cluster's sustainable development.

**Keywords** Hainan • Tourism industry cluster • Sustainable development • System framework • Systematic analysis

### 129.1 Introduction

Under the background of constructing Hainan into an international tourism island, we, as the scholars in tourism, should undertake the responsibility for the research of Hainan tourism. Hainan tourism can be regarded as a system from the angle of system theory, or it can be considered as an industry from the perspective of economics and management. It also can be thought as the combination of a system

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and an industry which are not contrary to each other. The paper will discuss Hainan tourism from the latter point.

The early study of industrial cluster mainly focused on the manufacturing and new hi-tech industry, but few cases were applied to the tourism industry. There has been a large quantity of literature on this field in the late twentieth century and the early twentyfirst century. Since the end of 2003, the domestic scholars with the representative of Professor Wang Jici from Beijing University begin to pay close attention to tourism industrial cluster. After fierce debates, they reached unanimous agreement that the tourism industrial cluster is theoretically possible (Wang 2001; Feng 2008).

This article mainly analyzes the composition and structure of tourism industry cluster and makes a quantitative judgment of the formation of Hainan's tourism industry cluster. It explores the connotation of sustainable development of tourism industry cluster both from the harmonious management theory and self-organization theory. It also gives some research on the macro and micro mechanism of industrial cluster's sustainable development, on which it provides a mathematical model for the sustainable development of industrial cluster.

## 129.2 The Cluster Judgement

The cluster judgment should be based on its definition as well as its characteristics. Take Michael Potter and Wang Jici as representatives from broad and home, many scholars have brilliant exposition on the definition and characteristics of industrial cluster respectively from different point of view. And the method to judge the industrial cluster is quantitative and qualitative. The method of Location Quotient is only used in this article to judge whether Hainan tourism industry cluster is formed or not.

Location quotient (referred to as  $LQ$ ) is a ratio between the share of a specific sector's output value in the regional total and the share of the whole sector's output value in the national industrial total. In area economics, location quotient is often used to determine whether an industry constitutes a regional specialized department. A  $LQ$  of more than 1.0 indicates the industry is the specialized department in this area. A higher  $LQ$  means more professional. Otherwise, a  $LQ$  equal to or less than 1.0 indicates this industry is self-sufficient department.  $LQ$  is also a tool to analyze the industry efficiency and benefits, which is a common method to identify clusters and measure a certain aspect of an industry and the relative concentration of a particular region.

The formula used to compute a  $LQ$  follows:

$$LQ = (L_{ij}/L_i)/(L_{kj}/L_k)$$

$L_{ij}$  refers to the output value of  $j$  industry in  $i$  region,  $L_i$  the total production value in  $i$  region,  $L_{kj}$  the production value of  $j$  industry in country  $k$ ,  $L_k$  the national

**Table 129.1** LQ of Hainan tourism

Items years	National			Hainan			
	Total GDP (trillion RMB)	Tourism revenues (trillion RMB)	Share of tourism in GDP (%)	Total GDP (trillion RMB)	Tourism revenues (trillion RMB)	Share of tourism in GDP (%)	LQ of tourism
2001	109,655.2	4,995.00	4.56	579.17	87.91	15.18	3.33
2002	120,332.7	5,565.63	4.63	642.74	95.37	14.84	3.21
2003	135,822.8	4,882.96	3.60	713.97	93.58	13.11	3.65
2004	159,878.3	6,841.13	4.28	819.67	111.05	13.55	3.17
2005	183,217.4	7,685.79	4.19	905.03	125.07	13.82	3.29
2006	211,923.5	8,936.15	4.22	1,031.90	141.45	13.71	3.25
2007	257,305.6	10,958.14	4.26	1,223.28	176.36	14.42	3.39
2008	300,670.0	11,585.85	3.85	1,459.23	192.33	13.18	3.42
2009	340,506.9	12,894.72	3.79	1,646.60	211.72	12.86	3.40
2010	397,983.0	15,680.43	3.94	2,052.12	257.63	12.55	3.19

Data from national statistics yearbook, National economy and social development statistics bulletin, Hainan statistics yearbook and the economic and social development of Hainan province

total production in country  $k$ . A  $LQ$  of more than 1 means the specialization of an industry. With over 1.12, it is a rather higher specialization. In the process of identify the industrial cluster; if  $LQ$  is greater than 1, it is considered the industrial cluster has been formed (Gan 2010). The data of Hainan's tourist industry from 2001 to 2009 have been calculated to find out the  $LQ$  of Hainan tourism in the following Table 129.1.

Table 129.1 shows that the  $LQ$  of Hainan tourism were above 3.0 from 2001 to 2010, with an increase year by year especially from 2004 to 2009, which fully illustrates the formation of Hainan's tourism industry cluster as well as a strong development tendency compared to other provinces in China.

### 129.3 The Composition and Structure of Hainan Tourism Industry Cluster

The article holds the opinion that Hainan tourism industry cluster consists of the following three parts (Feng 2008; Guo 2009; Chen and Zhai 2010; Zhuang 1993):

- Firstly, the core of industry includes tourist attractions (core attraction), hotels, travel agencies, tour companies, tourist goods and souvenirs, and so on.
- Secondly, tourism leading industry includes food and food processing industry, tourism real estate, tourism transports, tourism supply and repair business, tourism planning and consulting business, producing and processing of tourism products, landscaping and cleaning.

- Thirdly, the corresponding supporting mechanism and service mechanism include the providers and related organizations in the fields of finance, insurance, telecommunications, training institutions, government management departments and associations which are helpful to the cluster infrastructure, tourist activities, the production and operation of cluster enterprises.

The structure of Hainan tourism industrial cluster can be divided into three levels:

- The first level is tourist attraction (core attractions) and related business.
- The second level is food, housing, traffic, travel, shopping, and entertainment.
- The third level are the providers and related organizations in the fields of finance, insurance, telecommunications, training institutions, government management departments and associations which are helpful to the cluster infrastructure, tourist activities, the production and operation of cluster enterprises.

## **129.4 The Implication of Sustainable Development of Tourism Industry Cluster**

Since the birth of tourism industry, tourism industry cluster's sustainable development has been worthy of attention. The previous literature focused on the coordination of tourism cluster development from the static angle and its main index is a reasonable ratio among the essential factor investment, which is the foundation of sustainable development. The sustainability discussed in this paper has a wider perspective, not only including the "sources" harmony based on various elements reasonable input, but the "human" harmony of social relations and humanistic spirit (Hu 2007; Xu 2010). The following is to be illustrated both from the perspectives of harmonious management theory and the theory of self-organization.

### ***129.4.1 Perspective of Harmonious Management Theory***

It is thought that industry clusters' sustainable development consists of the sustainability of cluster system's development and the coordination development between the cluster system and the external social and economic environmental system. Harmonious development can be divided into "being together" and "harmony" according to the theory of harmonious management the former is persons' or people's ideas and behaviors desirable embedded. And harmony refers to all physical elements input reasonably in the organization. It carries out analysis in accordance with the principle of "being together" and "harmony". The principle "being together" is used to adjust the interpersonal relationship. There are various social relations of the inside and outside of cluster system, such as organizational

culture and humanistic spirit, which are important to cluster development. These soft factors were often ignored in the previous studies, together with the material elements, also known as the hard elements coordination and matching. “Harmony” refers to the rational investment of material elements. It is a process of pursuing optimization for material elements under the determined condition with the constraints of existing objectives and circumstances. Only both of them play their own roles, can the whole cluster system develop coordinately (Xi et al. 2006).

#### ***129.4.2 Perspective of Theory of Self-Organization***

Tourism industry cluster is characterized with openness, far from equilibrium, nonlinear effect and fluctuation, which are in accordance with self organization. Based on the analysis of self-organization mechanism of tourism industry cluster, we found that the synergy of competition and cooperation is the drive for the self-organization evolution of the tourism industry cluster and its order parameter is the tourism culture. It also reflects that the culture plays an important role in the tourism industrial cluster. The theory of self-organization gives an explanation the sustainable development is the system spontaneous evolution from a disorderly state to orderly and even to a higher one. This kind of evolution is necessarily to ensure its own compatibility, clear away outside interference and keep sustainable development.

### **129.5 System Analysis on Tourism Industrial Cluster Sustainable Development**

According to the theory of system science, the system development is closely related to the elements within the system, the links and interactions between the system itself and its external surroundings. Not only the internal dissonance of the system but the external will affect the system’s overall development (Gao 2005; Hou 2006). This part begins with analyzing the systematization of tourism industry cluster, namely, the macro mechanism of the sustainable development, followed by its micro mechanism. Finally, it provides a mathematical model for the sustainable development of industrial cluster.

#### ***129.5.1 Systematization of Tourism Industry Cluster: Macro Mechanism of Sustainable Development***

Tourism industrial cluster is a phenomenon of tourism industry aggregation. The internal of each subsystem within the cluster system, the subsystem themselves,

the cluster system itself and its external surroundings form a complex open system through a variety of interactions. Its macro mechanism for operating is to be discussed in the following, which is characterized with entirety, hierarchy, correlation, openness, self-adaption and environmental adaptability.

1. *Entirety*: Its unified entirety leads to the existence of tourism industry cluster. Integrity is the basic attribute of the system, which is demonstrated that only within the entirety, can each subsystem's purpose, nature, motion and function be performed, and they have to subordinate to the need of overall development. The subsystem is not the best one if it is pursuing the best results without considering the overall interests. Otherwise, even if each subsystem is not the perfect, they still can make the entire system function well through complementation, comprehension and coordination. This is the entirety of the cluster system. Entirety determines the overall functions of cluster system much greater than the linear summation of all subsystems'
2. *Hierarchy*: Tourism industry cluster has at least three levels. The core level is tourist attractions and related enterprises. The auxiliary level includes some subsystem such as food, accommodation, travel, shopping, entertainment, transportation. The supporting level refers to the suppliers of the cluster infrastructure, relevant organizations, institutions and organizations. Cluster system's hierarchy is reflected on the relative independence and effectiveness of each hierarch's function. Destroying their independence and effectiveness will eventually reduce the whole system's efficiency
3. *Correlation*: Tourism industry cluster correlation refers that each subsystem with the system restricts to each other, influence each other and interdependent on each other. They have mutual connections and dependence in the process of operation, including the structure, function and causal relations. Each subsystem's function and their reasonable and correct coordination will reach the system's goal. These links determines the whole system's operation mechanism. While, analyzing these links is the basis of constructing clusters (Miao 2006)
4. *Openness*: The tourism system is an open system. It exists in a certain environment and constantly exchanges its material, information and energy with the external environment. The main function of tourism industrial cluster is to provide tourists with tourism products and services, which determine its higher openness. Clusters take tourism resources as its core, the subsystem of food, accommodation, transportation, travel, shopping, and entertainment as its auxiliary layer, and infrastructure providers, related organizations, institutions and groups as the supporting layer. Each part of each layer is an open system, which does not only constantly exchange material, energy and information with the external environment, but the internal expanded cooperation and exchanges widens its openness
5. *Self-adaption*: Enterprises are the basic elements of tourism industrial cluster, and they have their own purposes, initiative and adaptability. Each enterprise is in the pursuit of their benefit maximization. With this goal, they have to be active and take the initiative to achieve it. In addition, enterprises and elements

within the cluster as well as without the cluster, and the internal and external environment interact with each other. This interaction and impact constantly changes the cluster itself, and also changes the surroundings. It is called the cluster's self adaption, which is basic power for tourism industry cluster development

6. *Environmental adaptability*: Tourism industrial cluster is operating in a certain environment, and changing its material, energy and information with the external environment. The system which can not adapt to the change of environment is no vitality. The boundary of cluster system is the dividing line between cluster system and its external environment. Objectively, there is no obvious line between them. Only for the convenience of research, the system scope, scale, structure and the problems to be solved should be limited

### ***129.5.2 Micro Mechanism for Sustainable Development of Tourism Industrial Cluste***

From above, tourism industrial cluster, as a system, has various characteristics which a system has. These characteristics are rather macroscopic. In order to conduct an in-depth research of the cluster system's sustainable development, it is necessary to analyze its microscopic structure and environment because the microscopic behavior determines its macroscopic properties (Pan 2008). The system's boundary should be firstly defined for the need of the study. The boundary of tourism industrial cluster in this paper is set between the system's core, auxiliary layer and supporting layer so as to clearly distinguish the inside and outside of the system. The fundamental object of the study concerns tourist attractions in which there are six subsystems related to food, accommodation, transportation, travel, shopping and entertainment. These subsystems are made up of enterprises. The model of energy standard, also known as the mathematical formula to test its function, is to be constructed according to the three layers. Energy standard here not only takes both the role of material elements and non-material one into consideration, but the linear and non-linear function. In the end, it offers the mathematical expressions to calculate the cluster system's overall energy level.

#### **129.5.2.1 Internal Energy Levels of Six Subsystems Composed of Tourism Industry Cluster System**

Enterprises are the basic unit of the six subsystem concerning food, accommodation, transportation, travel, shopping and entertainment. The enterprise itself can be regarded as an independent system, whose energy level is determined by its elements. Enterprises' subsystems are composed of all kinds of productive elements and non-productive ones which can be classified into material and non-material

according to their existing forms, marked respectively as  $m$  and  $k$ . The energy level of each subsystem depends on the enterprise's energy level (linear), marked as  $q(m, k)$ , within the system and the interaction (nonlinear) marked as  $\Delta q$  among enterprises. Suppose that there are  $j$  enterprises in each subsystem and there are  $i$  subsystem, then the energy level of each subsystem marked as  $E$  is:

$$E = \sum f_i(q(m_j, k_j), \Delta q), \quad (i = 1, 2, \dots, 6, j = 1, 2, \dots, n) \quad (129.1)$$

This is the energy level of a linear function, but the energy level of enterprises within each subsystem is nonlinear.

#### 129.5.2.2 Energy Levels Produced by the Interaction of Six Subsystems

The cluster system produces competition and cooperation among each subsystem because of their non-linear interaction. The energy level (marked as  $C$ ) produced by this kind of competition and cooperation is:

$$C = c(q(m_j, k_j), \Delta q) \quad (129.2)$$

It is necessary to point out that the coordination among the six subsystems relies on the culture which is the soul of tourism.

#### 129.5.2.3 Energy Levels Produced by the Exchanges and Cooperation Between Tourism Cluster and its External Environment

Tourism cluster, as an open system, has to continuously exchange with the external environment to maintain its sustainable development. The energy levels (marked as  $H$ ) produced by the exchanges between tourism cluster and its external environment can be expressed as:

$$H = a(q(m_j, k_j), \Delta q) \quad (129.3)$$

#### 129.5.2.4 Overall Energy Levels of Tourism Industrial Cluster System

The overall energy level of tourism industrial cluster system (marked as  $N$ ) is the function of these three kinds of energy levels. Its mathematical formula can be:

$$N = f(E, C, H) \quad (129.4)$$

### ***129.5.3 A Mathematical Model for Sustainable Development of Tourism Industry Cluster System***

From formula (129.4), it can be seen that the energy levels of tourism industrial cluster system are closely related to  $f$ ,  $E$ ,  $C$  and  $H$ . They should be improved in order to increase the overall energy levels  $N$ . At present, it is still hard to theoretically prove it continuously differentiable because the specific  $F$  function form can not be determined. However, it should be continuously differentiable according to the meaning of  $f$ .

It can be concluded that the tourism industry cluster is featured with systematization. Suppose that there is a good state among the inside of each subsystem within the cluster, each subsystem, the cluster and its external environment, a whole system has been constituted, in which each can integrate with others and promote others. Only then, can the industry cluster system achieve its maximum energy level.

Therefore, the sustainable development of tourism industry cluster system can be defined as the following. There is an overall coordination for the internal of the system and each subsystem concerning tourism core layers such as food, accommodation, transportation, travel, shopping and entertainment. And the cluster system can adapt itself to the external surroundings. Using  $K$  to represent the cluster's sustainable development, its mathematical expression can be:

$$K = k(k_1(E), k_2(C), k_3(H)) \quad (129.5)$$

$k_1(E)$  refers to the internal sustainable development of six subsystems,  $k_2(C)$  means the sustainable development of competition and cooperation among six subsystems, and  $k_3(H)$  represents the sustainable development of exchanges between six subsystems as a whole and external environment which also means the overall sustainable development of tourism industrial cluster system.

## **129.6 Systematic Description of Hainan Tourism Industrial Cluster's Sustainable Development**

On the basis of the above analysis, Hainan's tourism industrial cluster's sustainable development can be described like this: with the core of natural attractions and tourist attractions, it should focus on the sustainable development of six subsystems of food, accommodation, transportation, travel, shopping and entertainment. The energy levels of each subsystem and between them can reach its optimum. And the energy levels of the exchanges between the industry cluster system composed of six subsystems and the external environment also can be optimal so as to make the whole cluster energy level maximum. The higher the whole energy level is, the more its sustainable development is.

Taking the current situation of Hainan's tourism industry cluster into account, how to maximize its value is the significance of the paper since Hainan boasts its rich tourism resources. However, there are some issues to be solved. How to coordinate the six subsystems under the guidance of culture? How do Hainan administration, tourism infrastructure providers, relevant organizations, institutions and groups provide six subsystems support? In more detail, Hainan has good natural landscape and tourist attractions. The issue is how to make it coordinate and match with the subsystem of diet. It not only needs a hard material matching, but also a soft culture and organization. Whether the diet can match with tourist attractions in terms of specialty, price, location, environment and atmosphere? How do the tourists feel while eating? This paper stresses more on the coordination of charming natural environment, geographical resources and humanistic spirit, which is a special perspective in this paper to study the sustainable development of tourism industry cluster from system theory. It should be paid enough attention to in the research of cluster at all levels.

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# Chapter 130

## Research on Dispatched Employees' Voluntary Turnover in Electronics Industry

Xu-tao Zhang, Zhen He, Yun-na Liu and Yun Wang

**Abstract** In the context of “labor shortage” in china, dispatched employees' voluntary turnover in electronics industry is researched. In view of the characteristics of dispatched employees, employee retention model considered all possible variables is established based on analysis of traditional employee turnover model. 300 questionnaires are handed out by random sampling in three typical electronics industries in Tianjin. The key factors affecting dispatched employees' voluntary turnover are figured out by ANOVA and multiple regressions. Moreover, the motivation of turnover and some feasible suggestions are discussed, which can be referred by enterprises to improve job satisfaction and retention will of dispatched employees.

**Keywords** Dispatched employee · Employee turnover · Job satisfaction · Retention will

### 130.1 Introduction

As the approaching of Lewis turning point and the gradually disappearing of demographic dividend in china, “labor shortage” has gradually become a common phenomenon in the country. According to the report, labor shortage phenomenon

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has spread from east to west and a structural shortage of labor has been normalized. In the context of recruitment difficulties and rising labor costs, enterprises in China have to face the problems of high voluntary turnover rate of direct labors. In china, the direct labors in enterprises are very special group because most of them are “dispatched employees”. Dispatched employees are that hired by labor dispatch companies with whom they have employment relationship; they are dispatched to the employer for labor services if they consent to the dispatching (Guest 2004). This form of labor using is called labor dispatch, which has been prevail nowadays because it saves cost for organizations and brings flexibility to both organizations and employees (Neumark and Reed 2004). Traditional researches on employee turnover are mainly about enterprises management personnel or the general staff (Gaertner 1999; Payne and Huffman 2005; Wheeler et al. 2007), however, the researches on the turnover of direct labor in particular the dispatched employees are still blank. In this paper, based on the analysis of traditional turnover model, dispatched employees’ retention model considered all possible variables is established in view of the characteristic of dispatched employees. Questionnaire is designed based on the model and 300 questionnaires are handed out by random sampling in three typical electronics industries in Tianjin. The key factors affecting dispatched employees’ voluntary turnover are figured out by ANOVA and multiple regressions. Moreover, the motivation of turnover and some feasible suggestions are discussed, which can be referred by enterprises to improve the satisfaction and retention will of dispatched employees.

### 130.2 Dispatched Employees’ Retention Model

Since 1950s, many scholars have conducted in-depth study on the construction of turnover model (Weibo et al. 2010). They studied the determinants of employee turnover from the individual level, and tried to explain the decision making process of employees. The classic models of employee turnover include: the multipath Unfolding Model established by Lee and Mitchell (1994), the Job Embeddedness Model by Mitchell et al. (2001), and the Casual Model by Price (2001) and so on.

The Unfolding Model holds that multiple paths lead to employee turnover and that some decisions are independent of job satisfaction, but for “shock”, namely, the external events that generate implication for the job, which will cause a conscious judgments on the current employment status. Job Embeddedness (JE) is the degree to which individuals are enmeshed by all the factors in their jobs. JE model summarizes all the organizational or community factors that predict an employee’s tendency to stay in a job despite the unsatisfactory feeling or an external opportunity which might cause him/her to quit. Price’s Casual model is generally accepted by scholars as a classic model; it comes down to satisfaction, employee turnover and organizational commitment problem, which will in turn impact by affecting the turnover behavior. There are four variables related to

turnover taken into consideration in this model: environmental variable, individual variable, structural variable, and process variable. The model absorbs results of multi-disciplinary studies, including a large number of variables and shows good predictive ability in terms of the employee's psychological process of change.

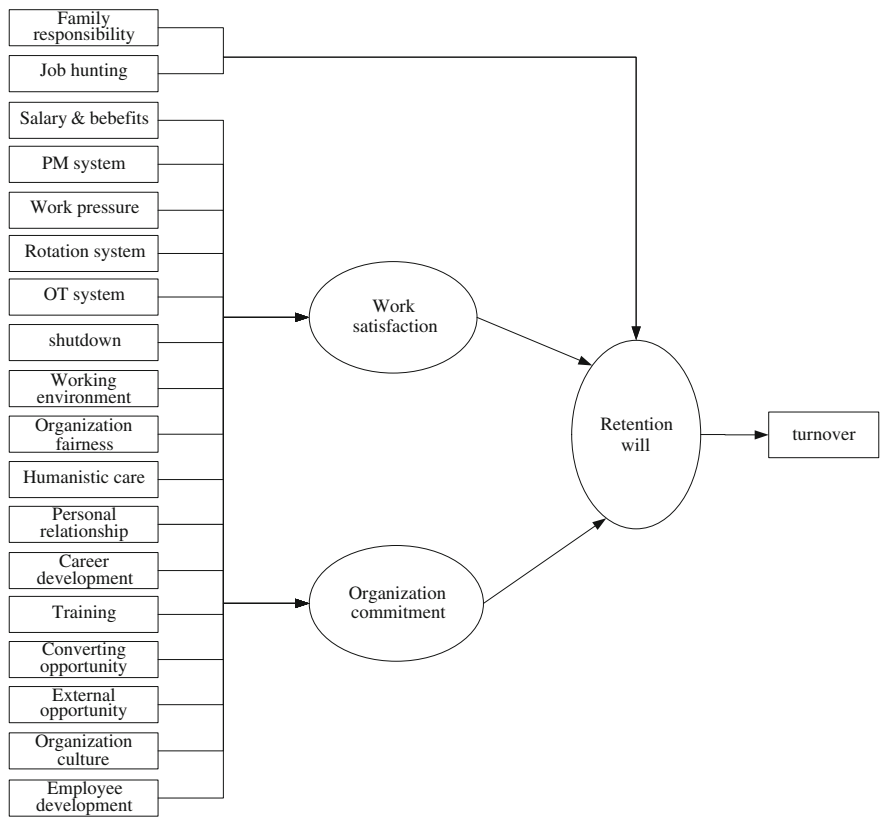
The Unfolding Model further explains the turnover act under high work satisfaction and organizational commitment; while JE theory can better explain the retention when the degree of work satisfaction and organizational are low. However, the business usually concern on finding the key to "work" factor, rather than employee turnover behavior path analysis. On the other hand, non-work factors in employee turnover are often part of a business' controllable range. Compared to multipath model and JE model, Price's casual model is more suitable for enterprises to reduce employee turnover rate. In view of this, this study builds the All Factor Retention Model of dispatched employees on the basis of Price's casual model. It consists of three mediating variables (oval), 18 external variables (rectangles), with the model structure shown in Fig. 130.1. The model takes retention will as the explanatory variable for employee turnover, work satisfaction and organizational commitment as intermediary variables, and the other 18 variables like family responsibility, salary & benefits, and work pressure as external variables. To meet the characteristics of dispatched employees and corporate form of employment, the model added factors like converting opportunity, shutdown, overtime etc. in comparison to Price's casual model.

### 130.3 Data Collection

Questionnaire is designed based on the model mentioned above, which uses five-point Likert item. It refers to Minnesota Satisfaction Questionnaire, Job Descriptive Index, Hewitt Engagement Survey Scale etc. in the process of questions design. Besides, the process of the survey is also a process of organization culture promotion, so all questions asked in the questionnaire are positively directed. We use SPSS18.0 to analyze the reliability and validity of the questionnaire. The Cronbach's  $\alpha$  is 0.931, KMO 0.928  $\gg$  0.5, Bartlett's Test level 0.000  $\ll$  0.05, indicating good reliability and validity (Chadwick and Hember 2008).

Three hundred questionnaires are handed out by random sampling in three typical electronics industries in Tianjin, 283 of them are handed in afterwards and 279 of them are proved valid, amounting to 93 % of the total. Table 130.1 shows the structure of the sample.

The characteristics of dispatched employees in electronics industry can be reflected by the constitution of people investigated. Women are the majority, occupying 76.3 %. Their age is young, employees aging 16–30 occupying 92.8 %. Most of them are unmarried, occupying 76 %. Working years are short, working years less than 2 years occupying 90.7 %.



**Fig. 130.1** Dispatched employee retention model considered all possible variable

**Table 130.1** Individual variables constituting the questionnaire

Contents	Category	Number	Proportion (%)
Gender	Male	66	23.7
	Female	213	76.3
Age	16–20	55	19.7
	21–25	156	55.9
	26–30	44	15.8
	31–35	20	7.2
	35 and above	4	1.4
Marriage Status	Married	67	24
	Unmarried	212	76
Working Years	0–6 months	96	34.4
	7–12 months	37	13.3
	1–2 years	120	43
	2 years and above	26	9.3

130.4 Data Analysis

130.4.1 ANOVA Analysis

In order to test whether individual variables have significant impact on satisfaction, organization commitment, and retention will, ANOVA analysis is done to gender, age, and years of service. Table 130.2 shows their significance respectively.

As the table shows, gender, age, and years of service have no significant impact on retention will, but marriage status has significant impact on retention will. To be specific, married employee is more apt to retain than unmarried employee. This might be resulted from married employee's consideration in family responsibility and social relationship out of which they cherish more about current work opportunity and they are more committed to the organization.

130.4.2 Multiple Regressions

Factorial analysis of retention will is carried out first. The significant levels of family responsibility, PM systems, overtime work, working environment and organization culture are surpass 0.10, indicating having no significant impacts on retention will. Those variables whose significant levels surpass 0.10 in Fig. 130.1 are regarded as insignificant ones and are discarded. Multiple regressions are done to significant variables and dispatched employee turnover path model is built (Fig. 130.2). All the external variables, intervening variables, and explanatory variables and their inter-relations are shown in the model. The path coefficient is applied to show the weight.

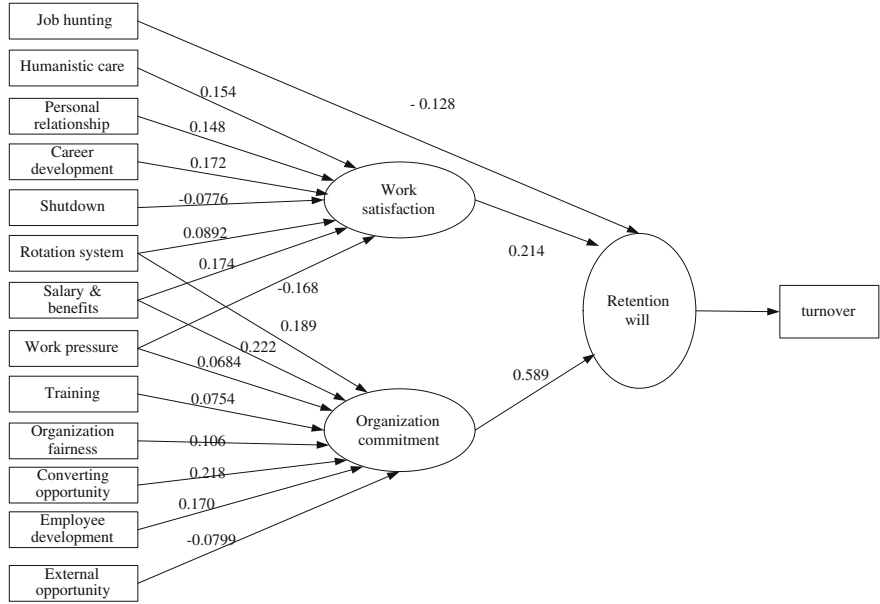
As Fig. 130.2 shows, organization commitment has more impact on dispatched employee's retention will than work satisfaction does.

Humanistic care, personal relationship, career development, salary and benefits, have significant positive impact on working satisfaction; working pressure, shut-down has significant negative impact on it; performance system, OT, working condition, training etc. have no significant impact on satisfaction.

Table 130.2 Significance of individual variable on retention will

	Satisfaction	Organization commitment	Retention will
Gender	0.843	0.591	0.383
Age	0.736	0.735	0.324
Years of Service	0.023***	0.366	0.511
Marriage Status	0.707	0.029***	0.054**

Note \*\*, \*\*\* denotes statistical significance at the 5, 1% level



**Fig. 130.2** Path of dispatched employee turnover

Salary and benefits, converting opportunity, working pressure, rotation system, management, training, and career development have positive correlation to commitment while external opportunities have negative correlation to it. However, organizational culture, traditionally an important factor affecting commitment, doesn't pass the test. This might be caused by the identity of dispatched employee.

**130.4.3 Figure Out Key Factors**

For further comparison of the affection of external variables on turnover intention, absolute value proportion of the correlation coefficient on each path is calculated, as shown in Table 130.3.

It can be concluded from Table 130.3 that salary and benefits is the most important variable that affect dispatched employees, and it has more impact on organization commitment than on work satisfaction. This conclusion could be explained by the fact that most dispatched employees in electronics industries are young people who value money a lot.

Converting opportunity and job hunting are of paratactic significance to contractors. On the one hand, this shows that dispatched employees are more cared about their identity recognition by the company. On the other hand, it indicates

**Table 130.3** Path coefficient and proportion of each significant variable

Variables	Impact on satisfaction	Impact on commitment	Impact on retention will	Absolute percentage (%)
Salary and benefit	0.143	0.222	0.161	18.38
Converting opportunity		0.218	0.128	14.61
Job hunting			−0.128	14.61
Employee development		0.170	0.10	11.42
Rotation system	0.0892	0.120	0.09	10.27
Organization fairness		0.106	0.062	7.08
External opportunity		−0.0799	−0.047	5.37
Training		0.0754	0.044	5.02
Career development	0.172		0.036	4.11
Humanistic care	0.128		0.027	3.08
Personal relationship	0.148		0.032	3.65
Shutdown	−0.0776		−0.017	1.94
Work pressure	−0.168	0.0684	0.004	0.46

that contractors are easily to pursuit new opportunities with the help of internet and the development of HR companies.

**130.5 Conclusion and Discussion**

The research on dispatched employees' voluntary turnover results in some new findings. Due to the unique characteristics of dispatched employees and the special form of labor using, factors affecting their turnover are different from traditional turnover model. Dispatched employees values salary and benefits more than regular employee, desire for organization recognition, and pursuit individual career development. For enterprises, increasing salary is always the first choice to retain employees. Without any doubt, this choice will cause burden to an enterprise which is going through declining profit. Under this circumstance, the enterprise should pay more attention to employee career development and provide more training opportunities so as to enhance its attraction and competence. Individual variables like gender, age, years of service have no significant impact on retention will, while the status of marriage has obvious impact on it. The new finding shows that family responsibility and social relationship have certain impact on employee's decision making in leaving a company. With the spreading of information in internet and the development of HR companies, external opportunities and job hunting become important factors in motivating a frequent flow of contractors. Organization culture has no significant impact on employee retention will. How to strengthen ties between dispatched workers and the employers by organization culture is an issue worth noting. The fluctuation of orders of an

enterprise leads to random overtime working or shutdown. Higher income out of overtime working can't strengthen employee retention will, but shutdown directly results in lower satisfaction and weaker organization commitment which causes intention to leave. Therefore, enterprises should pay more attention to the rationality of their manufacturing plan. These findings have enriched researches on employee voluntary turnover. Meanwhile, they provide references for enterprises in form of labor using and system designing for dispatched employees.

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# Chapter 131

## The Design and Realization of VB Excellent Course Website

Xiu-ying Wang, Yu-min Sui and Ming-hua Liu

**Abstract** Aiming at undergraduate teachers and students inconvenience exchange problems, combined the difficult point of VB course construction, A VB Excellent Course Website is developed by integrating Dreamweaver 2004, HTML, Asp language. In this paper, the system structure designing, frame structure chart, system of web page of construction and how to develop steps are introduced, explained the function of each module and teaching resource of course network in detail. The software is already run on Proxy Server in Campus Network, and the result is satisfying.

**Keywords** VB course · Website · Dreamweaver 2004 · HTML · ASP

### 131.1 Introduction

Excellent course is a demonstration course with features of first-class teachers, teaching content, teacher methods, textbook and teaching administration, which is brand course, demonstration course and welcomed by student (Office of Ministry of Education 2003). In 2003, on the basis of grass-roots unit recommendation, a total of 494 courses are elected as the national quality curriculum (Sun 2007). In 2004 February, the Ministry of Education selected 151 state-level quality courses from 494 courses, and free open, so that excellent resource sharing. In 2007 May, an academic seminar about “network courses and resources construction” held by the Ministry of Education the Curriculum Resources Construction Committee in Northeast Finance and Economics University. In this conference, the network course education quality and evaluation standard are discussed, and 50 network

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courses are selected. This conference has the epoch-making significance for the development of our country the network education (Wang et al. 2004).

In 2008, “VB program design” course was become an excellent course of Qingdao Science and Technology University. How are we to build up this course? It has been our think problem continually. We think, the student’s demands are our build up goal. Because the university teacher work hour is not fixed, the students meet teachers usually only the class time, other time meet rarely. The students have problems to find hardly the teacher. Teachers and students exchange time is too little. In addition students copy some course ware and other teaching materials from teachers only in class, teaching resources can’t share. These problems become the bottleneck of students learning. Aiming at situation, the excellent course “VB programming” website is designed and developed based on Dreamweaver 2004, HTML, Asp technology. The teachers and students will be public problems and an information on the web, the students have problems can also be timely in line to teachers. It is a communication platform between teachers and students.

## 131.2 Demand Analysis

An excellent course website should have the following functions and characteristics:

1. Serves teaching. Teaching is an important part of excellent course construction. So, the design of website should focus on the teaching and function design. It has the features, such as advanced, system, interaction, intelligent (Chi and Sun 2006).
2. Outstanding VB course features. Whether the website overall style, pictures or animation should have the VB course characteristics. On this basis, also enhance interesting and look of website (Lin 2009).
3. To students conveniently visit website. The structure of website should be simple and layering is not overmuch. Navigation must be clear, teachers and students understand easily the content of the website, students find easily what they want, so as to improve the visiting efficiency of the website.
4. Developed website must have the rich course source. Resource sharing is the site of another important function. There is a fund of information in website, helping students to study independently (Lin et al. 2010).
5. There must be a good interactive platform. Because teachers work hour is not fixed, the students rarely meet to teachers except for lesson. So, teachers and the students must have a communication platform, which is called the message board.

131.3 Interactive Platform Design

131.3.1 Design Ideas

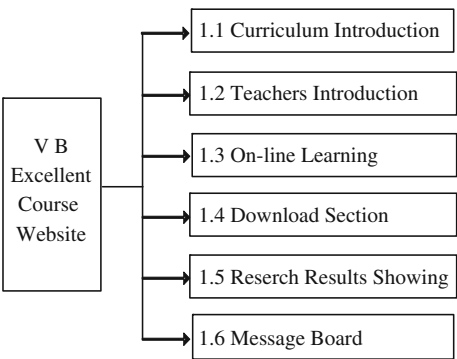
The mission of Excellent courses website development is to provide the most convenient and efficient service for teachers and students. Here teachers can deliver electronic materials, courseware, and exercises for students by internet. Students can leave their questions on the message board. Teachers answer timely student questions.

The entire website consist of static and dynamic webpage, static webpage will be used to complete general introductory content for this part of the contents won't often change, while dynamic ASP webpage is being used for those content often changed. Access 2003 is selected as the database for it is simple, easy to operate, small file, especially suitable for the website.

131.3.2 Function Structure for the Website

The structure of the website is shown in Fig. 131.1, including curriculum introduction, Teachers introduction, Online learning, download section, research results showing. Curriculum introduction mainly includes curriculum introduction, curriculum planning, curriculum outline and teaching material introduction. Teachers introduction mainly introduces teachers basic information of teaching VB courses, such as their age, professional title, learning experiences and achievements etc. Online learning can providing VB test, VB extracurricular examination, previous years examination questions and the answer for the students. The students can study online according to their own needs. Download section has provided teaching courseware, teaching video, activities video etc., which is suitable for those students didn't grasp at class. The research results showing mainly have showed the teachers achievements. An excellent course website must have an

Fig. 131.1 The total module of website



**Table 131.1** BBS

Filed name	Field types	Description of field
Id	Num	Taking message number
Name	Text	Name of taking message person
Sex	Text	Sex of taking message person
Email	Text	Email of taking message person
Homepage	Text	Homepage of taking message person
Content	Text	Content of taking message person
Ip	Text	Ip address of taking message person
Time	Date/time	Time of taking message person

online exchange places, this is a message board, where students can study and exchange on certain issue, also can ask questions to the teacher, the teacher reply regularly.

**131.3.3 The Design of Database**

A website will need a database to store some useful information, such as: user login verification, storing message content etc., because our website are static does not need database, so the database technology on the website is mainly used in the message board. There are have 5 tables, to save space, we list here only the theme table that is called BBS table.

They are 8 fields in the Table 131.1, they used to store user information and the message content. When message page is displayed, the corresponding content is displayed on the webpage, and the administrator can modify or delete the contents of the table, etc.

**131.4 System Implementation**

It is difficult to describe implementation of every module codes one by one. Now take a static webpage (from the Curriculum Introduction) and dynamic webpage (from the Message Board) for example to tell the implementation process.

**131.4.1 Implementation of the Curriculum Introduction**

Click on the curriculum message from the main menu in the front page, you will link to the curriculum introduction page. The module consists of three parts, respectively, at the top of the header portion, the left frame and the right frame. The left frame including the introduction of the courses, curriculum planning,

course outline and course materials. Click on the left menu, the corresponding contents are displayed in the right side of the main frame.

1. *The headline*: The headline is a flash, contains the photos of Qingdao University of Science and Technology (QUST), the name of QUST and VB excellent courses and so on.
2. *The left frame part*: The main theme of this part is the sub-menu, click on the sub-menu, the content is opening a web page in the side of the main frame and not the other one, this can give more help to the visitor when they open the browser and enhance the browsing effect, which is the framework technology. Bellow the sub-menu, we do a calendar which is convenient for students to view date and beautify the page.
3. *The right frame part*: This part is the theme of the entire page, all information is displayed in the right frame.
4. *The use of technology*: The main technology used in this website is the framework technology (Huang 2005). Different documents can be displayed in the same browser window. Different documents exchange is finished in the same widow by constructing documents linking. Generally speaking, framework technology mainly used two types of elements. One is frameset, the other is frame. Frameset is the collection of the framework and actually is a page, which is used to define the framework structure of multiple documents in a browser window. Frame is a document which organized and displayed in the framework set. Each frame is displayed in the framework, in fact, a frame is an independent HTML document. VB website composed of three frames, top, left and lower right. The top and the left is nested. The three frames constitute a frameset.

Part codes of the framework are as follows:

```
<frameset rows = "116,*" cols = "*" frameborder = "NO" border = "0"
framespacing = "0">
  <frame src = "123.htm" name = "topFrame" scrolling = "NO" noresize>
  <frameset
    rows = "*"cols = "255,*"
    frameborder = "NO" border = "0">
      <frame src = "12.htm" name = "leftFrame" scrolling = "NO" noresize>
      <frame src = "1.htm" name = "mainFrame">
    </frameset>
  </frameset>
```

Shown results in Fig 131.2.

### 131.4.2 The Implementation of the Message Board

This module has two sub-blocks: visitor message part and the administrator management part.



Fig. 131.2 Interface of curriculum introduction

1. *The implementation of visitor message:* The main function of this part is to realize visitor message and save the message to the database. First, the visitor login in the web page and register. In other word, the visitor fill in your name, sex, e-mail, home page, and you click the login button. Then you can also leave your message in the page and click the submit button. If you are not logged in, you will don't submit your message. A message function is achieved by using session variables in this page. We will pay the visitor a session variable when he is logged. The webpage will examine whether the session variable is empty when he want to leave his comments, if the variable is empty, then the visitor will turn to the login screen or the registration screen. If it is not empty, the visitor may get permission and leave his message.

1. The visitor sex, name and so on is realized by selection frame, there is sex code as follows:

```
<select name = "sex" >
<option value = "male" > male </option>
<option value = "female" > female </option>
</select>
```

2. Message content is realized by multiple textbox, the realization code as follows:

```
<textarea name = "content" cols = "30" rows = "4" STYLE = "back-
ground-color:transparent" >
</textarea>
```

Click the submit button, you will get the contents of the text. The contents of

the text will be inserted to the database.

Code as follows:

```
< %name = request.form("name")
sex = request.form("sex")
email = request.form("email")
homepage = request.form("homepage")
content = request.form("content")
ip = request.form("ip") %>
< %set savebbs = conn.execute("insert into bbs(name,sex,email,home-
page,content,ip)values("&name&","&sex&","&email&","&home-
page&","&content&","&ip&")") % > .
```

2. *Implementation of administrator management:* The administrator can show and retrieve all user messages by linking and query database technology. Here is the code that connect to the database.

```
< %Server.scriptTimeout = "10"
connstr = "DBQ = " + server.mappath("data/bbs.mdb") + ";Default-
Dir = ;DRIVER = {Microsoft Access Driver (*.mdb)}";
set conn = Server.CreateObject("ADODB.connection")
conn.open connstr % > .
```

After the message board is realized, the webpage is shown in Fig 131.3.



Fig. 131.3 Interface of message board

## 131.5 Conclusion

In this paper, A VB Excellent Course Website of Qingdao University of Science & Technology was designed and developed by integrating Dreamweaver2004, HTML, Asp and ADO technology. The Website interface is simple and clear. The interface gives a fresh, warm and comfortable feel. Access2003 is selected as the database because it is simple, easy operation, and file is very small, especially suited to the website.

This year, we have developed an online test system and embed this website. The website not only provided an exchange platform for teachers and students, but also provided a learning environment for the students.

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# Chapter 132

## VIKOR with Fuzzy TOPSIS Techniques to Investigate Nurses' Competency in Different Job Characteristics

Ying-chyi Chou, C. H. Lu and C. C. Sun

**Abstract** This study develops an integrated model to improve performance evaluation in the hospitals. In this paper we show the use of the Compromise Ranking Method, also known as the VIKOR method, in the performance evaluation of nurses' competency. The method is improved by introducing the fuzzy TOPSIS for assigning the weights of relative importance of attributes. The study thus presents a complete assessment model that helps managers to identify items for improvement, while simultaneously promoting cost and time efficiencies in nurses' competency.

**Keywords** Fuzzy set • Nurses' competency • TOPSIS • VIKOR

### 132.1 Introduction

Along with increasingly complex clinical nursing care requirements, comes an increasing demand for high-quality manpower (O'Connor et al. 2001). Many nursing skills need to be learnt on the job. The ability of hospitals to accurately

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assess and manage nurses depends on the correct adjustments to increase work loads, along with appropriate education and training programs. This will help to stabilize the phenomena of a high turnover rate, particularly among new staff nurses, who often leave temporarily or permanently due to frustration (DeYoung and Bliss 2002).

The problem of the complexity of performance evaluation makes the development and the application of standard models more difficult, while at the same time actually presents a motivation for the development of new, more flexible models, which, again, can be adapted to specific interest positions of those who compare the banks. The paper shows the VIKOR and fuzzy TOPSIS method is very appropriate for the development of such models. It is of special interest that this method provides the development of the multi-criteria evaluation models.

The development of clinical skills and competencies are given a central role throughout the college education of nurses. These skills include: nursing skills, knowledge, attitudes and performance ability (Calhoun et al. 2002). Due to the characteristics and working environments of different nursing units and cultures, the definitions of nursing skills vary. This adds to the complexity of developing a skills assessment performance tool (Calman et al. 2002). Especially in medical centers, as the severity and complexity of patients' conditions are more serious than those of patients at regional or district hospitals—training requirements for medical center capabilities are greater. In recent years the clinical skills of nurses are the standard used to measure medical care, hiring and performance evaluation.

Competence refers to an individual's overall ability. Competence includes technical skill in professional practice, as well as attributes such as: attitude, values, judgmental ability and personal disposition. Competency is a measure of an individual's particular skill or specialization (Chester 2003). Differentiation between the terms competence and competency are not clearly understood and are often used interchangeably in literature (Scott-Tilley 2008). Nursing ability is assessed mainly based on their clinical performance, whilst nurses' non-technical attributes are overlooked. This results in complaints from patients and their families. Therefore a complete nursing assessment needs to be implemented, which includes: relevant clinical skills, knowledge, attitude and all factors that measure a nurse's overall competency (Cowan et al. 2005).

In many countries nursing students and new staff nurses receive senior RN training and instruction (McCoy et al. 2011). This skills assessment does not provide a comprehensive evaluation strategy, as it neglects the feedback of students in the process. This results in disparities between the skills nurses learn and their on the job performance (McCarthy and Murphy 2008).

## 132.2 Methodology

### 132.2.1 Participants

The primary participants in this study were emergency department (ED) paramedics in hospitals because their jobs are fairly difficult and require a higher level of immediate reaction and more proficient skills than nursing personnel in other departments. We used the simple random sampling method to select survey candidates and distributed questionnaires to ED paramedics in three age groups: 22–29 years old, 30–39 years old, and 40 years old and above.

### 132.2.2 Questionnaire Design

The questionnaire was developed based on the KSAO model proposed by Catano (1998). The primary objective of this questionnaire is to understand the competency of each paramedic. The questionnaire used the 5-point Likert scale to assess the competency characteristics of paramedics. Survey participants provided ratings according to their degree of agreement with each question item. Ratings were as follows: 1 point for *strongly disagree*, 2 points for *disagree*, 3 points for *neutral*, 4 points for *agree*, and 5 points for *strongly agree* (see Table 132.1).

### 132.2.3 Fuzzy TOPSIS and VIKOR Methods

The VIKOR method was developed for multi-criteria optimization of complex systems. It is an effective technique for multi-criteria analysis and has been widely applied in compromise ranking problems in business management. There are also many researches adopt the VIKOR model to investigate the complex managerial problems. Sayadi et al. (2009) extended the VIKOR method for decision making problems with interval number. Büyüközkan and Ruan (2008) applied VIKOR method to evaluate of software development projects. Chu et al. (2007) to demonstrate the anticipated achievements of knowledge communities (KC) through simple average weight (SAW), “Technique for Order Preference by Similarity to an Ideal Solution” and “VlseKriterijumska Optimizacija I Kompromisno Resenje” (VIKOR). Opricovic and Tzeng (2004) compared with four multicriteria decision making methods: TOPSIS, PROMETHEE, ELECTRE, and VIKOR and find out the best method evaluation method is VIKOR. Tzeng et al. (2005) applied TOPSIS and VIKOR to determine the best compromise alternative fuel mode. Opricovic and Tzeng (2004) tried to reveal and to compare the procedural basis of these two MCDM methods, TOPSIS and VIKOR.

**Table 132.1** Definition of job competency assessment criteria for paramedics

General goal	First level assessment criteria	Second level assessment criteria	Definition of assessment criteria
Job competency of paramedics	Knowledge (K)	Education level	Graduate of domestic and international nursing school
	Skill (S)	Work experience	Actual years of experience in nursing practices
		Professional skills	Accuracy, integrity, and consistency of nursing practices
		Independent skills	Completes nursing jobs independently
	Ability (A)	Interpersonal skills	Interacts well with other people or in groups
		Communication ability	Effective communication with people or groups
		Innovative ability	Improves nursing procedures or rules to enhance work efficiency
	Other Characteristics (O)	Teamwork and corporate spirit	Cooperates with others to complete tasks
		Agreeable	Easygoing and empathizes with others
		Diligent and forthright	Able to complete the tasks delegated or assigned by others
		Outgoing	Has confidence and negotiation abilities
		Emotionally sensitive	Demonstrates perceptive reactions
		Open minded	Creative and optimistic

132.3 Results

132.3.1 Determine the Linguistic Weighting of Each Criteria

We adopt Fuzzy TOPSIS method to evaluate the weights of different criteria. Following the construction of Fuzzy TOPSIS model, it is extremely important that experts fill the judgment matrix. From the viewpoint of expert validity, the buildup of most of the operationalizations was based on the literature that caused them to have expert validity.

132.3.2 Weighting Each Criterion by VIKOR

Table 132.2 shows the relative weight of 12 factor of the competitive advantage for hospital, which obtained by Fuzzy TOPSIS method. The weights for each criterion are:  $C_1$  (0.677),  $C_2$  (0.833),  $C_3$  (0.833),  $C_4$  (0.730),  $C_5$  (0.670),  $C_6$  (0.687),  $C_7$  (0.573),  $C_8$  (0.713),  $C_9$  (0.733),  $C_{10}$  (0.557),  $C_{11}$  (0.497) and  $C_{12}$  (0.577). From the Fuzzy TOPSIS results, we can understand the first two important factors for the competitive advantage of shopping websites are  $C_2$  (0.833) and  $C_3$  (0.833). Moreover, the less important factor is  $C_{11}$  (0.497) (Table 132.3).

132.3.3 Estimating the Best Performance Model

We evaluate six hospitals' performance with the consensus weights of criteria identified before, and find out each hospital's performance (Table 132.4) and normalized the results (Table 132.5).

The value of  $S_k$  and  $Q_k$  are shown as Table 132.5. In this case, we set up the values  $S^*$  and  $Q^*$  as 0, the values  $S^-$  and  $Q^-$  as 1, so as to obtain the absolute relations for the index values  $R_k$  (Table 132.6).

In order to understand how the  $R_k$  of each objective is affected by  $V(0 \leq V \leq 1)$ , this study respectively adopts  $v = 0$ ,  $v = 0.5$ ,  $v = 1$  to compare

**Table 132.2** Linguistic scales for the importance of each criterion

Linguistic variable	Corresponding triangular fuzzy number
Very low (VL)	(0.0, 0.1, 0.3)
Low (L)	(0.1, 0.3, 0.5)
Medium (M)	(0.3, 0.5, 0.7)
High (H)	(0.5, 0.7, 0.9)
Very High (VH)	(0.7, 0.9, 1.0)

**Table 132.3** Weights of each criterion

		BNP	Ranking
C <sub>1</sub>	(0.48, 0.68, 0.87)	0.677	7
C <sub>2</sub>	(0.66, 0.86, 0.98)	0.833	1
C <sub>3</sub>	(0.66, 0.86, 0.98)	0.833	1
C <sub>4</sub>	(0.54, 0.74, 0.91)	0.730	4
C <sub>5</sub>	(0.48, 0.68, 0.85)	0.670	8
C <sub>6</sub>	(0.50, 0.70, 0.86)	0.687	6
C <sub>7</sub>	(0.38, 0.58, 0.76)	0.573	10
C <sub>8</sub>	(0.52, 0.72, 0.90)	0.713	5
C <sub>9</sub>	(0.54, 0.74, 0.92)	0.733	3
C <sub>10</sub>	(0.36, 0.56, 0.75)	0.557	11
C <sub>11</sub>	(0.30, 0.50, 0.69)	0.497	12
C <sub>12</sub>	(0.38, 0.58, 0.77)	0.577	9

**Table 132.4** The gap-values of six hospitals

		Criteria											
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Alternatives	A1	4.3	4.2	4.3	4	3.7	4.1	3.6	4.2	3.8	3.6	3.2	3.6
	A2	3.4	3.6	3.8	3.6	4	3.9	3.5	3.8	3.5	3.5	3.4	3
	A3	4.1	3.8	4.1	3.8	3.9	3.9	3.8	3.9	3.3	3.5	3.2	3.3
	A4	3	3.3	3.4	3.1	3.5	3.6	3.5	3.2	3.5	3.3	3.1	3.1
	A5	2.8	3.3	3.4	3.2	3.4	3.4	3.2	3.7	3.5	3.1	3	2.9
	A6	3.1	3.4	3.2	3.6	3.1	3.3	3.1	3.6	2.8	3.1	2.8	2.9

these index values  $R_k$  for the control objectives before and after implementation and presents them in Table 132.5

$$R_k = \frac{v(S_k - S^*)}{S^- - S^*} + \frac{(1 - v)(Q_k - Q^*)}{Q^- - Q^*}$$

(132.1)

132.4 Discussion

As mentioned earlier a combination of capabilities such as, technical skill, knowledge, attitude, level of work quality, efficiency and work performance are all influential. Assessment of nursing skills and on the job performance, are very important. Through accurate appraisal, nursing executives can develop training programs to improve patient safety and care. More complex duties such as advanced nursing (Advance Practice Nursing APN), anesthesia nursing, in patient care assessment and communication; counseling, research, ethical decision-making

Table 132.5 Normalized gap-values of six hospitals

Alternatives	Criteria											
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>	C <sub>7</sub>	C <sub>8</sub>	C <sub>9</sub>	C <sub>10</sub>	C <sub>11</sub>	C <sub>12</sub>
A <sub>1</sub>	18.49	17.64	18.49	16.00	13.69	16.81	12.96	17.64	14.44	12.96	10.24	12.96
A <sub>2</sub>	11.56	12.96	14.44	12.96	16.00	15.21	12.25	14.44	12.25	12.25	11.56	9.00
A <sub>3</sub>	16.81	14.44	16.81	14.44	15.21	15.21	14.44	15.21	10.89	12.25	10.24	10.89
A <sub>4</sub>	9.00	10.89	11.56	9.61	12.25	12.96	12.25	10.24	12.25	10.89	9.61	9.61
A <sub>5</sub>	7.84	10.89	11.56	10.24	11.56	11.56	10.24	13.69	12.25	9.61	9.00	8.41
A <sub>6</sub>	9.61	11.56	10.24	12.96	9.61	10.89	9.61	12.96	7.84	9.61	7.84	8.41

**Table 132.6** Comparison of value  $R_k$  of six hospitals according to ( $v = 0$ ), ( $v = 0.5$ ), ( $v = 1$ )

		Average gap-values $S_k$ ( $V = 1$ )	Compromise gap-values ( $S_k + Q_k$ )/2 ( $V = 0.5$ )	Max gap-values $Q_k$ ( $V = 0$ )
Alternatives	$A_1$	0.000 (6)	0.000 (6)	0.0000 (6)
	$A_2$	0.940 (4)	0.470 (4)	0.0000 (4)
	$A_3$	0.419 (5)	0.209 (5)	0.0000 (5)
	$A_4$	1.799 (3)	0.900 (3)	0.0000 (3)
	$A_5$	1.900 (2)	0.950 (2)	0.0000 (2)
	$A_6$	2.000 (1)	1.000 (1)	0.0000 (1)

and leadership are also performance assessment factors (Hamric et al. 2005 and Macdonald et al. 2006).

In our analysis, nursing supervisors consider past experience, professional skill, patient first value, plus the ability to work both independently and as a team member the most important factors. Skills such as reading biochemical test results for specific patients and other medical information, using evidence-based medicine, PubMed and other databases of secondary data, enable nurses to provide a specialized care plan for patients, ensuring proper use of equipment with technical medical equipment to monitor changes in a patient's condition and ensure accurate records are kept. Professional standards which are continuously upgraded and updated, along with the upgrading of standard care will enable nursing staff to deal with families of patients and patient consultation. This will provide a more positive, rather than defensive response when they answer patients' questions (Kimmel and Wolfe 2005 and Schmitt, et al 2007).

Team spirit and a strong patient first value have a remarkable positive effect on the psychological, social and physical needs of patients, as part of a multidisciplinary approach to planning and delivery of care—which is the most important factor of nursing performance (Fitzpatrick et al. 1997). Nurses are the front line of hospital care providing patients with information and care, and can improve the efficiency of professional care programs. Nurses interact with other nurses and doctors, so a comprehensive integrated service can be provided. Therefore interpersonal communication skills and clinical care have a significant correlation (Clercq et al. 2011).

## 132.5 Conclusion

The performance evaluation of nurses' competency for hospitals must be addressed in a multi-criteria context. In this paper, we have shown how the VIKOR method, which introduces the multi-criteria ranking index based on the particular measure of "closeness" to the "ideal" solution, can be used in the performance evaluation system. The VIKOR model allows decision-makers to understand the gaps between

alternatives and aspired-levels in practice. It provides the most satisfactory decision by achieving the aspired levels of the membership goals to the extent possible in the decision environment. We then applied the modified VIKOR method to establish the gaps in priorities between alternatives and aspired-levels. Finally, based on these gaps in priorities, we provide managerial implications to improve different carriers for satisfying the customers' needs to achieve the aspired-level. Combining the VIKOR method with fuzzy TOPSIS for weighting the importance of the different criteria, allows the decision-maker to systematically assign the values of relative importance to the attributes based on their preferences.

In summary, the Fuzzy-Decision making approach was used to re-evaluate the performance of various functions related to nursing performance. The three key factors for nursing performance are: Professional ability, patient first value and teamwork. It is necessary for managers and nursing staff to create a positive learning atmosphere in the work environment. This enables nursing staff to forward and share clinical techniques, process-related knowledge and nursing skill, which will significantly improve the performance of nursing and patient care quality.

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# Chapter 133

## Health Promotion Activities for Professional and Technical Workers in the Beauty Service Industry: Beauty Franchise Stores in Taipei as Case Study

Hsiu-chuan Chiu and Chien-pei Ko

**Abstract** This study used literature review and questionnaire survey to summarize domestic and foreign ideals in workplace health promotion and healthy workplace promotional strategies. By exploring the views of professional and technical workers in the beauty service industry in Taipei area toward workplace health promotional activities, this study aimed to understand beauty service industry workplace health promotion ideals and its promotional strategies. Based on the results, suggestions were proposed as reference for beauty service companies in the development of workplace health promotion plans for employees. A questionnaire survey was conducted, and 230 questionnaires were sent to human resources directors of 4 beauty service companies by mail. A total of 116 valid samples were retrieved, for a valid return rate of 50.4 %. The data were analyzed using statistical methods of frequency percentage, mean values, and Chi square test of homogeneity. The results showed that most respondents believe that workplace health promotion ideals should provide a safe and healthy work environment, and promote healthy and preventative capabilities. The top three activities of interest for a healthy workplace are regular health check-ups, alternative treatments, and sponsored leisure activities, as well as obtaining information on health. Respondents showed significant differences in the levels of interest toward workplace health promotion ideals and health promotion strategies, and in preferences for methods in obtaining information on health and views regarding health promotion activities.

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**Keywords** Beauty service industry • Health promotion • Professional and technical workers

### 133.1 Introduction

In the “Principles and Regulations on Transparency in Weight-loss and Beauty Industry Consumption Information and Treatment of Inappropriate Marketing Cases,” the Fair Trade Commission defined the beauty service industry as non-medical actions as composite guidance and measures to maintain and improve the appearance of the body and aesthetics through the usage of hands, machinery, tools, materials, cosmetics, and foods. According to the Standard Industrial Classification of Taiwan (2011), as compiled by the Directorate-General of Budget, Accounting, and Statistics, Executive Yuan, the category of “other services” in the service industry divides the body sculpting services that do not involve medical procedures into a sub-category under “cosmetics and beautification industry,” including cosmetics, skin care, make-up, nail art, and body sculpture (Kerr and Sloan 1987).

This shows that the beauty service industry is an industry of facial and physical beauty. In terms of the definition of the beauty service industry, the occupation categories, include beautician, body sculptor, cosmetics consultant, beauty treatment technician, and others, according to the corresponding occupational codes and work descriptions specified by the Bureau of Employment and Vocational Training (Dessler 1997). According to 104 job bank, with the coming of the knowledge-based economy, many “blue collar” jobs in the traditional understanding have gradually transformed into knowledge-based technical jobs, or so-called “gray collar” jobs. These jobs integrate personal techniques and knowledge to provide clients with more professional services; this trend is most clear in the development of “industries relating to cosmetics” (The Standard Industrial Classification of Taiwan 2011). The industrial character of beauty and hair styling involves long labor hours and major physical demands. Their roles in the work environment are overloaded, as the work style requires team cooperation, thus, they take on multiple jobs and work overtime to accommodate the company’s operation. Therefore, people in this industry require sufficient endurance and physical ability, as well as stress-resistance to face long work hours and business stress (Sue-Ling 2006; Chan and Lin 2004). In the perspective of human resources management, health promotion can be seen as a part of corporate welfare, and corporate welfare is regarded a way to subsidize salaries. Corporate welfare systems tend to influence the flow, morale, and organizational performance of employees (Deutz et al. 2005). Thus, from the perspective of employee welfare, using suitable health promotion strategies to lessen the physical and psychological

burdens on beauty service industry professional and technical workers, it has become an important issue for the HR professionals to develop employee health projects to improve their endurance, physical ability, and stress-resistance in order to reduce turnover (Harvery 2000).

Workplace strategic development plan can be considered from five aspects: (1) promote the work organization and environment; (2) establish comprehensive workplace health policies; (3) encourage employees to participate in health promotion; (4) enhance healthy lifestyles of employees, and provide the requisite health capabilities; (5) ensure that health promotion and preventative measures can be integrated into corporate management (Wilson et al. 1999; World Health Organization Regional Office for the Eastern Mediterranean 2000).

Some expert suggested that the main strategies of workplace health promotion implementation include: (1) information and education: the organization can provide employees with effective education information regarding health and behavior, which can take the forms of courses, booklets sent with salary payments, company communications, public notices, and monthly reports (WHO Regional Guidelines for Development of Health Promoting Workplaces 1999; Murayama et al. 2012); (2) information and opportunities: organizations can provide employees with structured opportunities for changing their health behaviors; compared to the unemployed, employees would have more convenient locations and capital input for disease screening and sports (Van Dongen and Proper 2011; Coleman 2010). Workplace health promotion strategies are important, can affect the overall welfare of organizations, and exist in different levels of the organization, including organization and personal areas, which would be conducted through information provision education or opportunities (Williams and Day 2011; Nigg et al. 2010).

## 133.2 Methodology

This study conducted a questionnaire survey, using the “Workplace health promotion questionnaire for professional and technical workers in the beauty service industry”. The subjects were professional and technical workers in beauty service companies in the greater Taipei area. The questionnaire is divided into workplace health promotion ideals and strategies; each item contains five levels, which are divided into two groups, the low interest group and the high interest group, detailed as follows: (1) high and low interest groups: the low interest group is not interested, somewhat interested, or neutral; the high interest group is interested or very interested; (2) high and low conformity groups: the low conformity group does not conform, somewhat does not conform, and somewhat conforms; the high conformity group conforms or highly conforms. Regarding the statistical methods, average means are used to understand the average level for items, and frequency

percentage is used to understand the low interest and high interest group conditions for the items. Chi square test of homogeneity is used to analyze the differences between the views of the low interest group and high interest group in subjects from different beauty service companies.

## **133.3 Results**

### ***133.3.1 Degree of Interest in Workplace Health Promotion Activity Strategies***

#### **1. Degree of interest in methods to improve workplace health**

Overall, the methods that interested the subjects regarding improving workplace health are, in sequence, providing regular health check-ups, alternative treatments, sponsor leisure activities, pressure management courses, nutrition education, training in socializing ability, and leadership training. Based on the 5-point scale, the mean values are all above 4.0.

#### **2. Acquired degree of interest in methods of obtaining information on health**

Overall, the methods that interested the subjects regarding obtaining information on health as a health promotion strategy are, in sequence, expert speeches, health information e-mails, e-doctor, and company health website. The mean values are all above 4.0.

#### **3. Degree of interest in participating in health promotion activities**

Overall, subjects are interested in participating in health promotion activities, in sequence, are sharing information on health with family members, reading communications relating to health or physical ability, obtaining instructional materials on health, assisting or planning company health promotion activities, assist or plan health promotion activities sponsored by the companies. The mean values are all above 4.0.

### ***133.3.2 Views Regarding Company Workplace Health Promotion Ideals***

Overall, subject views regarding workplace health promotion ideals at the companies they work for is that the companies conform to workplace health promotion ideals, provide a safe and healthy work environment, and promote healthy and preventative capabilities. The mean values are all above 4.0.

**Table 133.1** Levels of interest and preference for methods for obtaining information on health

Group	Companies							
	A		B		C		D	
	N	%	N	%	N	%	N	%
<i>e Doctor<sup>a</sup></i>								
Low interest	11	39.3	10	23.3	13	72.2	6	22.2
High interest	17	60.7	33	76.7	5	27.8	21	77.8
Total	28	100.0	43	100.0	18	100.0	27	100.0
<i>Using e-mail to receive information on health<sup>b</sup></i>								
Low interest	10	35.7	6	14.0	14	77.8	5	18.5
High interest	18	64.3	37	86.0	4	22.2	22	81.5
Total	28	100.0	43	100.0	18	100.0	27	100.0

<sup>a</sup>  $\chi^2 = 15.829$ ; df = 3;  $p < 0.05$  \* (Cramer's  $V = 0.369$ )

<sup>b</sup>  $\chi^2 = 26.879$ ; df = 3;  $p < 0.05$  \* (Cramer's  $V = 0.481$ )

### 133.3.3 Workplace Health Promotion Strategies for Subjects from Different Companies

#### 1. Degree of interest in methods to improve workplace health

Subjects from different companies show different ratios of high interest toward methods to improve workplace health, as shown by Chi square testing of homogeneity ( $p < 0.05$ ). These include providing physical ability courses, weight control activities, pressure management courses, training in socializing ability, leadership training, cardiovascular health education, and emergency aid training classes (Table 133.1). Company A's subjects have a far higher interest ratio in inviting family members to participate in healthy activities sponsored by the company, as compared to those in other companies.

#### 2. Interest in methods for obtaining information on health

According to the Chi square test of homogeneity, subjects from different companies have different levels of interest and preference on methods for obtaining information on health; subjects differ in their interest toward e-doctor (professionals answering emails) and using e-mail to receive information on health ( $p < 0.05$ ). Among the respondents in Company C, more than 70 % have low interest, which greatly differed from the respondents of other companies.

#### 3. Interest in participating in health promotion activities

According to the Chi square testing of homogeneity, subjects from different companies have different levels of interest toward health promotion methods. Subjects differ in high interest ratios regarding personal health activities that are challenging or provide rewards, participating in challenging or rewarding group health activities, inviting family members to participate in healthy activities

**Table 133.2** Interest in participating in health promotion activities—chi-square test

Group	Companies							
	A		B		C		D	
	N	%	N	%	N	%	N	%
Inviting family members to participate in healthy activities sponsored by the company								
Low interest	6	21.4	28	65.1	12	66.7	15	55.6
High interest	22	78.6	15	34.9	6	33.3	12	44.4
Total	28	100.0	43	100.0	18	100.0	27	100.0

$\chi^2=8.602$ ;  $df = 3$ ;  $p < 0.05$  \* (Cramer's  $V = 0.361$ )

sponsored by the company, and assisting or planning health promotion activities sponsored by the company ( $p < 0.05$ ) (Table 133.2).

### ***133.3.4 Views of Subjects from Different Companies Toward Workplace Health Promotion Ideals***

According to the Chi square test of homogeneity, subjects from different companies have different levels of agreement regarding their company's provision of workplace health promotion plans ability to lead to actual benefit and conforms to health promotion ideals by improving health ( $p < 0.05$ ). Respondents in Company D reveal a high conformity, as compared to other companies (Table 133.3).

## **133.4 Discussion**

### ***133.4.1 Degree of Interest in Workplace Health Promotion Activity Strategies***

Overall, subjects are interested in methods to improve workplace health, such as regular health check-ups, alternative treatments, sponsor leisure activities, and

**Table 133.3** Different companies toward workplace health promotion ideals- chi-square test

Group	Companies							
	A		B		C		D	
	N	%	N	%	N	%	N	%
Workplace health promotion plans can lead to actual benefit and conforms to health promotion ideals								
Low conformity	6	21.4	6	14.0	4	22.2	13	48.1
High conformity	22	78.6	37	86.0	14	77.8	14	51.9
Total	28	100.0	43	100.0	18	100.0	27	100.0

$\chi^2 = 10.779$ ;  $df = 3$ ;  $p < 0.05$  \* (Cramer's  $V = 0.305$ )

stress management. Workplace health promotion strategies include information on health and participation in health promotion activities, and obtaining information from expert speeches, health information e-mails, e-doctor, health websites of the companies, whether subjects like to share information on health with family members, and reading communications regarding health and physical abilities. The surveyed beauty service industry seeks health and beauty, thus, they would use industrial treatment procedures to help themselves, and can use information on health to gain professional knowledge, further sharing it with their family.

#### ***133.4.2 Views Regarding Company Workplace Health Promotion Ideals***

Overall, subjects believe that their companies conform to the workplace health promotion ideals of providing a safe and healthy work environment, as well as promoting healthy and preventative techniques. Since the beauticians at these companies tend to have know-how and techniques relating to cosmetics and health promotion, they place more emphasis on having a healthy workplace and hope to learn preventative techniques that promote health.

#### ***133.4.3 Views Regarding Workplace Health Promotion of Subjects in Different Companies***

Subjects of the various companies differed in their high interest ratios regarding improved workplace health methods, such as providing physical ability courses, weight control activities, pressure management courses, training in socializing ability, leadership training, cardiovascular health education, and emergency first aid training. Due to the different resources and focal points of work needs in the various companies, there are different preferences in health promotion courses. Respondents in Company D may have a lower ratio of high interest people due to workplace health promotion experience regarding the view that these plans would benefit their personal health.

### **133.5 Conclusion**

1. Regular health check-ups, alternative treatments, sponsor leisure activities, and stress management are preferred courses for professional and technical workers in the beauty service industry. Workplace health promotion strategies, in terms of information acquisition, are expert speeches, health information e-mails,

- e-doctor, and company health website, enjoyment of sharing information on health with family members, and reading communications regarding health or physical ability.
2. Professional and technical workers in the beauty service industry believe that ideals conforming to workplace health promotion provide safe and healthy work environments and promote healthy and preventative techniques.
  3. Professional and technical workers in the beauty service industry differ in their ratios of high interest regarding physical ability courses, weight control activities, pressure management courses, training in socializing ability, leadership training, cardiovascular health education, and emergency first aid training. Due to the different resources and focal points of work needs, they have differing preferences for health promotion courses.

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# Chapter 134

## The Construction and Evaluation of Consistency Between Compensation Management and Strategy

Gang Du, You-min Gao, Xiao-diao Wu and Jing Sun

**Abstract** As an important function of human resources management, strategic compensation management plays a significant role in motivation and constraint. How compensation management be consistent with operation strategy of enterprises, and whether compensation management can support execution of enterprise management strategy effectively have become research hotspots to many enterprises and scholars. To impel further development of theory in this field, research and evaluation of consistency between compensation management and enterprise strategy should be strengthen. Therefore, this paper constructs a consistency model of compensation management and enterprise strategy. Based on this model, an evaluation model about consistency between compensation management and enterprise strategy is also built. At last, a practical example is shown to explain the evaluation methods.

**Keywords** Consistency · Evaluation · Measurement · Strategic compensation management

### 134.1 Introduction

With the growing of economic globalization and the increasing competition of world market, the environments enterprises facing with are changing all the time. The working nature and working environments become more and more complicated. As an important role of motivation and constraint, compensation management and system stays no longer at operation, technology and rules, but becomes an important HRM method to assist the execution of enterprises' strategy

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effectively. It has been brought into the enterprises strategy frame and becomes a significant tool ensuring the implement of enterprises strategy. More and more scholars and consulting companies started to pay attention to the researches of consistency between enterprise strategy and compensation strategy. They also start at contingency research of how to adjust compensation management and design with the changing of compensation strategy. Meanwhile, many enterprises had also started to applicant the strategy-oriented integrative compensation project, which combined compensation system and operation strategy of expending business unit. It made the compensation strategy and management design can assist HRM strategy effectively, so that enterprise strategy and business operation strategy can be put into effect.

Strategic compensation management comes into being because of these opportunities. The focus of this theory is the consistency between enterprises' operation strategy and compensation strategy. To solve this problem, scholars at home and abroad have two different research ideas and systems. First one is the "contingency" or "consistency" which emphasizes that enterprise strategy decides compensation strategy and compensation strategy must adapt to enterprise strategy. Second one is the "universal perspectives" or the "best practice" which emphasizes compensation strategy decides enterprise strategy. Compensation strategy influenced by environment will decide enterprise strategy through mediating variables. The theory is based on the resource-based theory.

1. About strategic compensation management based on "contingency" or "compatibility", Gomez Mejia (1990, 1987) brought "consistency" into strategic compensation management early. He thought that the theory of compensation strategy is a contingency theory which means compensation strategy should change with environment, especially the enterprise strategy. While Montemayor (1996) thought that enterprises should design compensation system according to enterprise strategy. Andrew (2001) thought that with the fiercer competition between enterprises and the endless emergence of enterprise restructuring, merging and acquisition, compensation strategy should adapt to the changing of environments. Lewn and Mitchell pointed out that the match of compensation strategy and enterprise strategy can help organizations make use of market opportunities, expand organization advantages in enterprises and realize strategic targets (Milkovich 1988). Yueran Wen, Lingyun Wang, Hong Liu and many other scholars in China had started to study the consistency between compensation strategy and enterprise strategy. Among the scholars holding "matching" view, they made agreement that enterprise compensation reformation should consider design factors of compensation system based on enterprise development strategy and guide enterprise compensation decisions. Only by putting compensation reformation and management into strategic level, can HRM be really effective (Balkin and Gomez Mejia 1987; Ehrenberg and Milkovich 2000; Snell 2001).
2. "Universal perspectives" have been supported by some researchers. They thought that compensation strategy determines enterprise strategy (Atkinson

1998, Balkin 1988). The best practice exists with nothing to do with the environment. The perspective presupposes that adopting the best practice will be beneficial to introducing talents, who will in turn contribute to the strategic decisions in organizations as well as strengthen its competitive advantage. The concept of “best practice” is a worthwhile effort for compensation strategy determining enterprise strategy is a new research approach different from contingency (Micelle and Heneman 2000; Offstein et al. 2005). However, their perspectives also caused much controversy. Human resources management (HRM) practices focused on compensation are superior to other HRM practices. The best practice is suitable for all organizations and has nothing to do with the environment. Much work remains to be done if we want to examine these views.

In previous work, study of consistency between compensation management and enterprise strategy management only focused on exposition or description. Some researches only analyze the individual cases so the results can't be extended to a large scale, which will result in the lack of external validity. Empirical researches on consistency between compensation management and enterprise strategy are not enough.

With all these considerations, this essay proposes the construction for consistency between strategy and compensation management. It further proposes factors to evaluate the consistency between strategy and compensation management. We aim to help provide a direction for the control of strategic compensation management system to make up for the blank in this area.

## **134.2 Construction of Consistency Model of Strategic Compensation Management**

The concept of consistency has been an important issue in organization and strategy study (Ritz 2008; Du and Wu 2003). Nadler defines consistency as a degree that the needs, goals and structures of one component consistent with other components. Michael Porter points out that the essence of strategy is creating consistency of various enterprise activities. In organization management, consistency is the degree of the needs, goals, missions and structures of one part of the organization agree with those of other parts. The premise is better consistency produces more effective management.

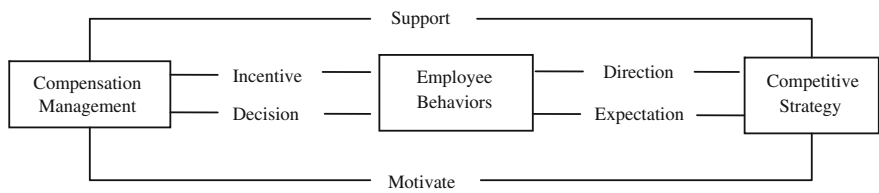
Based on previous study and dynamics of strategic compensation management, this essay defines the consistency between strategy and compensation management as properties of strategic compensation management system that can adjust system goals and structure according to the needs of organization strategy and environmental change so that compensation management can be an important component of enterprise competing advantages.

**134.2.1 Interaction Mechanism Between Enterprise Strategy and Compensation Management**

Compensation is an important method to motivate employees as well as one of the most direct and effective ways. By establishing effective compensation system, enterprises can not only use labor efficiently to keep cost advantage but also promote the combination of labor and the means of production. It can also create economic benefits and produce competition advantages. Enterprise develops compensation strategy under competitive strategy and constructs efficient compensation system to guide employees' behaviors so that expectations of enterprise can be achieved. Appropriate behaviors of employees make employees' individual goals consistent with enterprise's goal, so that the enterprise competition strategy can be achieved ultimately. Figure 134.1 illustrates the relationship between employee behaviors, compensation management and competitive strategy.

**134.2.2 Consistency Between Strategy and Compensation Management**

For the purpose of the best result of strategic compensation management, enterprise need to find out consistent points of strategy management and compensation management, that is, divide and search for consistency units. Consistency units are located in several levels (such as strategy level, tactic level and operation level) and several objects (such as consistency with environment, consistency with management objects and subjects) of enterprise. From the vertical aspect, strategic compensation management can influence on and produce consistency with different levels of the enterprise. From the horizontal aspect, strategic compensation management system contributes to the achievement of enterprise strategic goal as a strategy supporting subsystem. At the same time, it cooperates with other strategy supporting system in order to realize enterprise strategy. The consistency between strategy and compensation management follows the order from down to up, from inside to outside. Figure 134.2 illustrates the consistency model



**Fig. 134.1** A relationship map of employees' behaviors, compensation management and competition strategy

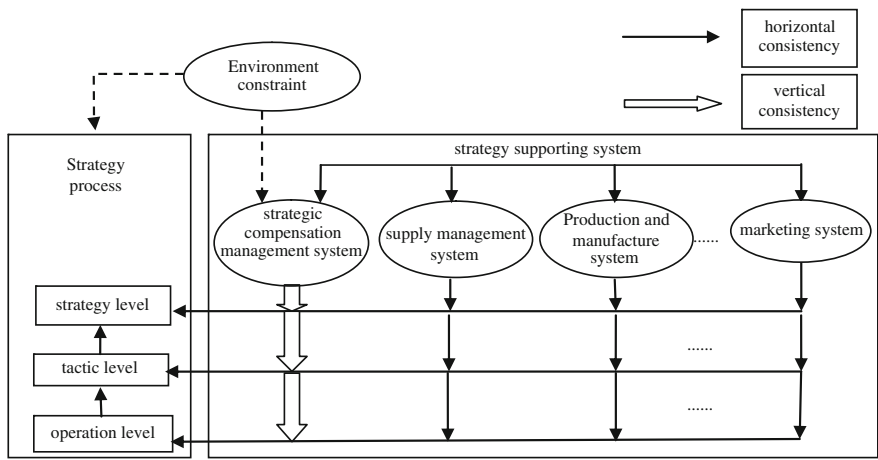


Fig. 134.2 Consistency model of strategic human resources management

This essay considers consistency of strategic compensation management system and enterprise strategy system as vertical consistency, that of strategic compensation management system and other strategy supporting subsystems as horizontal consistency. Horizontal and vertical consistency two constitute the key dimensions of consistency between strategy and compensation management. In this essay, vertical and horizontal consistency will be divided further on basis of functions of strategic compensation management and the principles of enterprise strategy, as is shown in Fig. 134.3. Researches on vertical consistency follow a time sequence. More details remain to be determined in aspect of strategy making, the transformation from goals of enterprise strategy to the goals of strategic compensation management, the compensation management mode consistent with enterprise strategy, and the approach of compensation management appropriate to the organization needs. Horizontal consistency needs to settle such matters from low level to high level as, the consistency of the practices of compensation management, the accommodation between compensation management system and the employees of strategy supporting subsystem, the support that the strategy supporting team and the cross-functioning team get from compensation management system, and the coordinated management of compensation management and strategy supporting.

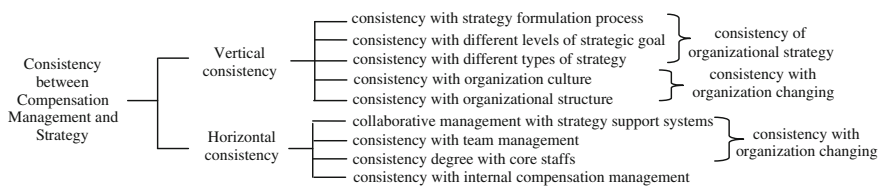


Fig. 134.3 Consistency of strategic compensation management

The realization of consistency between compensation management and strategy follows the order of top to bottom, within to outside. Vertical consistency is the guiding one with greater impact on overall strategic compensation management achievements and value creation. Horizontal consistency refers to collaboration in strategy support systems. As is shown in Fig. 134.2, horizontal consistency and vertical consistency are inextricably linked and horizontal consistency of strategic compensation management throughout the entire process of its vertical consistency, while the coordination process of vertical consistency must take horizontal consistency into account. In short, vertical consistency is the main line of strategic compensation management, and horizontal consistency contents are also considered comprehensively. The perfect combination between horizontal consistency and vertical consistency promotes the production of corresponding effect and the maximum effectiveness of strategic compensation management.

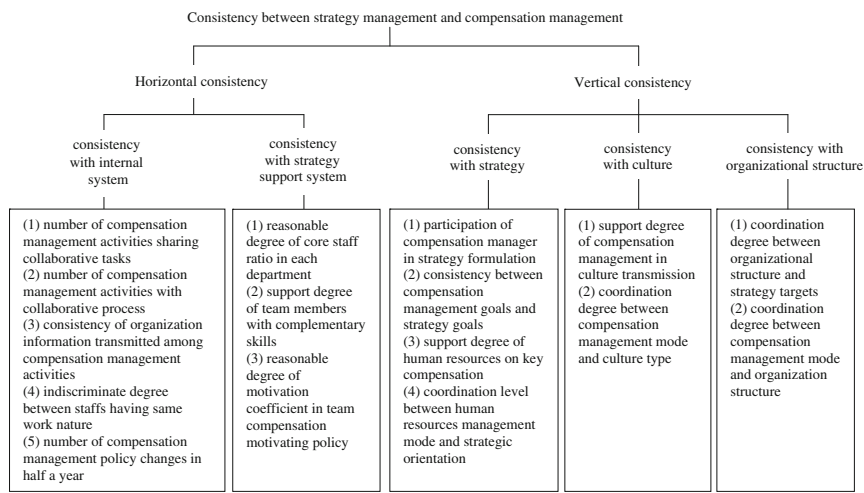
### **134.3 Establishment of Evaluation Model on Consistency Between Compensation Management and Strategy**

#### ***134.3.1 Determine Indicator System***

According to above analysis, strategic compensation management can be divided into two dimensions: horizontal consistency and vertical consistency. Through further excavation, vertical consistency includes consistency with strategy, consistency with culture and consistency with organizational structure; horizontal consistency includes consistency with internal system and consistency with strategy support system. Taking science system, effectiveness, qualitative and quantitative analyzed comparability and operability into consideration, this essay further analyzes consistency indicators of strategic compensation management to measurable level. Ultimately, evaluation indicator system on strategic compensation management correspond degree can be built as Fig. 134.4.

#### ***134.3.2 Determine Indicator Weight***

Both qualitative indicators and quantitative indicators are involved in the indicator system, and qualitative indicators are more than quantitative indicators, so the indicator value can be mainly determined by the way of experts scoring, which can be also called as the Delphi method. Through processing, indicators can be designed as questionnaire. According to the requirements of specific targets, designs can be flexible. For example, enterprises can score to themselves compared with the enterprise's own situation, average or highest level of the industry.



**Fig. 134.4** Indicator evaluation system on consistency between strategy and compensation management

The determination of indicator weight is as (134.1).

$$Z = B \times F, r_{ij}(i = 1, 2, \dots, m, j = 1, 2, \dots, n) \quad (134.1)$$

Significance degree is different among various indicators of indicator system at all levels, and the indicator hierarchies and the indicator number of the indicator system are more, so Analytic Hierarchy Process (AHP) can be used to determine their weights. Specific steps are as follows:

1. *determine the comparative judgment matrix*: ask experts to compare the importance between two subordinate indicators which relative to the same upper layer indicators, the ratio get from experts can construct the judgment matrix.
2. *hierarchical sorting*: use the square root method to calculate the largest matrix eigenvalue and the corresponding eigenvector of each matrix, normalize the eigenvector, and then to conduct matrix consistency test.
3. *general hierarchy ordering*: follows the order of top layer to bottom layer, using normalized characteristic component of each indicator of each layer as weights respectively, multiplying characteristic component of each indicator belonging to this layer, to get down layer indicator combination weights, and the last layer combination weights are required. And also consistency test should be carried out in the general hierarchy ordering process.

### 134.3.3 Model Construction

This essay adopts the multistage fuzzy evaluation method to construct the comprehensive evaluation model of strategic compensation management key

dimensionalities. First is to integrate each branch of the model, and then to evaluate each factor comprehensively to get the evaluation of main factors. Specifically, at first, the combination weighting method can be used to calculate the indicator weights of the critical dimensionality, and then comprehensive evaluation method can be used to calculate the quality level of the enterprise key dimensionalities. The fuzzy comprehensive evaluation method is a comprehensive decision making method for some purpose that takes a variety of factors into account in a fuzzy environment, and the specific steps are as follow:

1. *Constructing elements:*

Factors set:  $X = (x_1, x_2, \dots, x_n)$  is an indicators set consisting of measuring indicators;

Remark set:  $V = (v_1, v_2, \dots, v_m)$  is a comment set and comments are divided into 4 grades including excellent, good, medium and poor level;

Weight set:  $\omega = (\omega_1, \omega_2, \dots, \omega_3)$  is a weight set, it is determined by AHP.

2. *The fuzzy relation from X to V can be described by the following fuzzy evaluation matrix R:*

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$$

where: indicates the membership degree of the  $i$ th indicator corresponding to the  $j$ th  $v_j$ , the value of  $r_{ij}$  derives through integrating expert estimation.

$$r_{ij} = \frac{v_{ij}}{\sum_{j=1}^n v_{ij}}$$

3. *Using synthetic operation of fuzzy matrix gets comprehensive evaluation model:*

$$B = \omega \cdot R = (b_1, b_2, \dots, b_n)$$

If  $\sum_{j=1}^n b_j \neq 1$ , then normalization processing is applied to B

4. *Calculation of consistency and key dimensions level of strategic human resource management:*

Let  $F = (f_1, f_2, \dots, f_n)^T$  is score set,  $f_i$  indicates the score of  $j$ th remark, using the vector product calculates the final evaluation result. That is the key dimensions indicator of enterprise capability is  $Z = B \times F$ .

Table 134.1 L company's evaluation results of consistency between human resources management and strategy

Weight Dimension		Weight	Consistency sub-item	Weight	Indicator	Remark set
Consistency between compensation management and strategy	Lateral consistency	0.46		0.44	Consistency inside system	① Number of salary management subsystem interfaces (0.4,0.3,0.1,0.2)
						② Number of compensation management activities existing task cooperation (0.5,0.3,0.1,0.1)
						③ Number of compensation management activities existing process collaboration (0.4,0.4,0.2,0)
						④ Consistency of compensation management activities to deliver the organization information (0.3,0.4,0.2,0.1)
						⑤ Degree of non-discrimination treat of identical employees (0.4,0.4,0.1,0.1)
	Vertical consistency	0.54		0.56	Consistency with strategic supporting system	⑥ Number of changes of compensation management policies within half a year (0.5,0.3,0.1,0.1)
						① Reasonable degree of proportion of core staff in departments (0.3,0.5,0.2,0)
						② Extent of providing complementary support for the ability of team members (0.1,0.4,0.4,0.1)
						③ Rationality of the incentive coefficient in the team incentive compensation (0.8,0.1,0.1,0)
				0.44	Consistency with strategy	① Degree of participation of human resource manager on strategy making (0.8,0.1,0.1,0)
				0.26		② Consistency between compensation management goals and strategic objectives (0.7,0.2,0.1,0)
						③ Intensity of providing salary support for key business process (0.5,0.3,0.1,0.1)
						④ Degree of coordination between strategic orientation and compensation management model (0.7,0.2,0.1,0)
				0.3	Consistency with culture	① Support from compensation to cultural transmission (0.4,0.5,0.1,0)
						② Degree of coordination between cultural type and compensation management model (0.8,0.1,0.1,0)
				0.26		① Degree of coordination between strategic orientation and organization structure (0.8,0.1,0.1,0)
						② Degree of coordination between organization structure and compensation management model (0.8,0.1,0.1,0)

### ***134.3.4 Application Example: Calculation of Consistency Between Compensation Management and Strategy***

L Company was founded in 1993 and is located in a southern coastal city in China. The company has more than 2,000 technical personnel, managers and production staffs. It is a scientific and group-type agricultural industry enterprise which is mainly based on animal husbandry with many other industries simultaneously, makes production, transportation and marketing a coordinated process and integrates agriculture, industry and trade. L Company is committed to cultivating excellent team enterprise character, encourage employees to concentrate on scientific research, hard work, innovation and management. In recent years, it maintained the advantage of product leadership, while the company gradually expanded the scale and the product category became more various. To ensure the tacit cooperation between every subunit, the company introduced consistency between compensation management and strategy. Strategic compensation management was brought into company. In order to implement strategy management and compensation management, it has also taken a number of innovative measures. As part of the core competitiveness of the company, the executives paid attention to cultivating compensation advantages.

This essay will apply the proposed calculation method of consistency between compensation management and strategy to the company and make diagnosis and evaluation on the integrated degree between strategy management and compensation management.

First, the indicator weights are determined by AHP method. That is determining the comment set (excellent, good, medium, poor), evaluating the indicators in Table 134.1 based on fuzzy comprehensive evaluation method. By calculations, it gets that consistency between compensation management and strategy of L Company is (0.5547, 0.2621, 0.1473, 0.0360), this shows that current compensation management work of L Company is running well and the consistency is in good condition.

## **134.4 Conclusion**

Compensation management is a tough problem for any enterprise, and it is about the survival and development of employees. Important works which help enterprises motivate employees to understand enterprise business strategy. Strategic compensation management is considering from the perspective of enterprise business strategy to combine business strategy and compensation management. The process is oriented by enterprise strategy and takes balance between internal fairness and external competitiveness, performance correlation and human incentive, enterprise affordability and strategic planning into account. That is to promote compensation management to the level of enterprise strategy. This paper

carries out a study to consistency between compensation management and strategy management. It establishes an evaluation model of strategic compensation management. Finally, it demonstrates the calculation method of consistency by using a practical example, which provides research ideas to calculation of consistency between compensation management and strategy.

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# Chapter 135

## Brand Credit Degree, Choice Cost and Sales Model Building

Wei-liang Li and Hui Wang

**Abstract** From the demand theorem, sales model theory has fully discussed how price affects the sales process and manufacturer's competitive strategy under the background of supply surplus, but is little concerned with the effects of brand credit degree and choice cost on the sales process. Building sales model based on brand economics, using matlab to model and case studies of the variables such as brand sales cycle, brand purchase proportion of population, the paper provides theoretical support on how to optimize sales process and finally the study should become the theory guidance for corporations using brand as the core to establish business strategy and in order to obtain higher profits and market share.

**Keywords** Sales model • Brand credit degree • Choice cost • Case study

### 135.1 Introduction

The sales model is about a mathematical relationship between variables affecting product sales and the sales cycle in the research of brand sale process, which could effectively guide the corporations to establish the optimal marketing strategy and sales promotion mode, and to increase market share and profits rate. Hal R. Varian established the optimal sales model based on price and information to explain the retail behavior of real-world and provided a theoretical support for the corporation

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product sales (Varian 1980). The Peng SY established the sales model in which price is a decreasing function of demand rate, and proved the existence and uniqueness of the optimal policy (Peng 2006). Taking into account of the uncertainties, Han Xin-she and Ye Heng-kui established the product sales forecast model on product sales in a period of time which provided an important reference to forecast durable goods production and sales (Han and Ye 2002). Leng Ke-ping discussed a simple sales process in the market from the game theory, established corresponding mathematical model and suggested the optimal strategy of the corporation product sales (Leng 1993). Mo Jiang-tao, Pan Hong-juan, Mi Fang-fang and Zhou Fang-ming studied the advance sales of the seasonal demand products using a two-stage pricing strategy (Mo et al. 2009).

On the law of demand, past researches have discussed the mechanism of price impacting on sales and discussed corporations' competitive strategy in the condition of supply surplus, but lacked research on the influence of indicators in the sales process based on brand credit degree and choice cost. Taking the theory of SIS model for reference, this paper builds repeat purchase brand sales model based on the brand economics (Lang 2004), and aims to introduce brand credit degree and choice cost into the sales model, and make digital simulation on data models variables such as brand sales cycle, population proportion, extreme point of brand purchase, and brand coverage etc. It provides a theoretical support for corporations applying brand economics theory to brand building and decision-making. It can effectively guide the practice of corporations brand sales.

### 135.2 The Definition of Sales Model Variables Based on the Brand Economics

Brand category degree is the mental awareness degree of how consumers specify a certain brand as a category psychologically, and it can generally be obtained by testing and analysis (Sun and Liu 2007). Through the analysis of the audience and means in brand promotion, we can get the correlation coefficient of brand and the promotion means, thus the data of valid daily brand contact rate can be obtained which determined by brand category degree, the correlation coefficient between brand and promotion means, brand investment, which are all proportional to valid daily brand contact rate. The valid daily brand contact rate represents the degree of the promotion effectiveness.

We first define the valid daily brand contact rate  $\lambda$  which embodied brand credit degree is the function of  $B_c$ , such as,

$$\lambda = \lambda(B_c) \quad (135.1)$$

According to the definition of brand economics,  $B_c = b * s$  is brand credit degree, brand category degree  $b \in [0, 1]$ , brand strategy  $s \in [1, 0]$ , when  $b = 1$  and  $s = 1$ , thus  $B_c = 1$ . In order to simplify the analysis, we set  $s = 1$ , thus

$B_c \in [0, 1]$  (Sun and Liu 2007). Based on the above assumptions, we can obtain  $\lambda$  by the following equation,

$$\lambda = [c_1 \cdots c_i] \begin{bmatrix} m_{11} \cdots m_{k1} \\ \cdots \cdots \cdots \cdots \cdots \cdots \\ m_{1i} \cdots m_{ki} \end{bmatrix} \begin{bmatrix} b_1 \\ \cdots \\ b_k \end{bmatrix} \quad (135.2)$$

where  $c_i$  is brand promotion investment proportional of the category  $i$  of the brand,  $m_{ki}$  is correlation coefficient between brand category  $i$  and promotion means  $k$ , and  $b_k$  is brand category degree when the brand uses the promotion means  $k$ .

Equation (135.2) can be explained economically as follows: assuming that the brand needs  $k$  kinds of promotion means, valid daily brand contact rate is multiplied by the investment proportion of the brand in all promotion means, correlation coefficients of the brand and promotion means as well as brand category degree. Valid daily brand contact rate is not only a function of brand investment amount but also a function of the correlation coefficient between brand and promotion means.

Equation (135.2) also provides a method to measure the effectiveness of brand promotion. Generally, when we put the limited business promotion investment expenses into the maximum correlation coefficient between the brand and promotion means, its valid daily brand contact rate is maximum too. The correlation coefficient of brand and promotion means can be obtained by investigation and testing, we will focus on the  $\lambda$  value influenced by brand category degree in the following analysis.

We secondly define valid daily brand purchase rate embodied choice cost  $\mu$ , is the function of  $C_c$ , such as,

$$\mu = \mu(C_c) \quad (135.3)$$

According to the definition of brand economics,  $C_c$  is choice cost, and  $C_c = f(B_c)$ ,  $C_c$  is inversely proportional to  $B_c$  (Sun and Liu 2007). In order to simplify the analysis, we set  $s = 1$ , thus  $B_c \in [0, 1]$ ,  $\mu = \mu(f(B_c))$ , and  $\mu$  is inversely proportional to  $B_c$ . Equation (135.3) can be explained economically as follows, the smaller choice cost of the brand is, the higher daily brand purchase rate of the brand is.

To establish the repeat purchase brand sales model, we define variables as follows: (1)  $i$  is the purchase population proportion of a certain brand; (2)  $s$  is the potential purchase population proportion of a certain brand, and  $s$  is determined by brand position, target market size, population income level and consumption propensity; (3)  $\lambda$  is valid daily brand contact rate of a certain brand, or the population proportion contact rate of a certain brand, and is proportional to promotion effectiveness and brand category degree. (4)  $\mu$  is daily brand purchase rate of a certain brand, or the population proportion purchase a certain brand, and it is inversely proportional to choice cost and is concerned with the product type. (5)  $\bar{b} = \lambda/\mu$ , is the effective consumer contact number added by brand credit degree and choice cost during the brand sales. (6)  $t$  is the time of sales duration of a certain brand.

### 135.3 Repeat Purchase Brand Sales Model Analysis and Simulation Results

Repeat purchase brand sales model mainly analyzes the brands in the field of daily consumption (Jacoby and Kyner 1973). While brands are repeatedly purchased or products are relatively unimportant, consumers would not be excited in a lot of decision-making activities in the brain (Hoyer 1984). The brands will be purchased by consumers without hesitation and maintain a stable brand purchase rate.

We define  $s_0$  ( $s_0 > 0$ ) as potential purchase population proportion, and  $i_0$  ( $i_0 > 0$ ) as purchasing population proportion, and  $s_0 + i_0 = 1$ .

We can build the Repeat Purchase Brand Sales Model,

$$\frac{di}{dt} = \lambda si - \mu i, \quad \frac{ds}{dt} = -\lambda si \quad (135.4)$$

Using equation  $\sigma = \lambda/\mu$ , then we get,

$$\frac{di}{dt} = -\lambda i \left[ i - \left( 1 - \frac{1}{\sigma} \right) \right] \quad (135.5)$$

The solution of (135.5) is,

$$i(t) = \begin{cases} \left[ \frac{\sigma}{\sigma-1} + \left( \frac{1}{\sigma} - \frac{\sigma}{\sigma-1} e^{\mu(1-\sigma)t} \right) \right]^{-1}, & \sigma \neq 1 \\ \left( \lambda t - \frac{1}{i_0} \right)^{-1}, & \sigma = 1 \end{cases} \quad (135.6)$$

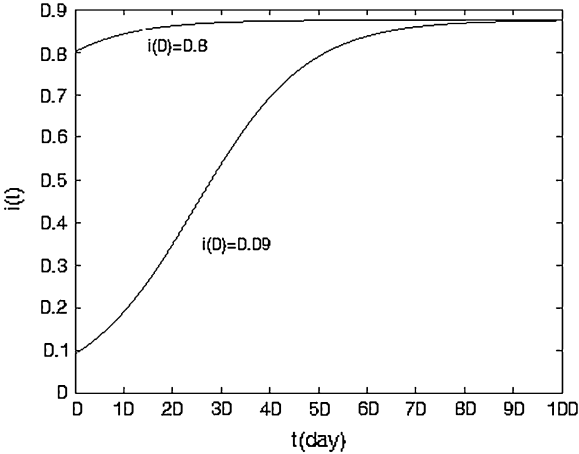
As  $t \rightarrow \infty$ ,

$$i(\infty) = \begin{cases} 1 - \frac{1}{\sigma}, & \sigma > 1 \\ 0, & \sigma \leq 1 \end{cases} \quad (135.7)$$

Drawn from the above model, for repeat purchase brand, we have:

Proposition I: When  $\bar{\sigma} > 1$  and  $\lambda > \mu$ , the valid daily brand contact rate is higher than the daily brand purchase rate, regardless of the initial  $i_0$  is large or small, as time passes  $i(\infty)$  converges to a stable value  $(1 - 1/\bar{\sigma})$ , by the definition of  $\bar{\sigma}$ , we know that  $\lambda$  and  $\mu$  determine the size of the  $i(\infty)$ ,  $i(\infty)$  is proportional to  $\mu$  and  $i(\infty)$  is inversely proportional to  $\lambda$ . The larger  $\lambda$  and the smaller  $\mu$  is, the larger  $\bar{\sigma}$  is, so is the larger  $i(\infty)$ . Thus the corporation has infinite life cycle, and can continue operating forever. At the same time  $\mu$  determines the duration of each stage of the brand life cycle. The smaller  $\mu$  is, the longer time  $i(t)$  convergence to the stable value needs. Thus increasing the brand category degree and lowering the choice cost are available to consumers to purchase a certain brand without hesitation. Ultimately increasing  $\mu$  can effectively improve the stability of brand production and sales as soon as possible.

**Fig. 135.1** Simulation graph when  $\bar{c} = 8, \mu = 0.1$



Using the software matlab (Chapman 2003) to simulate the model, we get the simulation as Fig. 135.1. The Fig. 135.1 shows  $i(\infty)$  respectively maintaining the same convergence  $(1 - 1/8) = 0.875$  on 50th and 80th days when  $\bar{c} = 8, \lambda = 0.8, \mu = 0.1, i_0$  respectively is 0.8 and 0.09. Figure 135.2 shows  $i(\infty)$  respectively maintaining the same convergence  $(1 - 1/4) = 0.75$  on 100th and 180th days when  $\bar{c} = 4, \lambda = 0.8, \mu = 0.05, i_0$  is 0.8 and 0.09 respectively. Through the simulation, we get the empirical formula, when  $i(t)$  reaches a stable value,  $t * B_c = 100 t_0$  (the unit is day), where  $t_0$  is a constant determined by product type. The larger  $B_c$  and the smaller  $C_c$  are, the smaller  $t$  is, then corporations can significantly shorten the brand promotion period and cut costs for promotion, meanwhile the production scale can keep stable at a reasonable level as soon as possible.

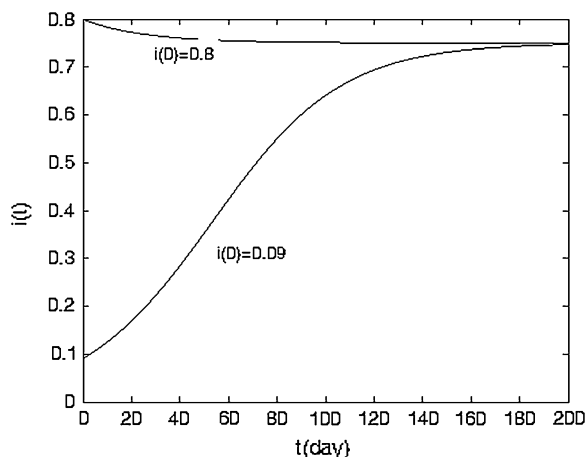
When  $\bar{c}$  gets smaller and gradually closes to a value 1,  $i(\infty)$  becomes smaller, then a brand with low brand category degree will converge to a low brand purchase population proportion. Corporations will fall into “muddy middle zone [Liu HJ, The economic approach to brands’ getting stuck in the muddy middle zone and the brand strategies of imitation and following vs. opposition and symbiotic growth. unpublished (Chinese)]” or the brand will die out of the market owing to the condition that the product scale fail to expand, then we get proposition II.

Proposition II: When  $\bar{c} \leq 1$ , then  $\lambda \leq \mu$ , and the brand purchase population proportion  $i(t)$  will decrease with the time  $t$  prolonged until it is 0, which means the brand could not be sustainable and has a life cycle.

From  $\lambda = \lambda(B_c), \mu = \mu(C_c)$ , with the other conditions remain unchanged, brand credit degree  $B_c$  and choice cost  $C_c$  influence  $\bar{c}$  through  $\lambda$  and  $\mu$  respectively, then  $i(t)$  has different changing curve, the smaller  $B_c$  and  $C_c$  are, the smaller  $\bar{c}$  is, thus the faster  $i(t)$  decreases. When  $\bar{c} = 0, \lambda = 0$ ,

$$i(t) = i_0 e^{-\mu t}.$$

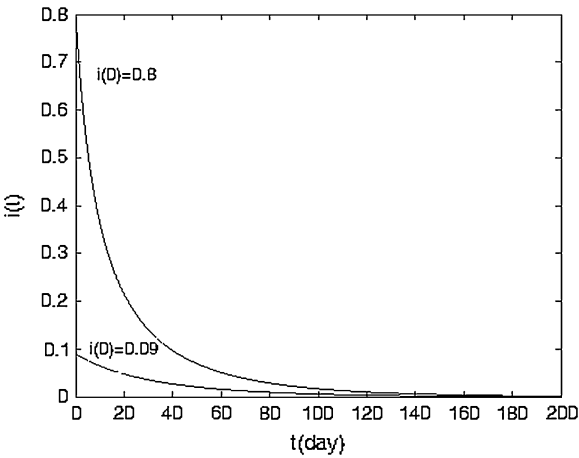
**Fig. 135.2** Simulation graph when  $\bar{c} = 4$ ,  $\mu = 0.05$



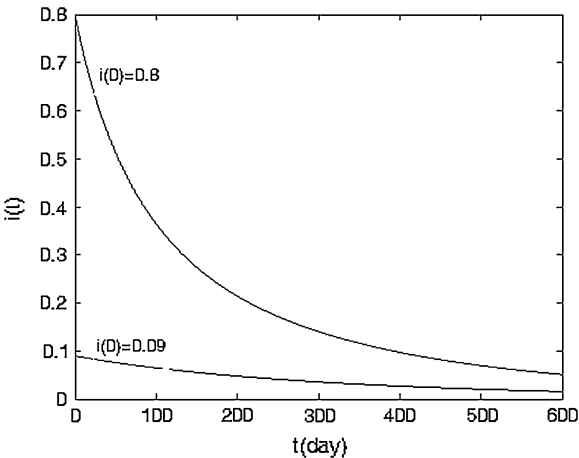
Using the software matlab to simulate the model, we get the simulation as Fig. 135.3,  $i(\infty)$  converges to 0 on about 160th day when  $\bar{c} = 0.8$ ,  $\lambda = 0.08$ ,  $\mu = 0.1$ , and  $i_0$  is 0.8 and 0.09 respectively, which means when brand category degree is low, regardless of the initial purchase population proportion is large or small, the brand category will die out of the market, but the brand duration may varies, as shown in Fig. 135.4,  $i(\infty)$  will converge to about 0.07 and 0.02 on 600th day when  $\bar{c} = 0.8$ ,  $\lambda = 0.008$ ,  $\mu = 0.01$ ,  $i_0$  is 0.8 and 0.09 respectively. Although the brand category can also exists, but will gradually withdraw the market because of lacking profit margins. When compared Figs. 135.3 and 135.4., we can infer that the lower the daily brand purchase rate is, the slower the brand dies, which would confuse the corporation's decision-makers to mistakenly believe that the brand can develop sustainably, thereby to increase the promotion investment. But when brand category degree is low, even if promotion investment increased, the result is still futile and even may be counterproductive to accelerate the death of the brand category.

Proposition I and proposition II illustrate what a key role brand category degree and choice cost play in brand sales model. Brand category degree can be gotten through testing and analysis generally. Valid daily brand contact rate can be gotten from analyzing the promotion investment and the correlation coefficient between brand and promotion means. At the same time daily brand purchase rate can be observed in actual sales process. Combined both rates, we can calculate the brand effective contact number, which can be great help for the certain brand to predict the change rule of  $i(t)$  and  $t$ , and can guide corporations' sales and production in the selling process.

**Fig. 135.3** Simulation graph  
when  $\bar{c} = 0.8, \mu = 0.1$



**Fig. 135.4** Simulation graph  
when  $\bar{c} = 0.8, \mu = 0.01$



**135.4 Repeat Purchase Brand Case Studies**

***135.4.1 Chinese Toothpaste Market***

Brand credit degree equals to the product of the brand category degree and brand strategy. If brand category degree is high and brand strategy is correct, the brand market share will maintain in a high level in long-term. We will research on the brand in Chinese toothpaste market for example. According to the survey data of ZhongJing-XianLue Investment Advisory Center, research on the Chinese toothpastes market shows that Crest’s shares more than 20 % in the Chinese toothpaste market in the first half of 2010, indicating that the implementation of Procter and Gamble Crest “no cavities” brand promotion maintains its high brand credit

degree and high brand repeat purchase rate. For repeat purchase brand, market share is the stable everyday brand purchase rate, so  $i(\infty) = (1 - 1/6) = 20\%$ , we can calculate  $\bar{\sigma} = 1.25$ ,  $\lambda = 1.25 \mu$ , which indicates that Crest toothpaste has high brand category degree by a large marketing promotion investment, making the valid daily brand contact rate higher than daily brand purchase rate to ensure its popularity in the market.

Chinese toothpastes have suffered much for a long time after foreign brands entered the Chinese market—the correct promotion strategy and heavy investment of foreign brands have already made them sidelined in the competition, together with the fact that they have a weak single interest point which impressed consumers that toothpastes are just cleaning supplies. In this reshuffle process, brand category degree and brand credit degree of Chinese toothpastes are low, thus Chinese toothpastes are vulnerable in the competition and even some brands died out.

According to the basic principles of brand economics, Chinese toothpastes have to establish a mutually exclusive category with the foreign brands, in order to increase brand credit degree and reduce choice cost, namely to implement category confrontation strategy (Sun and Liu 2007). In recent years, the Chinese herbal medicine efficacy toothpastes gradually rise, for example YUNNANBAIYAO toothpaste (Liu 2011) got market share around 9–10 % in China in the first half of 2010. This means that its brand credit degree has been significantly elevated; the core reason for this is that these Chinese toothpaste brands used the unique Chinese herbal formula for oral health care, which is of great significance to stabilize its brand repeat purchase rate by establishing a single interest point.

### ***135.4.2 Coca-Cola and Qinchì Wine***

Other examples are new-formula Coca-Cola and Qinchì (a wine brand in China). Due to the wrong product positioning, brands or categories above lasted only a very short time. The core reason is that they both have low brand category degree or product quality, leading to brand credit plummeting. In April 1985, Coca-Cola announced it would use the new formula instead of the old one, because the Company believed that “the bold decision was the best decision the Company has made (Pendergrast 2000)”. However, in July 1985, Coca-Cola Company announced to reuse the previous Coca-Cola formula because of the pressure. Only after 82 days, the new Coca-Cola quit from the market because of the wrong product positioning. Even Qinchì was the advertising pillar Wang in CCTV, unfortunately, its market situation was rapidly deteriorated because of bad product quality (Long 2010).

### ***135.4.3 Porsche and Apple***

Porsche is the world famous car brand, the production of Porsche 911 has been by far the world's best-selling since 1963 when the car was produced. It updated constantly averaging about 1.5 years on technology and shape, launched about 30 kinds of car models for consumers to choose totally. Porsche has a very high brand category degree in the field of luxury sports car, thereby enhanced its brand credit degree, thus it need constantly introduce new products to meet market needs and to ensure sustainable development of corporations. The new product release time is proportional to the valid daily brand contact rate and inversely proportional to daily brand purchase rate. The smaller  $\lambda$  and the larger  $\mu$  are, the shorter intervals of new product releases is. Luxury brand should arrange the production and stocking to prevent temporary supply shortage and surplus of products based on the extreme point of purchase population proportion.

Apple Inc. takes a completely different category confrontation strategy from the "Wintel" compatibility architecture and continues to invest into innovative research and product development, thus makes Mac, iPad, iPod, iphone and other products maintain a high brand category degree. Apple Inc. establishes unique market position and wins high recognition of the market. Because of its high brand category degree and the correct marketing strategy, Apple brand credit degree increases and accumulates rapidly. The queuing up to purchase and short supply of the recent products (iphone4s) is a good proof.

Corporaions need to innovate or introduce new products to maintain its brand credit degree in the brand sales cycle in order to improve their brand coverage. If the brands lack sustained R&D strength and ability to innovate, they will disappear without new category release after a short honeymoon-like time relying on powerful promotion. Different corporations can analyze the problems of their own brand in order to improve the final brand coverage by increasing brand promotion when brand category degree is a certain value, and increasing the valid daily brand contact rate. It also shows the importance of the rule "Have a promotion theme every year, Have promotion activities every month." in corporation marketing promotion (Sun 2004).

## **135.5 Conclusion**

The new sales model as proposed in this research paper on the basis of brand economics is an in-depth exploration and extension to traditional arrangement of new product launch and distribution. Through the research, we get functions of the variables and variation disciplines of brand sales cycle, brand purchase population proportion by adding brand credit degree, choice cost and other indicators to the sales model.

Realistic simulation results obtained by using software matlab to simulate the repeat purchase brand model brings us to a firm conclusion that brand can prolong the brand life cycle, quicken the process of product stability, boost sales, elevate purchase rate and enlarge market share as well by increasing brand category degree and reducing choice cost. In this way, brand economics theory is further developed in this paper, which should be significant in brand building and sales practice because it could provide a theoretical support to guild corporations to establish their core brand business strategy to obtain higher profits and raise market share through increasing brand awareness and using correct brand strategy.

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# Chapter 136

## Product Platform Design Services Architecture and Key Technologies Based on Cloud Computing

Hai Ji, Qian-jin Yang and Xin-min Han

**Abstract** A new product design mode, product platform design service mode based on cloud computing, is proposed. It can effectively integrate enterprise product development resources, and respond to dynamic and unpredictable market demands by creating serialization, personalized, diversified and high-quality products. The research background, characteristics, connotations of the platform design service is briefly described. Attention is concentrated on platform service application model. The emphasis is also placed on the technical architecture and design service process. Some key technologies, such as realization method, service describe, service discovery, message communication and services organization are discussed. The purpose for this study is to improve the utilization efficiency of distributed enterprise product development resources, and to strengthen the service collaboration capabilities for integrating product design resources.

**Keywords** Cloud computing · Product platform design · Web service

### 136.1 Introduction

In a global marketplace, intense, and dynamic competitive environment, the development of new products and processes has become a focal point of attention for many companies. Many companies are utilizing product platform and product

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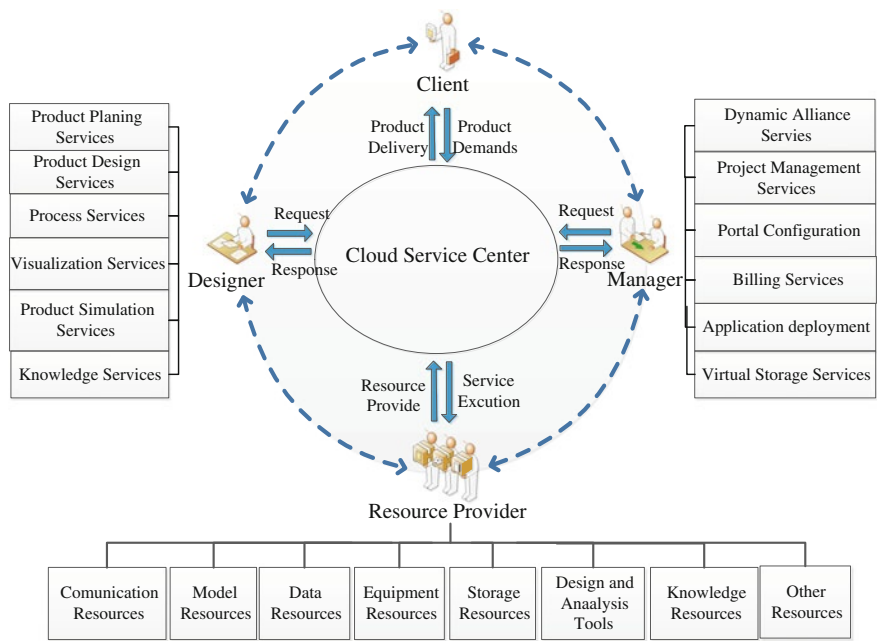
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families design method to increase variety, improve customer satisfaction, shorten lead-time, and reduce costs. It will form serialization, personalized, diversified and high-quality products to meet market demands by designing a group modules or subsystems to create rational planning product families (Zha and Sriram 2005). However, with the expanding of enterprise manufacturing scale and the deepening of market segmentation degree in the changing process from large-scale manufacturing to mass customization, the number of product platform modules and the amount of product families' resources are gradually increasing, which result in reducing controllability and scalability of product platform, and increasing complexity of platform structure, so that inhibit the development of new products because companies face challenges in platform management and product diversity.

On the other hand, it is an important trend that production manufacturing shift to service-oriented manufacturing in global manufacturing. With the developments of network technologies, especially the developments of cloud computing technologies, which have significant impact on manufacturing and speed up transformation of manufacturing services. Cloud computing is a special distributed computing model by resource virtualization to form physical dispersion but logic unified resource pool. Cloud computing not only provides application services, but also provides software services based on database center known as Software as a Service, hardware and software in database center is called cloud (Armbrust and Fox 2009). This article propose a new product design mode, product platform design services mode based on cloud computing, which integrate virtualization, service-oriented computing and grid computing technologies to build enterprise product platform service model and architecture in order to strengthen the integration of product design resources, collaboration and service capabilities.

### **136.2 Connotation and Application Mode of Enterprise Product Platform Design Services Based on Cloud Computing**

Product platform design services mode based on cloud computing is a network extension of enterprise product platform that supports distributed product platform development. In the context of enterprise development needs and based on cloud computing concept, platform design services is utilizing availability, capacity, performance and cost advantages of platform resources to manage it runtime and dynamically, and to select, sharing and integration of distributed product platform resources to optimize allocation of resources and work together to support completion of product development tasks. It provides an environment to build virtual product design center that supports product development resource sharing and development collaborative. Because product platform development includes planning, designing, analysis, management, supply chain and many other aspects (Halman et al. 2003), enterprise product platform design services based on cloud



**Fig. 136.1** A services application model of enterprise product platform design based on cloud computing

computing are divided into three services application mode: product design and simulation cloud service mode, virtual manufacturing enterprises dynamic alliance collaboration cloud service mode and public manufacturing platform cloud service mode. As Fig. 136.1 shown is a services application model of enterprise product platform design based on cloud computing.

### ***136.2.1 A Cloud Service Mode for Product Designing and Simulation***

Product designing and simulation cloud service is mainly for large-scale computing and storage capacity requirements in the process of enterprise product platform planning, designing and simulation evaluation. It focus on decomposing internal host computing center into independent heterogeneous systems and integrating external networks, resources and services to achieve cross-organizational collaborative product design. The important of this mode is product designing, simulation virtualization deployment for computing resources and resources scheduling.

### ***136.2.2 A Cloud Service Mode for Virtual Manufacturing Enterprises Dynamic Alliance Collaboration***

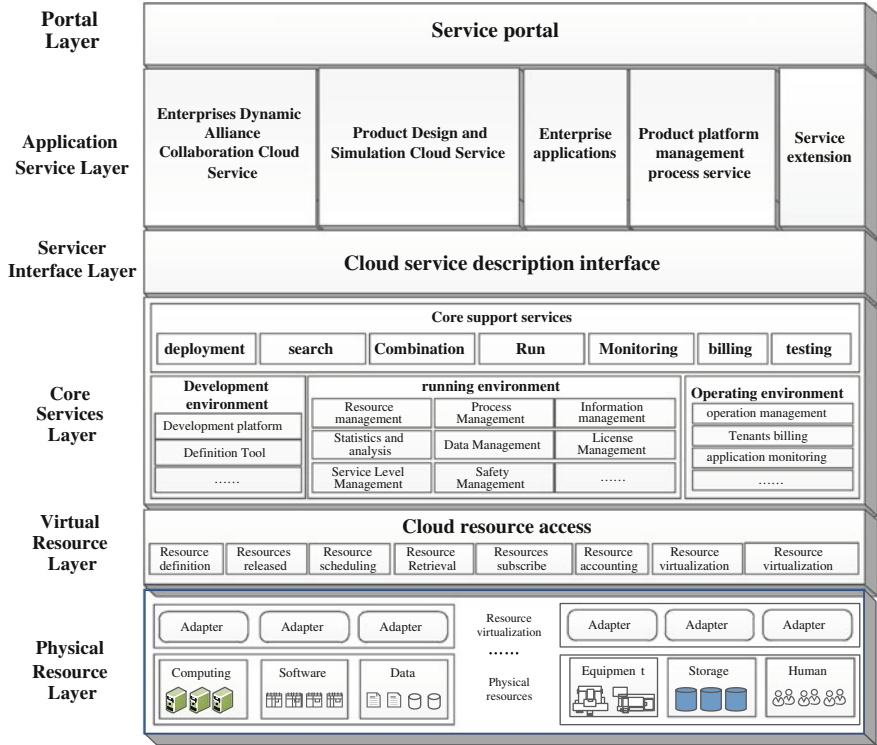
Virtual manufacturing enterprises dynamic alliance collaboration cloud service is mainly to solve distribution, heterogeneous, dynamic, autonomous and synergistic problems of inter-enterprise supply chain network in product development process. It supports competent enterprises, cooperative enterprises and third-party companies to achieve business collaboration and share product development information. It can fully apply product development resources scattered in different regions to establish a virtual manufacturing enterprise for sharing resources of supply chain, which can develop coordination and control mechanism to overcome the distance in space and heterogeneous resistance to enterprise collaboration obstacles.

### ***136.2.3 A Cloud Service Mode for Public Manufacturing Platform***

Public manufacturing platform cloud services integrate resources in existing enterprise product platform to establish an open service application mode, so that it supports the collaboration for distributed and heterogeneous enterprise product platforms to solve the secure access and sharing problems of resources in heterogeneous platform environments and create a virtual product development environment with a unified platform service model and portals to provide product platform development business service applications. It not only includes application software systems, such as supply chain management, order management, inventory, human resources management, and virtual storage, but also includes the professional services applications for product designing, simulation, mold design, model negates.

## **136.3 The Architecture of Enterprise Product Platform Design Services Based on Cloud Computing**

The enterprise product platform design services based on cloud computing apply service-oriented to support processes of enterprise product development and integrate platform resources by service package to complete product development task through transparent retrieval of product development services and scheduling and dynamic reorganization of self-organization services. The architecture of enterprise product platform design services is shown in Fig. 136.2.



**Fig. 136.2** The architecture of enterprise product platform design services based on cloud computing

**136.3.1 Physical Resource Layer**

Physical Resources Layer is generalized distributed resources related product platform development including hardware resources and software resources. Hardware resources include a variety of computing resources and equipment resources, and software resources such as data resources, software resources, knowledge resources, storage resources. These resources are divided into online and offline forms, which can connect to platform by resource adapter that a virtualization description and packaging resources (Younge et al. 2011), and provide a unified access interface to achieve transparent access and globally shared resources by shield resources heterogeneity.

### ***136.3.2 Virtualized Resource Layer***

Virtualized Resource Layer manage virtualized resources to direct manipulation of resources and optimal scheduling, such as resource definition, publishing, discovery, scheduling, subscription, billing and monitoring through network infrastructure, communication protocols, software, tools. The network infrastructure provides a basis for communication among platform resources and platform network environment. Resources run on resource container that monitor and management resources' real-time status in the runtime environment.

### ***136.3.3 Core Services Layer***

Core Services Layer is a cross-platform application service run-time environment developed by a series of cloud computing middleware that build cloud computing services functions to provide develop, deploy, and manage cloud computing core services including process management, information management, data management, resource management, service development and management, service operations management, service security management and service operation and management and so on. Process management for product platform development process to provide process management, task management, service composition and operation monitoring; Information management can monitor and manage user information, node information, operation information of product platform service system; Data management can manage, access and update data resource, and resources in data transmission system, and provide copies of data management services and data integration services.

### ***136.3.4 Services Interface Layer***

Service interface layer provides a set of interfaces for service-oriented applications to achieve product development services, business process modeling, restructuring and management.

### ***136.3.5 Application Service Layer***

Application Service Layer provides application tools for product development process in specific areas, such as applications of product platform planning, product design, product simulation, process and supply chain.

### ***136.3.6 Portal Layer***

The entrance of product platform design service system, which integrates product platform development tools to provide a service delivery platform for a variety of applications, and user use a variety of tools to achieve service calling.

## **136.4 The Execution Process of Enterprise Product Platform Design Services Based on Cloud Computing**

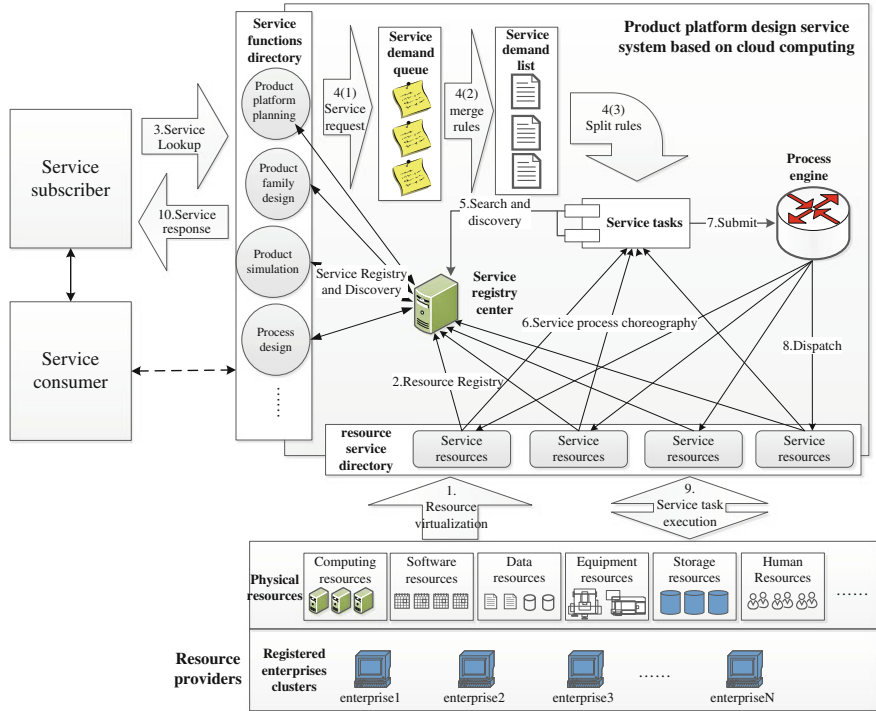
Enterprise product platform design services support collaborative product development among different enterprises under the coordination of product platform design services system. Users submit tasks and objectives of product development, and then system can build a virtual organization dynamically, which achieve resource sharing and collaboration to complete product development tasks. While the task is completed, the collaborative relationship in the virtual organization will come to disintegration. The basis of product platform design services system is a shared resource pool that consists of virtualized resources. System organizes distributed resources to complete product development tasks and need to descript product development process and effectively control, monitor and deal with possible exceptions. Product platform execution process is shown in Fig. [136.3](#).

### ***136.4.1 Description and Packaging of the Product Platform Resource Virtualization***

Product platform design services based on cloud computing use object-oriented modeling approach to describe resource properties and operations, which includes resource properties, resource relations and resource operations. Resource properties require inherent characteristics of abstract description of resources and status information. Resource operations are abstract shared use of resources. Resource relationship requires describe relationships in resources. Product platform design services encapsulate resources to form sharing resources pool.

### ***136.4.2 Product Platform Resources Registration***

Product platform resources deploy on different organizations nodes in the platform design service system. Services registered into platform service registry center in accordance with UDDI, and resources property description can be extended according to the needs of service retrieval.



**Fig. 136.3** The execution process of enterprise product platform design services based on cloud computing

**136.4.3 Product Design Process Choreography**

Product platform service system mainly consists of two phases: building product design process phase and product design process choreography phase. First, in the phase of building product design process, process should be defined according to business objectives and requirements of product design development, and be decomposed into multiple sub-tasks that have a clear description of design objective, input and output parameters. Second, in the product design process choreography phase, a design task will be completed by service portfolio, which is a procedure that a task request is mapped to specific product design services and combine them into a complete process.

**136.4.4 Retrieve Product Platform Resources**

Retrieve product platform resources is a process forming result set by developing constraints such as designing constraints, deadline, economic budget, service

quality and content. The search process is to select the best node based on constraints to search resource nodes for forming a collection of resources, and then sort the nodes according to the quantization value by evaluating them.

### ***136.4.5 Product Design Process Deployment***

After completing product design processes definition, processes will be deployed into process engine and drive by it (Kumar and Janakiram 2008). The engine is always running, and cannot be restarted when a new process deployed.

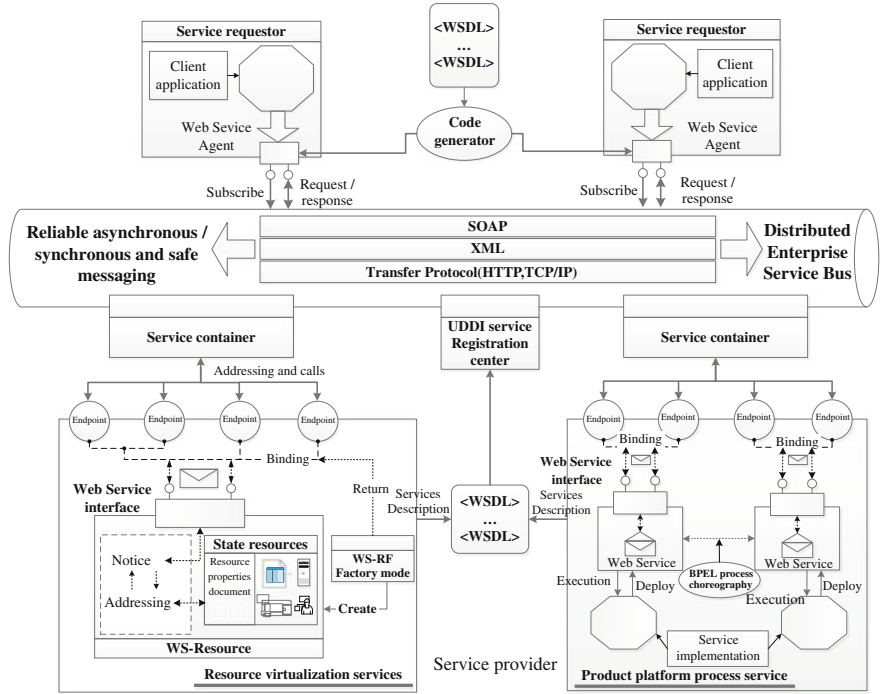
### ***136.4.6 The Implementation of Product Design Process***

The product design processes are performed under control of process engine through the analysis process description in design process file, and then completing design workflow tasks by according to combinational logic of design process to achieve design services calling. In the implementation process, to monitor the implementation of the process logic, including the view of the implementation process and hangs, recovery and suspension of the implementation of state control operations.

## **136.5 The Key Technologies of Enterprise Product Platform Design Services Based on Cloud Computing**

### ***136.5.1 SOA-Based Technology Services Architecture***

The product platform design services based on cloud computing architecture is loosely coupled, standards-based and protocol-independent distributed computing architecture. This article realize service functions of cloud computing platform through SOA architecture extend it to the cloud computing service platform to integrate product platform resources outside enterprises, not only call a single function services in local function services but also integrated to create complex applications or phase of the business process (ter Beek et al. 2010). The product platform design services architecture is shown in Fig. 136.4.



**Fig. 136.4** The SOA technology architecture of enterprise product platform design services based on cloud computing

**136.5.2 Product Platform Resource Services Modeling and Description Techniques**

Resource services can be described by WSDL based on XML. There are three types of resource service description information: first, business information, which is about resource provider and service implementation information; second, service information, which is the characteristics of resources; third, technical information, which is about resource service details and calling information. The product platform resource service description mainly includes two parts: resource services interface definition and resource services realized. Resource services interface definition is a structure of Web Service interface definition, including service operation, operating parameter, abstract data types, web service XML message protocol, message data type information, transmission protocol, binding information, resources service address information. Resource service realized binds interface to specific network addresses, protocols and data structures. Resource services client can be bound to a specific and call resource services.

### ***136.5.3 Product Platform Resource Services Registry and Addressing Discovery Technologies***

Product platform resource services provide cataloging and management mechanisms and apply UDDI technology to register resource services and classify product design resources in accordance with resource classification methods. SOAP protocol is applied as transport layer, so that requester can communicate with UUDI registration service center by SOAP-based XML technology and find services matching with demands. UUDI registration service center maintains a list of services, including three components: basic information, classified information, and capacity information of resource services. The basic information described address, contact information and other contact information of resource services. Classified information is based on resource classification to classify information. Capacity information is about resource services' ability information of business (Baker et al. 2002). State resource in product platform resource services has three characteristics: first, state resource is a specific state data set, and expressed by XML document defining a resource type; second, state resource has a well-defined identity and life cycle; third, one or more resource services can be found and to operate state resources. Construction and representation of state resource is realized by web service resource framework (WS-RF) in product platform design services, and WS-Addressing implied resource pattern is implemented by state resources to associate with Web Service message exchange (Yagoubi and Slimani 2006). Web Service and a combination of state resources called WS-Resource, and the status of resource is implemented as an XML document known as resource properties document.

### ***136.5.4 Reliable Message Delivery Mechanism***

The product platform design services use SOAP protocol as a message transfer protocol and the protocol is extended in order to establish a reliable messaging mechanism. Message reliability is mainly reflected in three aspects: first, Messaging and transport protocol-independent; second, high quality service; third, reliability of message delivery. This paper apply WS-Reliable Messaging mechanism in Web services technology to ensure reliability for message and eliminate duplication of SOAP message, and ensure same order that message send and receive (Xiong and Perros 2009). WS-Reliable Messaging mechanism can work together with WS-Addressing protocol to achieve cross-platform interoperability. Product platform design services based on cloud computing in designing message reliability around three core elements: first, message sequence, a sequence present in the messaging between two end points and each message in message exchange is given a unique serial identifier; second, message sequence number, message sequence number set in ascending mode that can be easier to detect lost or duplicate messages, and to simplify the generation and processing of received

confirmation; third, message receive confirmation, receive a confirmation that a message has been successfully sent to a destination.

### ***136.5.5 A Integration Mode of Distributed Enterprise Service Bus***

The enterprise service bus mode can solve the problems of heterogeneity and unmatched information model to implement, deploy and manage resource service solutions, or assemble, deploy and manage distributed service-oriented architecture (Papazoglou et al. 2008). Enterprise Service Bus provides service container to assemble and bind services to external resources and provides them to any other services on the bus. As shown in Fig. 136.4, endpoints provide a abstraction of physical destination and connection information to realize an asynchronous and reliable communication among service containers based on reliable messaging protocol. Because resources in product platform design services architecture is highly distributed, enterprise service bus is distributed, a single event-driven service is inserted into backbone of enterprise service bus if needed.

## **136.6 Conclusion**

In order to enhance availability of product platform design resources, and integrate distribute product platform resources, this paper has built a product platform design service architecture based on cloud computing concepts and Web services technology to provide a product platform development environment as a service mode. It is focus on application mode, implementation processes and technology architecture of platform services architecture and finally a framework of key technologies were discussed. Next phase of work include: First, in the application service layer, we will research product platform development application services such as product platform planning application services, product family design application services, application services of modular design, simulation and technology application services; second, in the core service layer, we will research resource optimization scheduling algorithm to support distributed enterprise resource coordination optimization.

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# Chapter 137

## Research on ERP and PLM Integration Based on R&D Project Management

Xu Zhao and Kai-chao Yu

**Abstract** Due to the uncertainty of characteristics of demand, technical and periodic progress of Product R&D projects, The conventional project management software is generally difficult to meet the demand of the product R&D projects management. The integration of PLM and ERP can make the project time, cost, task and resource integrated, in order to achieve the needs of R&D projects involving the effective management of costs, resources, and progress. In this paper, built a project management system architecture based on Windchill PLM and SAP ERP integration, and have been studied the key technologies of system implementation.

**Keywords** PLM · Product R&D · Project management ERP · System integration

### 137.1 Introduction

Under the aggressive process of globalization, more and more companies have recognized the importance of the success rate of new product R&D, continue to introduce competitive new products and improve the core- competitiveness of enterprises are the fundamental way to ensure the sustainable development of enterprises (Wei and Sun 2007). Project management, as an advanced management methods, not only contribute to comprehensive management the progress, costs, resources of product R&D projects, but also improve product R&D efficiency and quality (Lu and Wang 2005). Therefore, the project management of product R&D has become a new research topic.

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Based on domestic and foreign research and application of IT project management, project management software can be roughly divided into project management and non-project management of two major categories. Project management software is based on the project's construction methods, use of network planning techniques, integrated management of a class of application software during the construction progress, costs, resources, etc. (Master's Thesis 2010), such as P3, (the Primavera the Project Planner), the MS the Project, Harvard Total the Project management, Harvard Project Manager, and so on. At present, many types of project management software have a well developed. On the other hand, non-project management software, is a business management project based on project management and enterprise management integration of enterprise management applications such as ERP (Enterprise Resource Planning) and PLM (product lifecycle management), project management is usually one of the core functionality (Chen 2006).

Because of the uncertainty of demand, technical and periodic progress of R&D project management, the R&D enterprise is often use ERP and PLM project management software. However, due to the different focus of the ERP and PLM project management—ERP system focuses on the project time and cost management, while PLM system focus on the management of project tasks and resources. Therefore, ERP and PLM integration can be achieved effectively manage all the work involved in the project. In other words, based on the PLM and ERP integration project management can achieve the needs of product R&D projects, costs, resources, and the progress of a comprehensive, systematic management, it is worth in-depth study (Chuan and Luo 2009).

## 137.2 The Characteristics of R&D Project Mangement

R&D enterprise project management focuses on the whole process of management of R&D projects, R&D projects from the decision-making, project control, acceptance, trial production, the market reaction processes formed a large circle, while each of the specific implementation process a link composed of many small processes. R&D project has the following characteristics (Zhang and Zhang 2008; Qiu et al. 2003; Zhai 2000):

1. The uncertainty of demand, R&D projects can only be a rough target, may be the entire development process is a learning process, it is difficult to take a whole consider of the project details in the feasibility analysis stage.
2. The technological uncertainty, R&D project needs to overcome one or more technical problems in the process of research and development. It requires repeated judgment established the feasibility of technology roadmap, and the need to rely on external forces, etc.;
3. R&D projects have characteristics of the type of material parts of many but a small number.

The difficulty of R&D project management is:

1. R&D projects the need for timely follow-up market demand, resulting in a lot of R&D projects to the lack of overall R&D project strategy, in order to seize market opportunities, to accelerate the progress of the project, resulting in the increase in the rate of failure of the project.
2. R&D projects need in the project implementation process does not stop the overcome the technical problems and technical research, project progress is difficult to control, despite the project have a detailed project node program, but the actual implementation of it is difficult to achieve, and unable to timely carry out risk tips and alarm (Wu 2000; Pener 2005).
3. R&D project process knowledge information, the need for careful knowledge management, need a reasonable knowledge management and sharing of ways to make that knowledge can be passed to improve the similar R&D projects in enterprises, and improve the efficiency of the Enterprise Project Management (Ren 2004).

### 137.3 The Main Method of PLM and ERP Integration

There are three type methods of PLM and ERP integration. First, the public interface platform developed by PLM-owned or ERP-owned software company, such as SAP XI, SAP's exchange infrastructure is an application integration platform SAP NetWeaver middleware products the part is used to provide a platform for other heterogeneous systems with SAP data and processes interact. Public interface platform provides a variety of heterogeneous systems interface, easy to operate, but requires companies to purchase the module, and employ the module consultants for guidance, the costs incurred are generally spend so much, many enterprises to take difficult to apply, it is Applies to to large enterprises, and enterprises are involved in many kinds of information systems of the type of underlying database (Zhang 2002; Zhang 2002). The second way is direct database access, after the analysis of PLM and ERP systems database, direct access to the interaction between the two systems database (Hugh 2001). Third through business self-developed intermediate data in the middle of table conversion, real-time transmission of data, the investment in this way is small, quick, but generally only applies to data transfer between two systems. The multi-system will have a greater risk (Wang 2009).

This study only involved in PLM and ERP systems, so choose the third approach for integrated design and development.

137.4 The Information Model Based on PLM and ERP Integration

PLM and ERP integration module release the WBS and BOM data to the ERP system, publish the module to split the project to the specific tasks and split into parts data of material data, then integrated package in the form of release, release data stored as XML in the specified directory of the ERP system, ERP system conversion ERP WBS and BOM data. PLM and ERP integration information model in Fig. 137.1.

The biggest difference between ERP-PLM integration based on Project management and general ERP-PLM integration is that the transfer of information between the two systems is not only based on the BOM information, but also require the transfer of the project WBS, and project task split and issued. The BOM transfer between ERP system and PLM system makes the enterprise as a whole to the parts in the process of R&D projects for the control of the whole process, from the drawings, digital to analog models, assembly drawings to the relevant parts procurement, vendor selection, inventory control, and overall management of the R&D projects in various parts. However, if the R&D projects as a whole control, the WBS elements are the important elements need to pass between two systems, In the PLM system to build the project in the project WBS

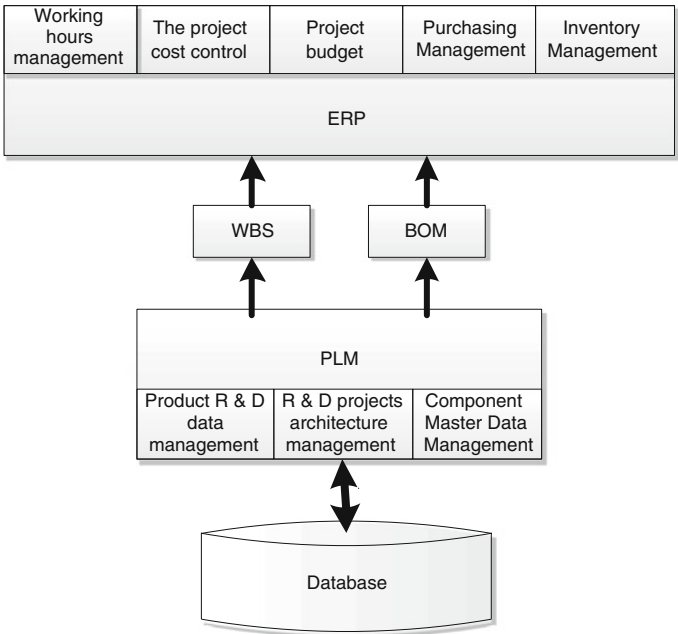


Fig. 137.1 the PLM and ERP integrated information model diagram

structure to determine the time of the project node and key nodes, after the interface through the middle of the WBS architecture and the corresponding project node and transmission of information to the ERP project in the ERP project budget for the project funding programs, materials and working hours, consumption control. Thus, it is reasonable to control project costs and tasks of the various stages of time, reduce the cost of doing business risk, and improve enterprise efficiency.

The data release from PLM to the ERP system:

1. The WBS structure of project and various stages of time node split the middle of the program WBS for specific tasks planned by the project management module of the ERP software implementation of the mandate.
2. Parts, including the encoded version, the drawing version and the involved manufacturers model attribute information by the corresponding modules of the ERP software, parts procurement, and various parts inventory management.
3. BOM structure information, Cloth to ERP BOM structure information BOM three elements: the parent, the number of sub key and sub key.

Data dissemination rules PLM-side data table to the three types of information from the ERP interface table one-to-one mapping, and ultimately through the program interface in the ERP software to create the appropriate project structure, corresponding to the procurement plan, the implementation of the project tasks (Wang 2009).

### **137.5 The Key Technologies of Integrated Development and Realization**

Establish a standardized and unified interface data structure design is a key technology integration and implementation of PLM and ERP, PLM integration output to establish a unified data structure of the base table, the other systems required to enter all the information classified in the base table in a seemingly close actually very flexible integration; implementation and development is fairly easy to do so in the application of the integrated system. Only need to create the same data structure and the same name of the base table view, this integrated approach and procedures designed to naturally have a comprehensive migration and inheritance.

The integrated solution is the most important technical point is the data reorganization technology, construction code generator.

1. The data reorganization is one of the ultimate goal of PLM and ERP integration, data sharing and use of data reorganization to achieve data consistency, to reduce the complicated types of interfaces between systems;
2. When integration of the two systems using the middle of the table, the structure of the code generator is very important. Generally, the formation of the concept

of parts and materials generated at the stage of product development and design, this time also generate the formation of the items code in the PLM system, production planning, procurement, use of the above items code. However, the heterogeneous ERP system and PLM system may exist to express the mutual opposite sex and multiplicity of the same items encoded. So in the design of the integrated program will generate a code translation table to construct a code generator translates the information of the two different encoding WBS coding, and data transfer between two systems.

## 137.6 Conclusion

PLM solution of the product development process, data and process management, and R&D department, the relevant departments of the enterprise, collaborative applications on the product data between enterprises and R&D projects in the tasks and the cycle of detailed and accurate control; and ERP is overall balance and optimize the management of human, financial, material, information, time and other resources owned by enterprises. PLM and ERP integration, play to the strengths of the two management software, to solve a large number of special needs exist in the R&D projects.

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# Chapter 138

## Research and Application of General Collision Detection Simulation Platform

L. Zeng, T. Ning and P. Xi

**Abstract** System architecture of simulation platform based on assembly model with constrained motions is presented. By using accurate collision detecting algorithm library, collision detection function is implemented in the simulation platform. Control mechanism of the simulation platform is illustrated. To verify the practicality of the system and validity of the algorithm, a three dimensional numerical control tube bender simulation system is built based on this platform.

**Keywords** Assembly model · Collision detection · Constrained motion · Pipe bending machine · Simulation

### 138.1 Introduction

Collision detection simulation system has a wide range of practical applications, for example, there are great demands for it in engineering fields, such as assembly process simulation, motion simulation of CNC machining, scheduling of transport equipment in warehouse, port constructing simulation, cargo handling management and so on (Qu and Xi 2002; Li and Cai 2002; Zhou 2008; Duan et al. 2007). The main research of this paper is about the collision detection simulation system for mechanical equipment. The related softwares include Dassault Systèmes's VirtualNC, CGTech's VeriCut, etc. Existing simulation systems generally use OpenGL as internal graphics platform, models that can be imported include 3DS (Li 2007), VRML and so on. Chen (2008) uses Solid works to establish simulation system directly. SimMechanics (MathWorks 2009) realizes the export of assembly model of commonly used CAD software by plug-in method, it can also be

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exported through the API function provided by SimMechanics. Yang (2006) uses XML technology to store assembly model information, which facilitates the follow-up data retrieval and application. Literature (Feng 2007) uses sample-point method to implement collision detection. Literature (Duan et al. 2007) adopts bounding box subdivision to deal with collision detection. Ali (1996) uses linear programming to implement real-time collision detection of convex polyhedral in translation and rotation conditions. Zheng et al. (2005) implements collision detection of assembly model by fast detection method based on hierarchical subdivision. Miguel and Lin (2003) uses double-layer multi-resolution to improve detection efficiency, and OBB-tree (Gottschalk et al. 1996) is a common method. However, existing collision detection simulation systems have the following problems:

- VirtualNC and other software are basically for CNC machine tool, but can't implement the simulation of other types of mechanical equipment (such as CNC pipe bending machine (Wei et al. 2001)).
- In assembly modeling, some simulation systems depend on the specific CAD software, or lack the necessary assembly relations, assembly constraints and some other information, which would hinder the subsequent simulation application (Smith 2006).
- In the collision detection algorithm, the current literatures generally adopt discrete method based on bounding box, which is hard to ensure the detection precision and speed (Yang and Zheng 2005).

To improve the practicality and usability of the simulation platform, this paper derived assembly relations, constraint relations and parts geometric data based on the assembly model of CAD software. Related assembly information is recorded in text file, and parts geometric information is stored in file similar to STL. Objects defined in simulation platform correspond to these defined in CAD system's assembly models, which would facilitate data transformation and motion constraint relations building. The G-code is used to define the system's trajectory and control equipments' running status. To improve the precision and efficiency of collision detection, we developed our own exact algorithm library, based on which we implemented collision detection in simulation platform (Sun 2007; Tang 1994; Wan et al. 2006).

The rest of this paper is organized as follows. In the methodology, Sect. 138.2.1 introduces the relations and definitions of three kinds of objects in assembly model. Section 138.2.2 discusses kinematics constraint object based on the degrees of freedom of assembly model and the driven approach. Section 138.2.3 introduces the interface design of collision detection algorithm library. Section 138.2.4 gives the process analysis of model simulation. The results analyze the collision detection algorithm library and the test results of assembly model simulation. The last section summarizes the research contents of this paper.

## 138.2 Methodology

### 138.2.1 Representation of Simulation Model

Product assembly mathematical model mainly describes hierarchical relations and assembly relations between product parts and components, as well as the constraint relations among assembly design parameters in different levels of assembly body:

1. Hierarchical relations. Product parts and components have hierarchical relations. A product can be decomposed into several components and parts, a component can be decomposed into several parts. These hierarchical relations can be visually represented as the assembly tree. The root node of the assembly tree corresponds to the product, every leaf node stands for each part, and the mid-side nodes stand for components. Assembly tree visually expresses the affiliate relations among products, components and parts.
2. Assembly relations. Assembly design in product parts and components is expressed by assembly relations between each other. The basic assembly relations include positional relation, connection relation and fit relation, etc.
3. Kinematic relations. Kinematic relations describe the relative motion and transmission relations between components.

The core data of assembly mathematical model in this paper is component and fit relations. Component consists of parts and subassemblies, while fit relations consist of fitting, aligning, coaxial, parallel, vertical and tangent, etc. All components in assembly model constitute a hierarchical model according to the nested relations between each other. Components in the same level belong to the same assembly, and they have fit relations but no nested relations. Components in different level do not belong to the same level, and they have no fit relations but nested relations. Degrees of freedom (DOF) of a part is the number of possible movement patterns of the part while it is assembled with the connected parts under the constraints relations, and the connected parts are assumed to be fixed. Degrees of freedom can be divided into translational degrees of freedom (TDOF) and rotational degrees of freedom (RDOF),  $DOF = TDOF + RDOF$ . If a part is connected with no any other parts, then its  $DOF = 6$ , that means it has three translational degrees of freedom and three rotational degrees of freedom. When the six degrees of freedom have all been constrained, then  $DOF = 0$ , it is full constraint state. When  $6 > DOF > 0$ , it is under constrained state.

Related model objects are briefly described as follows. The data members of assembly model object CAsm mainly include name, bounding box and component set. The data members of Component object CComp mainly include local coordinate system, part model (or assembly model) and degrees of freedom attribute. The data members of part model object CPart mainly include name, material property, triangle set and bounding box. The degrees of freedom attribute of

component contains specific geometric information. For example, rotation axis information is recorded for the rotational degrees of freedom. The geometric information will be used to define kinematics constraints.

### ***138.2.2 Realization of the Constrained Motion***

First we should note that each component of assembly model has a local coordinate system and a number of assembly constraints (such as fitting, aligning or coaxial, etc.). Moving parts have certain degrees of freedom, such as for 3D CNC pipe bending machine, the bending arm (C axis) has a rotational degrees of freedom, and the car (Y axis) has a degrees of freedom of straight-line motion. To associate the moving parts in assembly model with the straight-line motion and rotational motion of mechanism, we proposed axis object (CAxis) simulation servo motor. Since this paper is only for collision detection simulation, we deal with simplified motion control model, and the change of acceleration and deceleration is not in our consideration. The main attribute of CAxis include motion type (straight-line or rotational), current coordinate, movement direction signs, total displacement, speed, movement starting time and so on.

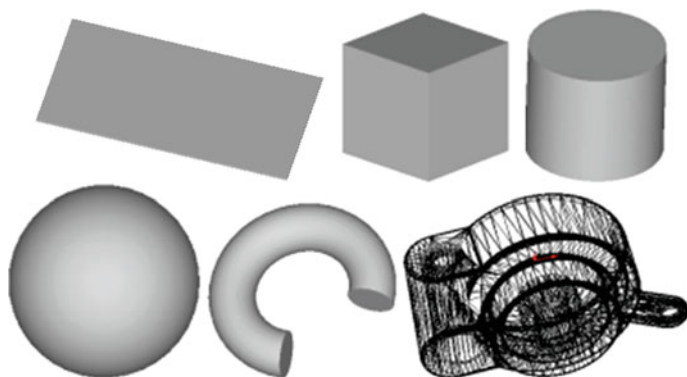
The main interfaces of CAxis:

- Initialize. The interface is used to initialize a movement, and to specify the movement direction, coordinate increment, movement speed and starting time.
- Get the current coordinate (YBC data).
- Status update. The interface function is constantly updating CAxis coordinates, and inputting the current time, positive and negative limit position, outputting coordinate increment and limits.
- Reset. This interface is used to reset all state parameters of CAxis.

Every motion axis of machine tool corresponds to a CAxis object. When a movement starts, if it is a single-axis movement, then a corresponding axis CAxis is initialized; if it is interpolation, then several corresponding axes CAxis are initialized at the same time. The input parameters are movement direction, coordinate increment and starting time. Then, current axes CAxis coordinates would be updated every time slice and the local coordinate system of the corresponding components in assembly model are updated according to axes CAxis coordinates, then the whole assembly model starts to move.

### ***138.2.3 Collision Detection Algorithm Library***

Six types of geometry were defined in collision detection library to enhance the generality of the system. These geometries are half-space, cube, cylinder, sphere,



**Fig. 138.1** Basic geometries and general polyhedron

torus and polyhedron. The surface of polyhedron is triangular mesh, as shown in Fig. 138.1.

To ensure the collision detection precision, the algorithm library doesn't adopt discrete algorithm but dozens of geometrical and algebra accurate algorithm. There is no complete collision detection algorithm based on accurate calculation in existing literatures, for example, no accurate algorithm for cutting torus has been provided at present. Results from collision detection contain two collision geometries, collision marks, interference depth, collision point and some other information. To detect the collision of assembly model, first we use the bounding box of each component in assembly model to judge the collision roughly, then for the parts whose bounding box intersected, we use algorithm in collision detection library to detect the collision precisely. The algorithm is developed by our own research group and is in patent application, and will be introduced in another paper. This paper only gives the test results.

To realize the openness of the general simulation platform, the collision detection algorithm is designed to be independent algorithm library, and is associated with simulation platform by standard interface.

#### ***138.2.4 Control Mechanism of Simulation Platform***

The motion trajectory and running status of model in simulation platform is defined by G-code in ISO standard. G-code consists of word and block. Each word has a key word, key word G stands for movement, M stands for ready to action, S stands for speed of main axis and F stands for feed rate. A number of words form a block. For example, G00 X0 Y100 Z50 is a block formed by three words, G00 stands for fast straight-line motion, XYZ stands for coordinate values.

G-code compiler handles G instruction set inputted into it and output specific motion control commands to drive each related axis to produce movement, and

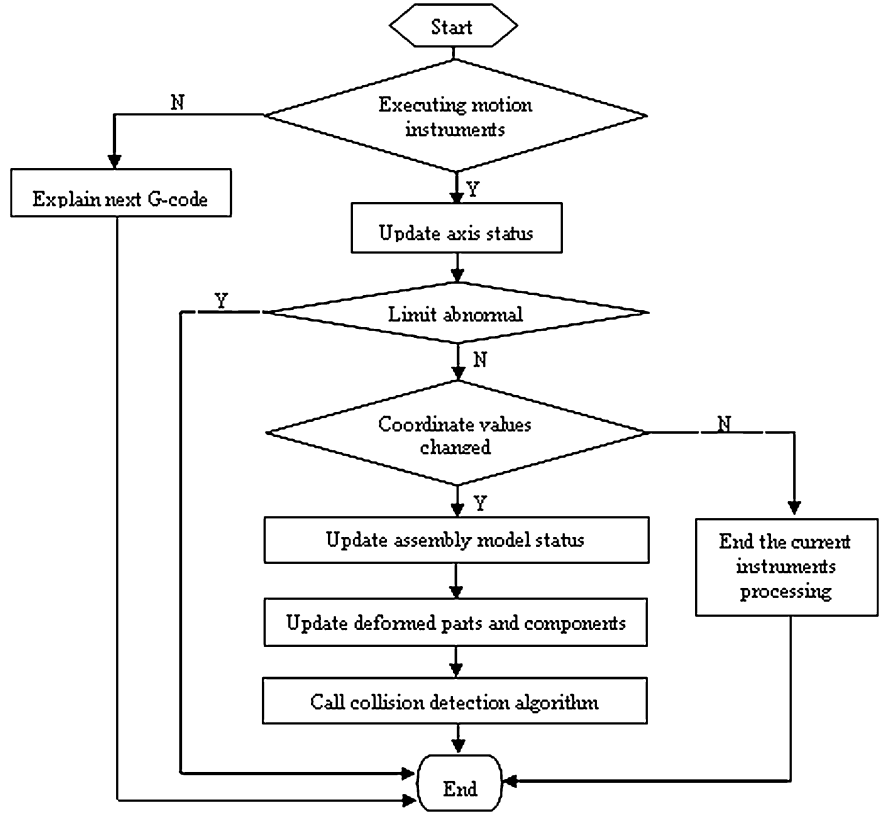


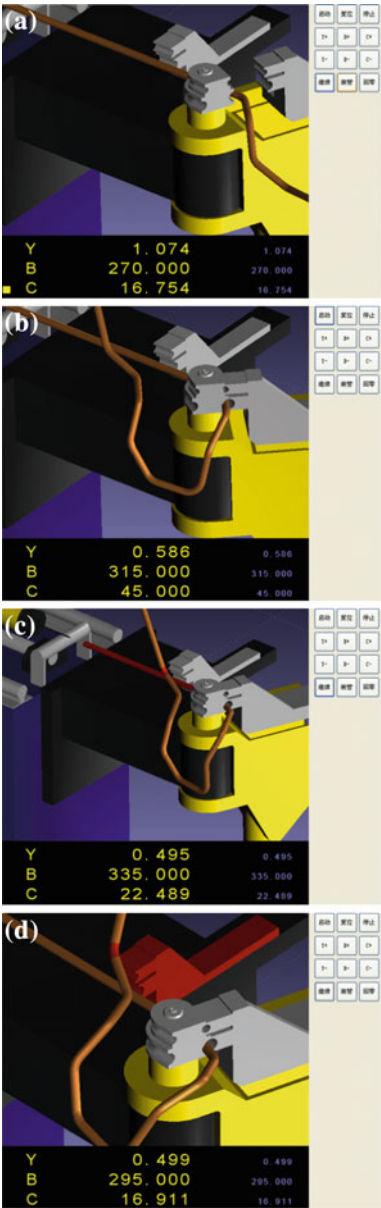
Fig. 138.2 System status update mechanism

then mechanism starts to move. A timer is defined in simulation system, and every time slice (such as 0.001–0.01 s) it would perform a subroutine to update model status, as shown in Fig. 138.2.

### 138.3 Results

We built general collision detection simulation platform with VC6.0, OpenGL graphics package and collision detection library in Windows XP system. Based on the simulation platform we implemented 3D CNC pipe bending machine simulation system. The whole mechanical model of pipe bending machine consists of 7 assemblies and 18 parts, and occupies 5.3 MB space. The YBC three axes of pipe bending machine can be manually controlled to rotate by single step. Pipe can be bent continuously by executing G-code, and it can also be bent step by step manually. The simulation system displays the current coordinates and G-codes

**Fig. 138.3** Collision detection. **a** Pipe bending process 1. **b** Pipe bending process 2. **c** Collision of pipe itself. **d** Collision between pipe and machine tool



real-time. Wall and ground can be added to the system as collision constraints. The system status (that is collision detection) updates every 0.01 s. The pipe bending simulation system implements collision detection between pipe fitting and machine tool, pipe fitting and pipe fitting, pipe fitting and wall or ground.

**Table 138.1** Test results of collision detection algorithm

Pipe bending time duration	Number of detection	Total time consuming of algorithm	Single detection time	Maximum single detection time
12.3 s	300	0.492 s	1.6 ms	16 ms

Parts in collision section are shown in red during the simulation, as shown in Fig. 138.3. From the test results we can find that the collision detection algorithm library can detect collision accurately. Our test hardware platform is DELL Vostro1400, CPU is Intel(R)Core™2Duo and 1 GB of physical memory. The collision detection algorithm is relatively the most time-consuming when pipe fitting or machine tool is about to collide or has already collided. The specific test results of case c in Fig. 138.3 are as follows (Table 138.1).

138.4 Conclusion

This paper presents the general simulation platform architecture with kinematic constraints based on assembly model, and implements CAD model import, G-code parsing and system simulation control mechanism. Collision detection of the system based on accurate collision detection algorithm has also been implemented. Take 3D CNC pipe bending machine as example, we verified the practicality of the simulation system.

To further improve the general simulation system and apply it to assembly and simulation field, the follow-up work is mainly in three aspects. The first one is to support more model definition file format, such as the wildy used VRML file format, as well as lightweight CAD model JT and 3DXML file format offered by UG and CATIA. The second one is to integrate the platform with simulation software, and realize Working Model 3D or ADAMS data interface. The third one is to optimize the collision detection algorithm library, and implement accurate calculation of interference amount (interference depth).

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# Chapter 139

## Resource Productivity in Tianjin Based on Ecological Footprint

Jian Li and Zhe Pan

**Abstract** This paper regards the ecological footprint as the comprehensive indicator of natural resource to Calculation and analysis the resource productivity in Tianjin from 2000 to 2010. The results indicated that the resource productivity generally represented the trend of escalation in Tianjin. The resource productivity increased 1.66 times from 1128.778 yuan per hectare in 2000–3005.613 yuan per hectare in 2010, the average annual increase value was 187.68 yuan per hectare. The GDP growth rate of Tianjin exceeded the growth rate of ecological footprint, but the growth rate of resource productivity is less than GDP growth rate. So the pressure on the environment in Tianjin still increases gradually. The growth rate gap between resource productivity and GDP has narrowed since 2003. This is consistent with the fact of more pollution disposal investment, higher resource productivity and better environmental quality.

**Keywords** Ecological footprint · Resource productivity · IPAT model · Tianjin

### 139.1 Introduction

At present, to develop recycling economy, and build a resource-conserving and environment- friendly society has become the important objectives of China, and the key to achieve this goal is resource productivity theory. Living Planet Report

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2008 of World Wide Fund for Nature (WWF) tells us, we consume resources too fast, so that beyond the speed of updating of the resource. As reckless spending causing economic recession, reckless spending will also run out of global resources, and endanger future prosperity (Loh and Steven 2008). Living Planet Report 2010 indicated that by 2030 the human will need two earth to absorb carbon dioxide and to satisfy the demand for natural resources (Loh and Steven 2010).

The importance of resource productivity was acknowledged in the very early, the British economist Jevons had involved it in “coal crisis” in 1865 (Pearce 2001). Since the 1990s, resource productivity research has entered a rapid development period, and the definition and calculation method formed a preliminary unity. In short, resource productivity refers to output efficiency of resources (Pearce et al. 1989). But this definition has its narrowness and one-sidedness, so the improvement of the definition continues on. For example, Material Input Per Service Unit (MIPS) proposed by Hinterberger et al. (1997) is a definition which expanded resource productivity from the output per unit resource input to the service attached to per resource. From the essence of sustainable development, the emergence of MIPS is a great progress undoubtedly.

Since the reform and opening up, China's economy has been in a steady, rapid growth pattern, but economic growth largely depends on the expense of resources, the economic growth pattern is characterized by “high investment, high consumption, high pollution” (Jinping 2009). At present, China is in a stage of accelerated development of urbanization and industrialization. The contradiction between economic development and environment and resources protection is becoming increasingly acute (Jiansheng et al. 2008). Sustainable economic growth must be constrained by resource bottlenecks, so we have to improve the efficiency of resource utilization on the basis of protecting environment.

## 139.2 Methodology

### 139.2.1 Principle

Resource productivity is the ratio between the Value of a country or region or enterprise socio-economic development and the physical quantity of resources and environment consumption (He et al. 2010). It represents the relationship between economic growth and environmental pressures. The resource productivity is a good substitute for labor productivity, but the notion can't be practiced in a feasible way (Giancarlo 2006). The reason is that no indicator has been found to denote the collective consumption of natural resources. Therefore, the only way is to estimate the productivity of energy, land, water, materials individually.

Ecological footprint (EF) method presents a methodologically simple but integrated frame work for national natural accounting of capital (Wackernagel et al. 1999), which is capable of measuring the impact of Human's consumption on ecosystem. Through the introduction of the ecological productive area to realize the integrated of natural resources, the ecological footprint can measure the consumption of natural resources comprehensively. Therefore, EF can represent the input of all kinds of natural resources in the production function in some way.

### ***139.2.2 Ecological Footprint***

“Ecological footprint” (EF), refers to the biologically productive land area (including land and water) consumption of resources and services to produce a certain population, and to absorb the waste these populations produce (Wackernagel and Rees 1996). All of the indicators which ecological footprint method involved should be replaced by the corresponding biologically productive land area.

This method not only reflects the occupation of the natural capital, but also reflected the impact of human consumption of natural.

### ***139.2.3 Resource Productivity***

“Resource productivity” (RP) is a measure of the resource use efficiency (Ruoyu 2008). It combines ecological footprint indicators and economic indicators to comprehensively reflect the efficient use of resources. “Resource productivity” (RP) is the ratio of GDP and ecological footprint.

$$RP = \frac{GDP}{EF} \quad (139.1)$$

EF refers to ecological footprint. Because natural resource is limited, and in the mining will produce the environment load, we should improve the resource productivity to create more GDP by fewer resources.

### ***139.2.4 Synergy Effects of Economic Development and Environmental Pressures***

In the ideal state, human and nature should live in harmony, co-evolution and balance each other.

This paper uses IPAT model to measure the relationship among material consumption, environmental degradation and economic growth.

IPAT model was first proposed by famous demographer Ehrlich and Holdren of Stanford University. It is actually an identity about the environmental impact (I), population (P), affluence (A) and technology (T) (Huang 2006). It can be expressed as:

$$I = P \times A \times T \quad (139.2)$$

“A” represents the average annual per capita GDP. It can be expressed as:  $A = \frac{GDP}{P}$ . From a resource perspective, “T” represents the resource consumption per unit GDP, that is:  $T = \frac{EF}{GDP}$ .

Considering that the resource productivity can represent the relationship between economic growth and environmental pressures, the IPAT model can be used to analysis resource productivity. It can be seen that the RP and T has a reciprocal relationship, Eq. (139.2) can be expressed as:

$$I = \frac{P \times A}{RP} = \frac{GDP}{RP} \quad (139.3)$$

Set the base year's GDP and resource productivity for GDP<sub>0</sub> and RP<sub>0</sub>, the average annual growth rate of GDP and resource productivity for RGDP and RRP, then GDP and resource productivity in year n are as follows:

$$GDP_n = GDP_0(1 + R_{GDP})^n \quad (139.4)$$

$$RP_n = RP_0(1 + R_{RP})^n \quad (139.5)$$

The environment load of year n is:

$$I_n = \frac{GDP_n}{RP_n} = \frac{GDP_0(1 + R_{GDP})^n}{RP_0(1 + R_{RP})^n} \quad (139.6)$$

Equation (139.6) shows that, when GDP and resource productivity has grown exponentially, the environmental load (or resource consumption) may rise, remain unchanged or decrease, its conditions are as follows:

1. If  $R_{GDP} > R_{RP}$ , the environmental load (or resource consumption) will increase with GDP growth year by year, and the greater the difference between RGDP and RRP, the faster environmental load (or resource consumption) increases;
2. If  $R_{GDP} = R_{RP}$ , the environmental load (or resource consumption) and economic growth will achieve “decoupling” (no matter how GDP grow, environmental load or resource consumption will not rise);
3. If  $R_{GDP} < R_{RP}$ , the environmental load (or resource consumption) will decline with GDP growth year by year, and the greater the difference between RGDP and RRP, the faster environmental load (or resource consumption) declines;

### 139.3 Data Collection and Processing

This paper uses a comprehensive method to calculate the ecological footprint of Tianjin. The data is from calendar year “Tianjin Statistical Yearbook”. In the data collection process, according to the results already at home and abroad, the actual situation in Tianjin, do the following treatment:

- A. Divided consumer items, and calculate the consumption of major consumer items and waste elimination on natural resources. In this paper, consumer project is divided into three categories: the consumption of biological resources (mainly the consumption of agricultural products, livestock products, aquatic products and forest products), energy consumption, building land.
- B. The average yield data, these two types of resource consumption were converted into the six categories of ecological productivity of the main land and water ecosystems in accordance with the region’s ecological capacity and waste elimination, the assimilative capacity of the area (arable land, grassland, woodland, fossil energy land, built land and waters).
- C. Conversion. Per unit area of arable land, fossil energy land, grassland, woodland and other biological production capacity very different, in order to make the calculation results into a standard of comparison, it is necessary to multiply each of the biologically productive area by an equivalence factor, to transfer it into unified, comparable biological productive area. Equivalence factors refer to the comparison of a certain type of land with world average productivity of land. Each kind of ecological system equivalence factor is determined by the unit space area of each ecosystem type relative biomass production. WWF’s latest adjustment, namely: arable land, 2.19; grassland, 0.48; waters, 0.36; woodland, 1.35; built land, 2.19; fossil energy land, 1.35 (Meng 2007). They weigh the equivalence factors basing on the maximum potential crop yields of the various types of land estimated by the FAO Global agro-ecological zones (GAEZ) and the International Institute for Applied Systems Analysis (IIASA) (Wackernagel 2002). In the specific calculation, because continental shelf is the biggest currently available marine resources so marine waters area mainly refers to the continental shelf (Table 139.1).

According to the calculated results finishing Tables 139.2, Table 139.2 is for the 2000–2010 real GDP in Tianjin, the ecological footprint (EF) and resource productivity (RP) values. In 2010, the GDP, ecological footprint (EF) and resource productivity (RP), respectively, compared with the 2000 increased by 442.0, 75.1 and 209.6 %, with an average annual growth rate of 44.20, 0.75 and 20.96 % respectively. In the analysis of 11 years, Tianjin’s annual growth rate of resource productivity is less than the annual GDP growth rate, and is consistent with condition (139.1).

**Table 139.1** Ecological footprint and its components in Tianjin from 2000 to 2010

Years	Per capita ecological footprint of various types lan (hm <sup>2</sup> /person)				Per capita ecological footprint (hm <sup>2</sup> /person)	Population (million)	Ecological footprint (hm <sup>2</sup> )
	Arable land	Grassland	Woodland	Fossil energy land			
2000	0.224	0.5491	0.0043	0.7882	0.0311	0.0565	1.6532
2001	0.2436	0.5819	0.0043	0.9071	0.0375	0.0589	1.8332
2002	0.238	0.5973	0.0043	1.0726	0.0594	0.0596	2.0312
2003	0.2419	0.6089	0.0043	1.1132	0.0798	0.062	2.1101
2004	0.247	0.6064	0.0043	1.1936	0.0882	0.0651	2.2046
2005	0.2523	0.6131	0.0043	1.2376	0.1047	0.0657	2.2777
2006	0.2512	0.6149	0.0043	1.3368	0.1112	0.0661	2.3845
2007	0.2506	0.5654	0.0046	1.4463	0.1162	0.0683	2.4513
2008	0.2514	0.5764	0.0047	1.5634	0.1282	0.0685	2.5926
2009	0.2484	0.5896	0.0047	1.6273	0.1392	0.0704	2.6795
2010	0.243	0.6183	0.0051	1.6314	0.1134	0.0691	2.6803

**Table 139.2** Tianjin resource productivity

Years	Ecological footprint (hm <sup>2</sup> )	Ecological footprint growth rate (%)	Real GDP (one hundred million yuan)	Real GDP growth rate (%)	Resource productivity (yuan/hm <sup>2</sup> )	Resource productivity growth rate (%)
2000	1,50,77,184	—	1,701.88	—	1,128.778	—
2001	1,67,55,081	11.13	1,720.312	1.1	1,026.74	−9.04
2002	1,86,67,744	11.42	1,931.084	12.3	1,034.45	0.75
2003	1,95,39,526	4.67	2,190.836	13.5	1,121.233	8.39
2004	2,05,58,997	5.22	2,600.487	18.7	1,264.89	12.81
2005	2,13,94,664	4.06	3,086.791	18.7	1,442.785	14.06
2006	2,26,26,282	5.76	3,691.184	19.6	1,631.37	13.07
2007	2,3,510,418	3.91	4,389.554	18.9	1,867.068	14.45
2008	2,51,18,924	6.84	5,298.238	20.7	2,109.262	12.97
2009	2,62,54,813	4.52	6,719.01	26.8	2,559.154	21.33
2010	2,63,96,935	0.54	7,933.898	18.1	3,005.613	17.45

## 139.4 Conclusion

Through the calculation of the Tianjin's resource productivity and the detailed analysis of the relationship between economic development and environmental pressure, the following main conclusions can be reached:

- A. The analysis of Tianjin's GDP, the ecological footprint (EF) and resource productivity (RP) in 2000-2010 shows that, Tianjin's GDP growth rate is higher than the growth rate of the ecological footprint (EF), but the growth rate of resource productivity is lower than the GDP growth rate. That indicates that environment pressure of Tianjin is still increasing.
- B. Since 2003, GDP and resource productivity gap was becoming narrowed. The reality is consistent with the fact of more pollution disposal investment, higher resource productivity and better environmental quality.
- C. The resource productivity of Tianjin had a gradual upward trend, but the IPAT model analysis results showed that the "high investment, high consumption, high pollution" mode of economic development had not fundamental changed.
- D. By improving resource productivity and promoting the absolute reduction of consumption of substances (or resource), the sustainable development of Tianjin can be finally achieved.

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# Chapter 140

## Research on Operation Mode of Green ERP Based on Multilife Cycle

Yong Ren, Min Zhou, Yan-xia Chen and Hua Zhang

**Abstract** By analyzing the background and research fields of green manufacturing, the authors propose the concept of green ERP (enterprise resource planning) based on multilife cycle, elaborates its essence and characteristics. On the basis of that, an operation mode of green ERP is built and each operation stage of it is expatiated in detail. During multilife cycle of green ERP, the factors of cost and resource efficiency are focused on. The proposed operation mode is a comprehensive qualitative answer to the question of what is green ERP as well as a roadmap for future quantitative research to better understanding.

**Keywords** Green · Multilife cycle · Operation mode · ERP system

### 140.1 Introduction

The way of society development is challenged by environment, resource and population problems, and the mode of sustainable development is expected to be a selection for human being. Achieving green sustainable development mode of high efficiency, low cost and energy consumption and less environment pollution becomes goal of human society development. The “Twelfth Five Year Special Program” led alone by Minister of Science and Technology, presents two special programs: great task of manufacturing informationization and green manufacturing.

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The Ministry of Industry and Information also argues that green growth in industrial development and information is a new growing point.

At present, green subject is widely researched, such as green manufacturing (Fei and Cao 2000; Ahmed 2011, green design (Zhu and Deshmukh 2003), green supply management (Gavronski et al. 2011), green project management and so on. Green IT/IS (Dedrick 2010; Chou and Chou 2012; Joumaa and Kadry 2012; Jenkin and Webster 2011; Zhang and Liu 2011; Bose and Luo 2011) subject is also involved, but it mainly focuses on energy consumption and enterprise implementation strategy from perspective of enterprise. Among them, green ERP is rarely involved. In process of informationization, ERP system is also required to be more and more scientific with the development of industry management. It is required to be innovation and green feature etc. Indeed, virtualization of hardware and embedding accounting of environment cost (Li 2005) into ERP system to save electric energy and reduce environmental impact are concerned by some scholars, but greening ERP system itself is ignored, such as adopting green design of ERP system based on multilife cycle and green development of ERP system based on virtual team. Generally speaking, green ERP is in a fuzzy concept and growth period. Based on the analysis above, the authors propose a concept of green ERP based on multilife cycle and analyze its essence and characteristics by referencing philosophy of green manufacturing.

## **140.2 Concept and Characteristics of Green ERP Based on Multilife Cycle**

### ***140.2.1 Concept and Essence of Green ERP Based on Multilife Cycle***

According to value theory, green technology is a combination of multivalue. It takes green ecotype society and environment value as its core beyond traditional enterprise boundary. Green technology integrates the benefits of customers, society and environment with process of company value's increment. From perspective of cost (including primary development cost and secondary upgrade cost) of ERP development taken by customers (enterprises that implement ERP system), an efficient and low cost green ERP based on multilife cycle aims to achieve unification of economic, environmental and social benefits. In this paper, green ERP is defined as following: green ERP based on multilife cycle is a green philosophy of management, method and tool which integrates with traditional ERP system such as purchasing management, design and production management, sales and distribution management, and embeds environment cost management module into financial management subsystem and so on, is oriented for customers demand and market, associates with advanced technology superiority and supports rapid reconfiguration technology, emphasizes on high efficiency, low cost during

multilife cycle stage to optimize resource allocation of inter and extern of enterprises for unification of economic, environmental and social benefits.

Green ERP based on multilife cycle extends traditional space and time boundary of ERP system, its essence integrates with system theory during multilife cycle to achieve green goal of high efficiency and low cost. Its essence can be understood from the following aspects:

- (1) From perspective of ERP system itself, green ERP system requires a green design in system architecture and a guarantee of perfect performance quality such as a good system expansibility, reconfiguration and portability and other advanced technology merits to own the ability of upgrading or “remanufacturing” that oriented for multilife cycle. This perspective presents the green merit of reuse, remanufacturing and other green requirements.
- (2) From perspective of development process of ERP system, green ERP requires a green operation model of development team to reduce cost, especially the human resource cost, to promote resource efficiency of development process. So a collaborative method and platform, such as virtual team, information network technology and so on, should be taken to guarantee a green ERP development process.
- (3) From perspective of customers, green ERP is required to own the ability of promoting enterprises’ green management level based on GSCM(green supply chain management) and cultivating green culture for enterprises.

### ***140.2.2 Characteristics of Green ERP Based on Multilife Cycle***

On the basis of a thorough understanding of essence about green ERP based on multilife cycle, a three dimensional characteristics model is built by referring to philosophy of green manufacturing. In this three dimensions model, green evaluation on ERP will be made in different project stages according to resource consumed by each stage. The green degree is evaluated by time, quality, cost, resource, environment five dimensions. Then an accumulated green degree curve will be made after evaluations. In fact, the accumulated green degree curve oriented for multilife cycle varies from different ERP projects and different stages. It is shown as Fig. 140.1.

#### **140.2.2.1 Process Dimension**

Process dimension extends life cycle of green ERP system. It includes demand analysis, system analysis, system design, system development, system debugging, system running, system service, system upgrade, and developing next generation system and so on. For example, in process of design and plan for green ERP system, not only a thorough consideration on factors those affect this generation

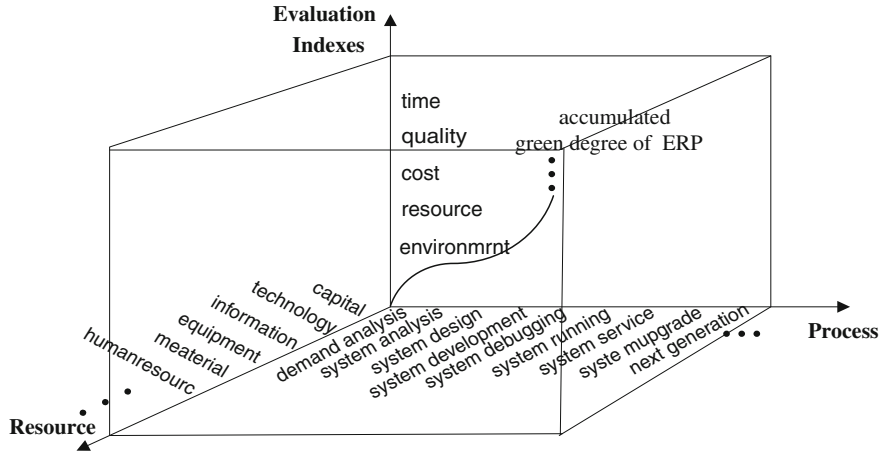


Fig. 140.1 Characteristics of green ERP based on multilife cycle

ERP system should be predicted, but also a further research on next generation ERP system such as upgrading cost, technology feasibility and other factors, should be considered.

So that an overall consideration on cost (consists of development cost, running and maintenance cost, upgrade cost), technology portability and reconfiguration, effectiveness and implementation achievement and so on, is required to be scheduled systematically oriented for multilife cycle.

140.2.2.2 Resource Dimension

Under green background, resource includes capital, technology, information, equipment, material, energy, human resources etc. During multilife cycle of green ERP, how to make use of resource more efficiently, especially human resource, is a core factor for green ERP. Integrating different types of resources effectively and optimizing resources allocation in every key process node group are very important reflections of green ERP.

In fact, different types of resources consumed by different processes will affect the evaluation indexes in certain degree and these green indexes of ERP will totally produce effect in green degree of ERP.

140.2.2.3 Evaluation Indexes Dimension

Green ERP is a kind of product and service in deed. According to green manufacturing theory, green product can be evaluated by TQCRE (time, quality, cost, resource, environment). As to green ERP, it involves a series of green manufacturing processes and activities during multilife cycle with information exchange, resource consumption, and environmental impact etc.

In evaluation indexes dimension, time refers development period, service respond time. Quality represents system functional quality, technical performance quality, service quality etc. Cost consists of primary development cost, maintenance and service cost and upgrade cost etc. Resource refers the efficiency of different kinds of resources consumed by each operation stage. Environment reflects the environment impact during multilife cycle of green ERP. Generally speaking, evaluation indexes dimension should be extended to cover a more wide green conceptual scope and activities with a broad understanding about green ERP.

140.3 Operation Mode of Green Erp  
Based on Multilife Cycle

Operation mode of green ERP based on multilife cycle consists of four stages: green philosophy and design process, green development process of ERP R&D team, green implementation and running process, “remanufacturing” process. Its operation mode is shown as Fig. 140.2.

140.3.1 Green Philosophy and Design Process

Green philosophy and design are the basis of obtaining green product. Green philosophy does not simply refer to ecological economy, it makes more sense to save energy and resource consumption, to promote operation efficiency, to realize benign circulation and great vitality. Green design (Li et al. 2004) (also called ecological design or design for environment) means to make use of related product data during multilife cycle of product, including technology information, environment information, economy information, resource information etc., to take advanced design theory and method such as CE (current engineering) for product design process which does not only meet the common requirement of function,

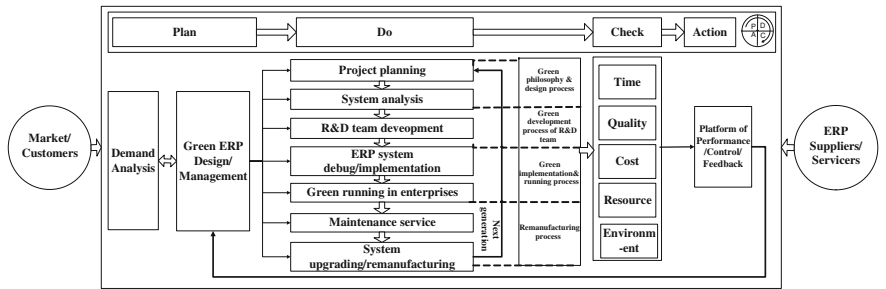


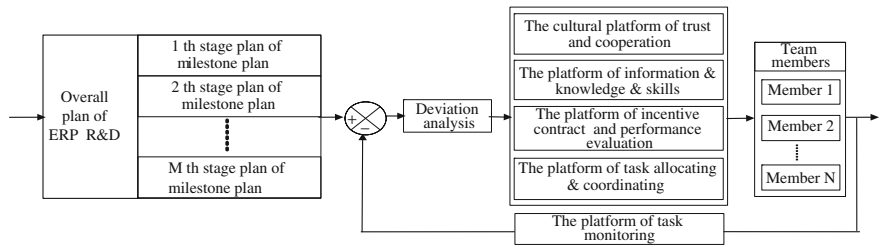
Fig. 140.2 Operation mode of green ERP based on multilife cycle

quality, cost and so on, but also meets requirement of good coordination with environmental characteristic. So the whole goal of green design is to optimize design factors that consist of static design data and dynamic design data for minimizing negative environmental effect, and promoting resource efficiency.

As to green ERP, designers should consider technology factors, economy factors and environment factors etc. in each stage and process of ERP during multilife cycle. In process of design, technology information includes technology feasibility, technology reconfigurability and flexibility, technology maintainability, technology advancement. For example, technology of supporting virtualized hardware and software should be taken to reduce energy consumption and promote operation efficiency of ERP system. For economy factors, economic feasibility, primary development cost, maintenance cost, secondary development & upgrade cost should be paid more attention to systemically. For environment factors, design of green ERP requires an accounting module of environment cost embedded into financial management in ERP's running process and an effective development process design. In fact, a conceptual model and whole project plan oriented for ERP multilife cycle that meet green requirement of function, quality, cost and other factors should be built to make reasonable decision during green philosophy and design process.

**140.3.2 Green Development Process of ERP R&D Team**

In this stage, the concept of green ERP refers to high efficiency and low cost. In the traditional development team, the team members complete their task personally according to their own experience or knowledge. But in the era of knowledge economy and information, product development method of traditional team is confined to low efficiency and high cost. So collaborative work mode under network platform, effective virtual team (Zhou and Chen 2011) should be applied to green ERP development process associated with KM (knowledge management), CE and significant incentive and coordination mechanism and so on. The development mode of ERP R&D team is shown as Fig. 140.3.



**Fig. 140.3** Team operation mode of green ERP

As Fig. 140.3 shows, in order to have a significant efficiency and controlled cost of ERP R&D project, it is necessary to make overall schedule and milestone plan for each stage ahead. And quality, cost and time plans for each task also should be scheduled. During implementation of ERP project, the progress must be tracked dynamically. When the deviation rate exceeds the allowable range, remedy measures should be taken timely. ERP R&D team will locate every role of team member taken in ERP development project according to their individual skills and expertise and adhere to principle of ability priority. Each member's task taken in ERP R&D team will be controlled in a certain scope and equipment and fund and so other resource also do not exceed a set limit. As shown in Eq. (140.1).

$$S_j = \sum_{n=1}^N S_{nmxt} | x=j, t=t_1 - t_2 < S' \quad (140.1)$$

where  $S_j$  is the total amount of resource  $j$  in a certain period of time  $t_1$  to  $t_2$ ,  $S_{nmxt}$  is the consumption of resource  $j$  by member  $n$  and stage  $m$  in a certain period of time  $t_1$  to  $t_2$ ,  $S'$  is the limit consumption of resource  $j$  in a certain period of time  $t_1$  to  $t_2$ . Suppose that

$$C = C(m, n, s_j, t) \quad (140.2)$$

where  $C$  is the cost of ERP project,  $m$  is project stage,  $t$  is the time of cost occur,  $S_j$  is resource  $j$ .

$$C_m^P = \sum_{j=1}^J \sum_{n=1}^N C^P(m, n, s_j, t) \quad (140.3)$$

where  $C_m^P$  is the plan cost of ERP project in stage  $m$  of the total consumption resource  $J$  by all members  $N$ .

$$C_m^d = \sum_{j=1}^J \sum_{n=1}^N C^d(m, n, s_j, t) \quad (140.4)$$

where  $C_m^d$  is the actual cost of ERP project in stage  $m$  of the total consumption resource  $J$  by all members  $N$ .

Because of a lot outside factors, there is always much difference existed between actual and planed cost. The cost discrepancy of ERP project is to subtract the actual cost from the planed cost. As shown in Eq. (140.5):

$$\Delta C_m = C_m^d - C_m^P = \sum_{j=1}^J \sum_{n=1}^N C^d(m, n, s_j, t) - \sum_{j=1}^J \sum_{n=1}^N C^P(m, n, s_j, t) \quad (140.5)$$

where  $\Delta C_m$  is the cost discrepancy between actual cost and plan cost of ERP project.

When  $\Delta C_m$  exceeds a set limit or allowable range, remedy measures should be taken timely and then improve.

As the same,  $\Delta C_n$  that in a certain period time  $t$  by all members  $N$ ,  $\Delta C_{mnj}$  that total project cost of in all stage  $M$  by all member  $N$  can also be controlled and evaluated.

Similarly, other green indexes of ERP such as time, quality, resource and environment can also be controlled or evaluated by experts marking or other methods. By this operation mode of ERP R&D team, high efficiency and low cost of ERP development process can be realized in a more green method to prompt green degree of green ERP.

### ***140.3.3 ERP Implementation and Green Running Process***

Green running process of ERP means that ERP system helps to promote green operation ability and cultivate green management philosophy for enterprises. It bases on standard management and efficient operation mode of enterprise by controlling every “business node” of management mechanism to realize green philosophy that rapid response to market, efficient and agile operation, lean management and low cost running process, friendly environmental production. Based on environment cost management module of enterprise ERP system, and associated with financial management, production management, material management, sales and distribution management and other modules, green ERP makes use of ERP system’s powerful prediction, planning, accounting, control, analysis, and other functions during production activities to improve economy benefit of enterprise. For example, controlling the environment cost of enterprise is an effective approach of implementing green management philosophy.

### ***140.3.4 “Remanufacturing” Process***

For green ERP based on multilife cycle, upgrade of technology and “remanufacturing” merits are very important reflections of green ERP system. It means “reuse”, “recycle”, “reconfiguration” and low cost. Green ERP requires advanced, reliable, reconfigurable system technique architecture to manifest its green philosophy such as taking agent technology with rational, aptitude, autonomy, ego drive merits, adopting object oriented for design based on components development, dispensing exorbitant dependence on hardware or database, supporting virtualized hardware to save energy consumption and modularized function design programming and so on. Indeed, next generation and “remanufacturing” of ERP system make a multilife cycle, green, efficient and low cost ERP system.

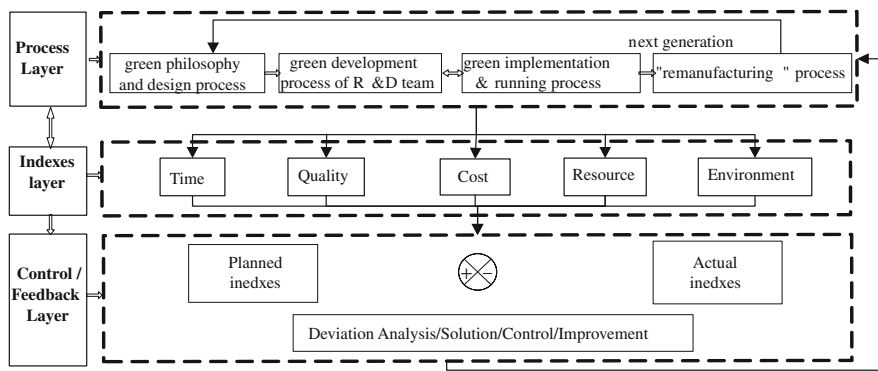


Fig. 140.4 Performance evaluation & control mode

140.3.5 Platform of Performance Evaluation and Control

In order to guarantee the total green degree of green ERP based on multilife cycle, a platform of performance evaluation and control should be built. The platform of performance evaluation and control consists of process layer, indexes layer, control and feedback layer. In process layer, process is oriented for multilife cycle and it consists of four operation stages during each life cycle. In indexes layer, green indexes include TQCRE five dimensional indexes from perspectives of ERP supplier and customers. And each 1th level index can be divided into more 2th level indexes and even 3th level indexes. In control and feedback layer, planned indexes and actual indexes will be evaluated according to experts, ERP project plan, knowledge database etc. Then deviation analysis and solution will be feedback to control and improve process layer continuously in real time. The whole control platform mechanism is shown as the Fig. 140.4.

140.4 Summary and Future Work

With the development of informatization construction, energy, resource, cost, effectiveness become key influencing factors for enterprise’s initiatives to informatization implementation, especially the cost factor. From the two perspectives of life cycle and green concept, the paper has put forward the concept of green ERP based on multilife cycle, analyzed its operation processes, especially ERP R&D team green development process. Greening ERP design and adopting highly efficiency development process such as virtual development team are effective approaches to reduce cost of ERP system. On the other hand, research on green ERP stays preliminary stage. How to achieve green operation goal and reach

enterprises' green philosophy for enterprises with the help of green ERP system, how to build a standard criterion for green ERP, are all needed to be further research.

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# Chapter 141

## Development of Automatic Downloads System for Slub Yarn Parameters Based on MODBUS/TCP

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**Abstract** In order to solve the issue of laborious and time-consuming caused by excessive parameters manual inputting during slub yarn production, a system was developed to realize the database management and automatic downloads of slub yarn parameters included slub length, base length and multiple. This invention relates to slub yarn controller with human machine interface (HMI) and programmable logic controller (PLC). It's a configuration system based on MODBUS/TCP communication protocol between King View and HMI that saves time and reduces the mistakes for the operators. The system realizes integrate controlling, which improve the automatic level.

**Keywords** Slub yarn · Configuration · HMI · MODBUS/TCP

### 141.1 Introduction

Nowadays, most of slub controllers were controlled by PLC and HMI, quite a few production parameters must be set up, and it is arduous and more mistakable to operate for workshop operators. Moreover, it's hard to organize network in workshop because of the PLC without Ethernet port. By contrast, the touch screen with Ethernet port could be easily accepted rather than PLC network module on cost. A configuration system was developed to answer current difficulties.

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This configuration was connected to the slub yarn controller, more particularly to means for controller with PLC and HMI. It is a system of the present invention to provide parameters downloads for slub yarn which presented an unusual appearance and can be employed in manufacture of varieties of fabrics used as upholstery, draperies, clothing and the like (Clifford and William 1964; Lu et al. 2007, 2009).

Most of our adoption of producing slub yarn system is to change the draft or feed a little sliver (Michael and Lee 1995; Dawes 1974; Donald 1988). Due to the machine precision and locale's environment, the characterization of production necessarily was not match with the pre-set parameters of slub yarn. For the reason mentioned above, what we need to do is to fine-tune the pre-set parameters. In this pattern the clicking of the mouse can easily transfer all parameters, which take place of moving around workshop.

## 141.2 System Composition

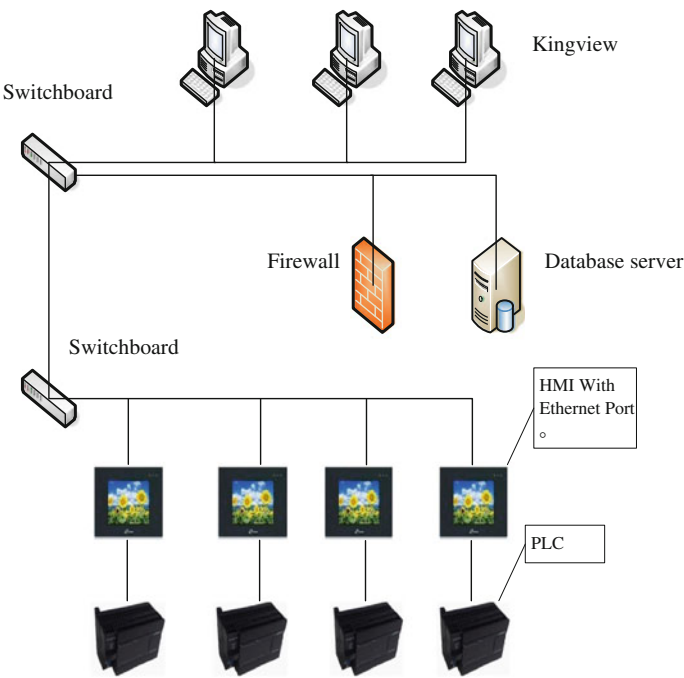
The system hardware is composed of industrial personal computer (IPC), database server, HMI and PLC. HMI is highly praised in industry for its complete product ranges, stable and reliable hardware as well as user-friendly configuration software and high cost performance. HMI can provide network interface and supported the standard MODBUS, so that the network can be formed easily. The system structure is illustrated in Fig. 141.1.

The main software of system includes king view6.53 and SQL server2008. The SQL functions of king view6.53 that run on IPC can realize storage, read, deletion and other types of operation. The slub yarn parameters stored in database and collected by King View are distributed to scattered touch screen and then be transmitted to PLC.

The overall systems architecture is implemented based on Ethernet which is versatile enough to be employed in new and various fields of application. As the superior of system, IPC was communicated with subordinate HMI through MODBUS/TCP protocol (Skeie et al. 2006; Witsch et al. 2006). RS-485 communication standard is used for the communication between HMI and PLC.

## 141.3 Access to SQL Server

Data preservation inquiry, updating and other operations were easily to realize as the convenient way to access SQL server provided by King View which includes SQL access manager and SQL function. King view SQL access manager including form templates and record body was mainly used to build relationship between database column and king view variables (Sun and Wu 2007).



**Fig. 141.1** System structure

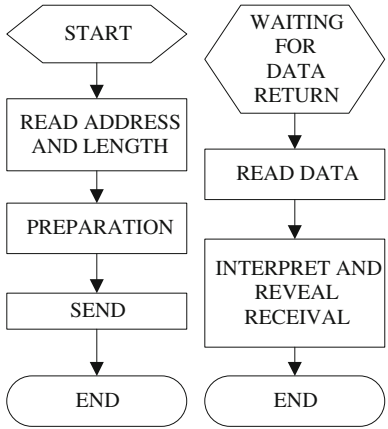
Corresponding database must be defined to realize data transmission in open database connectivity (ODBC) data source. Open the 32-bit ODBC data manager of windows control panel and then choose SQL Server. Fill data source name, server name and requested address of SQL server in corresponding column. The allocation was achieved after completing the process mentioned above. The grammar can be depicted as below: [Result Code=] SQL Connect (Device ID, “dsn=;uid=;pwd=”) (Yin and Zhu 2008). The Device ID means connect number; the value of below attribute is the data resource name; Login ID, password and database was named in proper order.

### 141.4 Communication Between King View and HMI

MODBUS/TCP is a TCP/IP variation of MODBUS protocol which encapsulates slightly modified MODBUS serial frames into TCP segments. The pattern of the network communication is CLIENT/SERVER model, and the circulation process of MODBUS/TCP protocol is illustrated in Fig. 141.2 (Tiago 2009; Wu and Wan 2009; Liu and Li 2006).

Build up a MODBUS/TCP device after open the Touch Explorer of King View by following the instruction of wizard. A uniqueness logical name was assign for

**Fig. 141.2** The circulation process of MODBUS/TCP



the device in the engineering, and a fictitious serial port was chosen. Then the address for the device should be set. The MODBUS/TCP device was completed after the recovery interval and the longest recovery time were set finally.

Device address required special explanation. Address format: IP [: Port] Address [/Timeout], and three formats in common use of TCP was introduced as below.

<1>219.243.53.173 : 502 1/50

219.243.53.173 IP Address

: Port separator

502 Port number

1 Station number

/ Network timeout separator

50 Delay time

<2>219.243.53.173 1

The default of port and network timeout was 502 and 50, respectively.

<3>219.243.53.173 1/30

Format <2> is the style used most frequent, and <3> is the best choice as device break.

Open EV5000 that is editing software for HMI, and creating a touch screen project. Screen model and Ethernet should be chosen from the component window firstly. And then the device number, IP address, port number, communication protocol and station number should be set. There is no doubt that the protocol should be MODBUS/TCP slave. The subnet mask and default gateway should be allocated at last.

**Table 141.1** Register of king view

Name	Form	Channel range	Read-write	Data type
0	odd	1 ~ 65535	Read-write	Bit
4	4dd	dd: 1 ~ 65535	Read-write	Ushort/
	4dd.xx	dd: 1 ~ 65535 xx: 0 – 1	Read	short/
	4 m.n	m: 1 ~ 65535	Read-write	BCD/
		n: 0 – 127		Long/
		m + n <= 65535		LongBCD/
				float/
				Byte/
				String

**141.5 Register Excursion**

HMI provided bit and word address, which separately corresponds to registers 0 and 4 of King View in MODBUS/TCP. The address excursion should be noticed as the address in HMI started from 0 which was different with that from 1 in the King View. For instance, 01 correspond LB0 and 41 correspond to LW0. What’s more, the screen system reserved some LW, LB and RW address for some particular purposes. These registers should be used by following introductions.

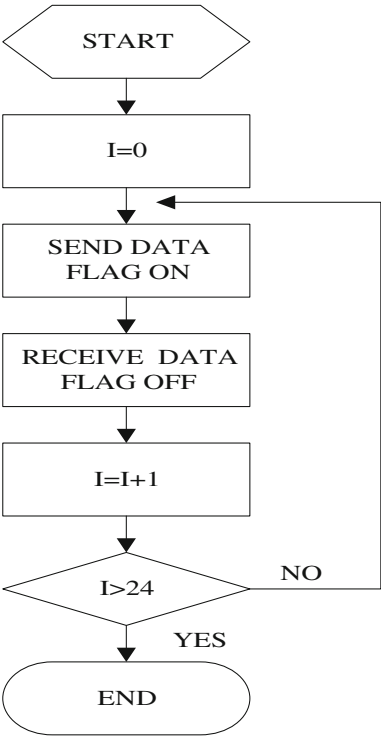
Acquisition frequency should be set to 0 in King View for write-only register. Secondary channel must be set up separately represented the high-order word and the low-order word as reading byte data. For example, 41.0 stand for the low byte, and 41.1 represent the high byte. Additionally, byte data can be only read. Short or Ushort data must be redefined if the data need to be written. The instance of x.y will be cited to illustrate the string data: x indicated the start address and y presented the length of data. The register of king view was shown in Table 141.1.

**141.6 Work Process of System**

Parameters were divided into several strings with same length as the fugitive loops and cycle length before stored on a database. Consequently, the parameters can be cited according to slub yarn serial number with the help of abundant database functions. Letter I is set to circulation of variable as much data repeat transmission. The original set was to OFF for flag bit, which was defined to guarantee reliable data transmission. The supervisory computer started to transfer as the system started up. Flag was set to ON to order the lower position machines receiving data. Flag is set to OFF after one receipt, then next until end. The working process of the system is illustrated in Fig. 141.3.

All parameters have been stored in the HMI register after the end of circle. Then the system stimulates the data transmission component, transferring data to PLC. The production begins as soon as the basic parameters matched.

**Fig. 141.3** The working process of the system



**141.7 Conclusion**

This paper reported a configuration system to realize automatic downloads of slub yarn parameters based on MODBUS/TCP protocol. A method of downloading the main parameters of slub yarn included slub length, base length and multiple was proposed and a determination software system compiled by king view 6.53 was developed. Database access is achieved through not only IPC but also HMI, which enhanced the flexibility of the designing system. In this system, slub yarn parameters were stored in the database through the SQL access manager and the quick, effective and practical data message management was realized through SQL functions. IPC could communicate with corresponding HMI by entering machine serial number on the user-friendly interface of system. Supervision appearance configuration of multiple devices was facility with the help of structure variable application. An operator can not operating multiple devices at the same time was thing of the past. Hence it's easy to set the basic parameters including the adjustment coefficient, roller speed and others. After lab test and onset installation test, it is proved that the slub yarn parameters can be effectively transmitted by the system.

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# Chapter 142

## The Effect of Transformational Leadership on Innovation Performance of Subordinates: Psychological Capital as Mediator

Jiang-lin Ke, Han-xi Zhang, Rui Sun and Hang Zhang

**Abstract** Transformational leadership is a hot-debated research topic. However, the study about underlying mechanism for understanding the impact of transformational leadership on performance outcomes from the perspective of cognitive psychology is few. According to this, the attention of this article is paid to the effect of transformational leadership on subordinates' innovation performance using psychological capital as a mediator. We examine the relationship among psychological capital, transformational leadership and innovation performance of subordinates and give some practical advices on how to enhance the subordinates' innovation performance.

**Keywords** Transformational leadership · Psychological capital · Innovation performance

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## 142.1 Introduction

Innovation is a nation's inexhaustible strength. In enterprises, leaders make a great effect on the subordinates' innovation performance. Burns and Bass proposed the theory of transformational leadership in 1980s and therefore triggered the revolution of research about leadership theory. Transformational leaders are assumed to 'motivate people to do their best' and make their followers perform beyond expectations by moving them to transcend their own self-interest for a higher purpose or vision. Bass and Avolio (1994) characterized transformational leadership as comprising four components: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. The relationship between transformational leadership and leader effectiveness is the key point of the overseas transformational leadership study and most empirical studies have indicated that transformational leadership is highly related to the followers' job performance and it seems to be different from traditional leadership styles as it is more about emphasizing change and envisioning (Avolio 1994). Hence, transformational leadership theory is regarded as a promising approach to foster subordinates' innovation (Waldman and Bass 1991). In this paper, we will study the effect of transformational leadership on employees' innovation performance with psychological capital as a mediator variable, analyze the relationship and underlying mechanism among them and give some practical advices on how to enhance the subordinates' innovation performance.

## 142.2 Literature Review and Hypothesis

### 142.2.1 *Transformational Leadership*

The concept of transformational leadership was first proposed by Burns. According to the study of political leadership, Burns (1978) divided the leadership into two opposite ones: transformational leadership and transactional Leadership. Bass (1985) introduced the Burns' concept into the business organization. He pointed out that transformational leadership inspires the subordinates' higher need, establish the atmosphere of mutual trust, make subordinates to sacrifice their own rights for the organization's rights and exceed the expected outcome through making employees to realize the magnificence of their taking the tasks.

Some researchers identified transformational leadership's effect on some employees' behaviors. From the aspect of positive working behavior, Li et al. (2006) indicated that transformational leadership had positively significant correlation to OCB (organizational citizenship behavior). From the aspect of negative working behavior, Brown et al. (2006) indicated that charisma or idealized influence had negatively significant correlation to interpersonal deviance and organizational deviance.

### ***142.2.2 Psychological Capital***

Psychology campaign started by American's psychologist Seligman emphasizes that psychology should focus on the study of human's positive affection, positive characteristic and positive state. Affected by this, Fred Luthans, the famous organizational behaviorist and' former president of Academy of American Management, established POB (Positive Organizational Behavior) and proposed the concept of psychological capital in 2004. Psychological capital is an individual positive mental strengths which can be measurable, developed and managed to promote job performance. It consists of efficacy, hope, optimism, and resilience and has positive effect on job performance. In the Chinese organizations' situation, employers' psychological capital consists of Task-orientated Psychological Capital and Guanxi-orientated Psychological Capital, which were developed by Ke, Sun, and Li (2009).

### ***142.2.3 Innovation Performance***

There are different opinions about what is innovation performance and whether it should be understood from the perspective of innovation process or result is inconsistent. Therefore, there are varieties of scales to measure it. In this paper, Janssen's (2001) scale will be used because we want to survey the employee innovation performance from process view. Janssen (2001) conceived innovation as complex behavior consisting of a set of three different behavioral tasks: idea generation, idea promotion, and idea realization.

### ***142.2.4 Hypothesis***

#### **142.2.4.1 Transformational Leadership and Innovation Performance**

Li and Shi (2005) established the structure of transformational leadership catering to the Chinese background using the inductive method. The research results indicate that transformational leadership is a four-dimension structure, which includes moral norm, vision inspiration, charisma or idealized influence and individualized consideration. Therefore, following hypotheses can put forward.

H1: Transformational leadership has positive effect on the subordinates' innovation performance.

H1a: Moral norm has positive effect on the subordinates' innovation performance.

H1b: Charisma or Idealized Influence has positive effect on the subordinates' innovation performance.

H1c: Vision inspiration has positive effect on the subordinates' innovation performance.

H1d: Individualized Consideration has positive effect on the subordinates' innovation performance.

#### **142.2.4.2 Transformational Leadership and Psychological Capital**

Ke, Sun, and Li (2009), defined the Chinese indigenous psychological capital as a measurable, open to develop and positive attitude or psychological capacity in the workplace under Chinese background. Their research results indicated that the Chinese employees' psychological capital can be divided into two dimensions: task-oriented ones and guanxi-oriented ones. Task-oriented psychological capital is the positive attitude one takes when facing "tasks", including four sub-dimensions Guanxi-oriented psychological capital is the positive attitude one takes when facing "guanxi" Transformational leadership emphasizes the employees' development, family and living and makes them feel the care from the leaders and therefore make become grateful and dedicatory. On the other hand, the affection between the employees will contribute to their mutual respect and humility is a merit all Chinese share. Consequently, we assume,

H2: Transformational leadership has positive effect on the subordinates' psychological capital.

H2a: Moral norm has positive effect on the subordinates' psychological capital.

H2b: Charisma or Idealized Influence has positive effect on the subordinates' psychological capital.

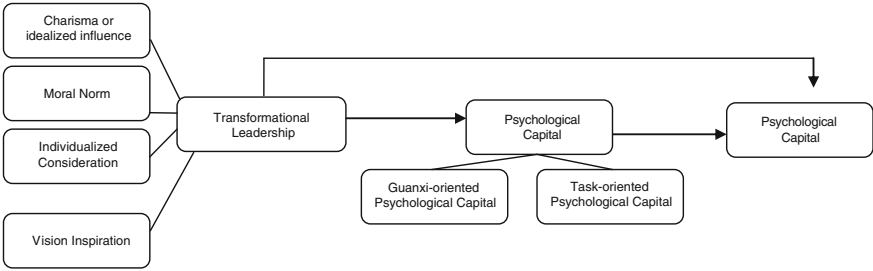
H2c: Vision inspiration has positive effect on the subordinates' psychological capital.

H2d: Individualized Consideration has positive effect on the subordinates' psychological capital.

#### **142.2.4.3 Psychological Capital and Innovation Performance**

Janssen (2000) divided employee innovation into three stages—generation, promotion and implement. It's easy to see that the process of innovation has close relationship with one's own psychological capital. On one hand, employees with characteristics like confidence, optimism, enterprising and tenacity will be more likely to propose their new ideas, promote them and implement them. On the other hand, employees with merits like tolerance, courtliness, humility and gratefulness will easier to get others' recognition and support. Therefore, psychological capital has become important for one to make innovation performance. Therefore,

H3: Subordinates' psychological capital has positive effect on innovation performance.



**Fig. 142.1** The relationship among Transformational Leadership, Psychological Capital and Innovation Performance

- H3a: Subordinates’ task-oriented psychological capital has positive effect on innovation performance.
- H3b: Subordinates’ guanxi-oriented psychological capital has positive effect on innovation performance.

**142.2.4.4 The Mediating Effect of Psychological Capital on the Relationship Bbetween Transformational Leadership and Innovation Performance**

Nowadays, there are plenty of researches about the action mechanism of transformational leadership in the field of leadership theory. However, no research has focused on the relationship of transformational leadership and subordinates’ innovation performance and its action mechanism. The research about relationship of the leadership and innovation performance from the aspect of psychological recognition is even rarer. Therefore, we intend to study transformational leadership’s effect on subordinates’ innovation performance using psychological capital as mediating variable. Therefore,

- H4: Psychological capital has mediating effect on the relationship between transformational leadership and innovation performance.
- H4a: Psychological capital has mediating effect on the relationship between moral norm and innovation performance.
- H4b: Psychological capital has mediating effect on the relationship between charisma or Idealized Influence and.
- H4c: Psychological capital has mediating effect on the relationship between vision inspiration and innovation performance.
- H4d: Psychological capital has mediating effect on the relationship between individualized consideration and innovation performance Fig. 142.1.

## 142.3 Method

### 142.3.1 Sample

This study has been conducted with a questionnaire survey based upon convenience sampling. Sample comes from 24 provinces or cities in China (including Beijing, Tianjin, Shanghai and Sichuan province, etc.) and involving a variety of industries including real estate, finance and aviation etc. The survey lasted two months since March 2010. 306 samples were received out of 350, representing a 87.43 % response rate. The amount of valid sample is 250, accounting for 71.43 %. The male account for 52.4 % and the female is 47.6 %. 43.2 % is aging from 20 to 29, 39.6 % is from 30 to 39, 12.4 % is from 40 to 49 and 4.8 % is older than 50. 63.6 % is married and 36.4 % is unmarried. People of degree lower or equal to high school accounts for 11.6, 34.8 % is of college degree, 36.8 % is of bachelor's degree and 16.8 % is of higher or equal to master' degree. As to the working years, 59.6 % is shorter than 10 years, 28 % is from 10 to 20 years and 12.4 % is longer than 20 years. 36 % has a position about management, 36 % is about technique and 28 % is about others.

### 142.3.2 Measures

1. Transformational leadership was measured using a 26-item scale developed by Li and Shi (2005) and all items were evaluated by Likert's six categories, from "strongly disagree" to "strongly agree". After deleting 10 items, we get three aspects—norm and charisma, vision inspiration and individualized consideration. Moral norm and charisma or idealized influence variable of former transformational leadership theory can be combined as one—norm and charisma. The contribution rate of accumulative total of variance of the 3 dimensions of transformational leadership is 70.57 % and the reliability value, which is reasonable, can be seen in the Table 142.1.
2. Psychological capital was measured using a 40-item scale developed by Ke, Sun and Li (2009) based on the Chinese cultural background and all items were evaluated by Likert's six categories, from "strongly disagree" to "strongly agree". Deleting 5 items, the contribution rate of accumulative total of variance we get is 62.45 %. In general, the results of factor analysis are acceptable. We carried on factor analysis on guanxi-oriented psychological capital. Deleting two items, the contribution rate of accumulative total of variance we get is 60.55 %. The reliability value can be seen in Table 142.1.
3. Innovation performance was measured by scale modified from the Janssen (2001) and all items were evaluated by Likert's six categories, from "strongly disagree" to "strongly agree". The scale was fulfilled by the employees themselves. The factor analysis results indicate that subordinates' innovation

performance is a one-dimension structure and the contribution rate of accumulative total of variance we get is 53.44 %. The reliability value can be seen in Table 142.1.

## 142.4 Results

### *142.4.1 Descriptive Statistics and Correlation Analysis*

Table 142.1 shows the mean and the standard deviation of each variable. The requirements for mediating effect of regression model are as follows. (1) Transformational leadership has significantly positive correlation with task-oriented psychological capital, guanxi-oriented psychological capital, total psychological capital and innovation performance. The coefficient of transformational leadership and guanxi-oriented psychological capital is lower than that of the former and total psychological capital, but higher than that of the former and the task-oriented psychological capital. The coefficient of transformational leadership and subordinates' innovation performance is the lowest, which is 0.367. (2) Task-oriented psychological capital has high correlation with guanxi-oriented psychological capital and innovation performance and has high-level positive correlation with total psychological capital. The coefficient of task-oriented psychological capital and guanxi-oriented psychological capital is lower than that of the former and total psychological capital, but higher than that of the former and innovation performance. (3) Guanxi-oriented psychological capital has the highest correlation with total psychological capital, which is 0.947 and has significantly positive correlation with innovation performance. (4) The total psychological capital has significantly positive correlation with innovation performance.

### *142.4.2 Mediating Effect of Psychological Capital*

When independent variable affects the dependent variable and the internal cause, the relationship between the two variables exists only with the absence of the third one, then this third variable is mediator variable. There are two methods to examine the mediator variable: (1) Correlation and partial correlation analysis. (2) Structure equation. At the article, we chose the method (1) and designed models in which the effect of transformational leadership on innovation performance has been removed to examine the mediating effect of psychological performance. There are four steps to reach it. (1) We should examine the correlation between independent variable and mediating variable. There are 6 models to test the effect of transformational leadership and its dimensions on innovation performance and their VIFs are all lower than the critical value of 10, which indicates the absence of

**Table 142.1** Descriptive statistics and Correlation analysis (N = 250)

Variable	Mean	Sd.	1	2	3	4	5	6	7	8	9	10
1 Sex	1.48	0.50										
2 Marriage	1.36	0.48	-0.050									
3 Education	2.61	0.95	0.204 <sup>b</sup>	0.021								
4 Working year	1.54	0.77	-0.029	-0.477 <sup>b</sup>	-0.227 <sup>b</sup>							
5 Position	1.91	0.79	0.085	0.138 <sup>a</sup>	-0.029	0.080						
6 Transformational leadership	4.69	0.84	0.028	0.057	0.007	-0.038	-0.099	(0.95)				
7 Task-oriented psychological capital	4.70	0.62	-0.032	-0.050	-0.069	0.083	-0.163 <sup>a</sup>	0.483 <sup>b</sup>	(0.87)			
8 Guanxi-oriented psychological capital	4.74	0.63	0.019	-0.015	-0.003	0.068	-0.122	0.524 <sup>b</sup>	0.743 <sup>b</sup>	(0.90)		
9 Psychological capital	4.72	0.58	-0.004	-0.033	-0.035	0.080	-0.150 <sup>a</sup>	0.541 <sup>b</sup>	0.919 <sup>b</sup>	0.947 <sup>b</sup>	(0.93)	
10 Innovation performance	4.22	0.80	0.029	-0.091	-0.070	0.101	-0.154 <sup>a</sup>	0.367 <sup>b</sup>	0.628 <sup>b</sup>	0.472 <sup>b</sup>	0.580 <sup>b</sup>	(0.89)

Sex: Male = 1, Female = 2; Marriage: Married = 1, Unmarried = 2

Education: Lower or equal to high school = 1, College = 2, Bachelor = 3, Master = 4, Doctor = 5

Working year: Shorter than 10 years = 1, 10–19 years = 2, 20–29 years = 3, 30–39 years = 4, longer than 40 years = 5

Position: Management = 1, Technique = 2, Others = 3; Reliability is shown in ( )

<sup>a</sup> Correlation is significant at the 0.05 level (2-tailed)

<sup>b</sup> Correlation is significant at the 0.01 level (2-tailed)

the multi-collinearity of the models and that the results are acceptable. (2) The correlation between independent variable and dependent variable should be studied. Also, we used 6 models to test the effect of transformational leadership on subordinates' task-oriented, guanxi-oriented and total psychological capital and their VIFs are all lower than the critical value of 10, which indicates the absence of the multi-collinearity of the models and that the results are acceptable. (3) Whether mediating variable is correlated with dependent variable is tested. There are 6 models respectively to test the effect of task-oriented, guanxi-oriented and total psychological capital on innovation performance and their VIFs are all lower than the critical value of 10, which indicates the absence of the multi-collinearity of the models and that the results are acceptable. (4) When considering the mediating variable, the effect of independent variable on dependent variable will decline or even become insignificant. We get support for our hypothesis.

### ***142.4.3 Analysis of Results of Hypothesis Testing***

Table 142.2 illustrates the relation of variables in the models and we got all support for our hypothesis. Although transformational leadership dose not directly affect innovation performance, it has mediating effect though psychological capital.

## **142.5 Discussion**

Our study results show that transformational leadership has positive effect on subordinates' innovation performance (including 4 dimensions—moral norm, Charisma or Idealized Influence, vision inspiration and individualized consideration) as psychological capital (including both task-oriented ones and the guanxi-oriented ones) mediator.

### ***142.5.1 Contributions to Theory Building***

Though transformational leadership has been researched widely, we also know a little about its impact on innovation performance from the perspective of cognitive psychology. In this paper, we used psychological capital theory to explain the underlying mechanism of the relationship between transformational leadership and subordinates' innovation performance. The hypotheses testing results show that the established theory is robust. Psychological capital theory provides us a new way to understand innovation activity and leadership.

**Table 142.2** Regression analysis of transformational leadership and psychological capital's effect on innovation performance<sup>ab</sup>

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 14	Model 15	Model 16	Model 17
<i>Control variable</i>									
1 Sex	4.790 <sup>c</sup>	3.408 <sup>c</sup>	3.651 <sup>c</sup>	3.443 <sup>c</sup>	3.122 <sup>c</sup>	1.062 <sup>a</sup>	1.086 <sup>a</sup>	1.041 <sup>a</sup>	1.034 <sup>a</sup>
2 Marriage	0.064	0.050	0.032	0.057	0.044	0.045	0.043	0.047	0.044
3 Education	-0.080	-0.119	-0.102	-0.077	-0.107	-0.101	-0.094	-0.088	-0.097
4 Working year	-0.110	-0.134 <sup>a</sup>	-0.076	-0.080	-0.101	-0.093	-0.079	-0.077	-0.084
5 Position	0.031	0.012	0.039	0.074	0.041	-0.007	-0.001	0.011	0.002
	-0.187 <sup>b</sup>	-0.152 <sup>a</sup>	-0.157 <sup>a</sup>	-0.145 <sup>a</sup>	-0.141 <sup>a</sup>	-0.093	-0.093	-0.090	-0.091
<i>Independent variable</i>									
1 Norm and charisma		0.369 <sup>c</sup>				0.108			
2 vision inspiration			0.313 <sup>c</sup>				0.059		
3 Individualized consideration				0.354 <sup>c</sup>				0.104	
4 Transformational leadership					0.395 <sup>c</sup>				
5 Psychological capital						0.529 <sup>c</sup>	0.556 <sup>c</sup>	0.534 <sup>c</sup>	0.118
R <sup>2</sup>	0.062	0.195	0.157	0.184	0.215	0.399	0.393	0.399	0.519 <sup>c</sup>
Adjusted R <sup>2</sup>	0.042	0.175	0.136	0.163	0.195	0.381	0.375	0.381	0.400
F Test	3.143 <sup>b</sup>	9.604 <sup>c</sup>	7.398 <sup>c</sup>	8.919 <sup>c</sup>	10.869 <sup>c</sup>	22.493 <sup>c</sup>	21.932 <sup>c</sup>	22.445 <sup>c</sup>	22.583 <sup>c</sup>
ΔR <sup>2</sup>	0.062	0.133	0.095	0.122	0.153	0.204	0.236	0.215	0.185
F Test	3.143 <sup>b</sup>	39.385 <sup>c</sup>	26.968 <sup>c</sup>	35.529 <sup>c</sup>	46.510 <sup>c</sup>	80.567 <sup>c</sup>	92.141 <sup>c</sup>	84.771 <sup>c</sup>	73.109 <sup>c</sup>

<sup>a</sup> The regression coefficient in the scale is the standardized value

<sup>b</sup> Δ R<sup>2</sup>'s value of Model 2, 3, 4, 5 is based on model 1 and model 14, 15, 16, 17 is based on model 2, 3, 4, 5

<sup>a</sup> p < 0.05; <sup>b</sup> p < 0.01; <sup>c</sup> p < 0.001

### ***142.5.2 Practical Implications***

Innovation is the everlasting power of a country and a nation and no organization can develop without innovation. Through the research on how transformational leadership affect subordinates' innovation performance, there are some revelations like leaders must play an exemplary role and give his subordinates individualized consideration, which significantly affects their guanxi-oriented psychological capital, task-oriented psychological capital has greatest effect on innovation performance. To practice, we should use transformational leadership and emphasize employees' psychological capital (task-oriented psychological is more important) in order to improve employee's innovation performance.

### ***142.5.3 Limitations and Future Research***

There are some limitations in our study. First is convenience sampling. Second is all data was collected at the same time from the same respondent. Finally, we studied transformational leadership's effect on subordinates' innovation performance using psychological capital as mediator, which extends the theory of transformational leadership and innovation. However, there is great potential space to study how transformational leadership affects innovation performance. Some new theories can be expected to research their relationship using other mediators or moderators.

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# Chapter 143

## The Research of “Crossover” Marketing Strategy

Xiao-feng Ji and Hai-na Shen

**Abstract** The brand’s crossover strategy has become a tendency of branding strategy when industries try to have a better development at this moment. It is great importance for us that how to indeed understand the crossover strategy, and how to apply the crossover strategy as a marketing approach as well as the significance of implementing crossover strategy in enterprise. First, in this article we elaborate the definition and forms of crossover strategy, and the most importance point is that distinguish similarities and differences between co-branding and crossover. Second, we narrate four factors that affect the evaluation of crossover products briefly, that is, customer-based brand equity, joint matching, consumer’s involvement and consumer innovativeness. Finally, this paper discusses the significance of crossover to enterprises.

**Keywords** Crossover · Consumer innovativeness · Consumer involvement · Marketing strategy

With the diversification of consumer demands, a single brand has been insufficient interpretation about the attitude toward life. The crossover strategy has become another main branding strategy after branding extension as a new marketing strategy, which proved to be a most popular topic among entrepreneurs. As the “Crossover” strategy comprehensive popularizing, whether garment industry, IT industry, automobile manufacturing, food industry or entertainment industry began applying the “Crossover” marketing model to derive own brand meaning and expand potential consumer groups, as well as cooperate with another well-known

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brand to seek market penetration and expansion in multi-field. In 1999, when the Puma and fashion designer Jil Sander jointly launch a series of upper-scale casual shoes, Jochen Zeitz, the CEO of Puma, put forward the viewpoint of “crossover”. Since then, several products such as beer and clothing, real estate and luxury, Coke and music, garment and automobile that unrelated totally, they join together and gain mutual benefit through the “crossover” strategy.

## **143.1 An Overview of Crossover**

### ***143.1.1 The Definition of Crossover***

The original explanation of “Crossover” is a path where something can be crossed to get from one side to the other, but when it is introduced into Marketing Science, researchers have different definitions about it. For example, by analysis an advertising case about “Nike” and “Buick”, Deng Yong bing termed “Crossover” as a phenomenon that two brands from different areas joint to illustrate the characteristics of target consumers with multiple perspectives. Hu Shui called “Crossover” that one uses the core elements of its own brand to match the core elements of partner’s brand as crossover marketing strategy. Jia Yi considered “Crossover” dissemination is that brands or products in diverse areas unite together in order to attaining effective marketing spread and penetration. Du Yongli thought that “Crossover” refer to the way that two or more brand highly recognized by consumers in different fields get together for commercial cooperation, in which all those brand names involved in will be retained. At the same time, the new brand or product generated by crossover strategy is called crossover product. Now, scholars have no uniform definition to “Crossover”, but crossover must generate new brand or product by uniting with two brands in different areas. And in this regard, the viewpoints of all researchers are absolutely consistent.

### ***143.1.2 The Form of Crossover***

At present, there is no standard classification about crossover strategy, but numerous scholars have divided crossover into all kinds of forms from different perspectives. From the approaches to cooperation, (Yang 2009) divided crossover into three forms, namely, product crossover strategy, commodity circulation channel crossover strategy and marketing crossover strategy (Pan Yang 2009). In detail, product crossover strategy means the alliance occur among different product categories, thereby it can create a new selling point for company. Such as in 2003, the Puma and the BMW Mini cooperated to launch a black driver shoe—Mini Motion 2 part shoe. Commodity circulation channel crossover strategy means

the cooperation based on sharing commodity circulation channel between partners. Like Skyworth invited Huadi Group to participate in the activity as “Rural Theater Project” in 2006. With the help of cultural transmission, two establishments sell sets of home appliances and kitchen products into rural consumers and open the rural marketing successfully. Marketing crossover strategy is a branding marketing that combined with different products or brands in the industry, and which bring different user experience to consumers. For example, Hermes selects 46 silk scarves as a “tool” and merged with the artist Hilton McConnico’s art works, which present a royal Hermes scarves art exhibition named “The Tale of Silk”. Zhiming Zhu divided crossover strategy into horizontal crossover strategy, longitudinal crossover strategy and intersected crossover strategy when study the crossover cases in wines. Horizontal crossover strategy is that different industries complement each other’s advantages for consistent target and create a competitive advantage. Longitudinal crossover strategy mean that the manufacturers and merchants connect together to achieve benefit-sharing by investing market, developing commodity circulation channel and servicing consumers corporately. Then intersected crossover strategy means that enterprises, Retailer and consumers link together for sharing their interests and values. In a book of “Crossover”, the author subdivided crossover strategy to product crossover, service crossover, technical crossover, design crossover, regional crossover, emotional crossover, brand crossover, sales crossover, channel crossover and communication crossover based on diversified cooperative field.

### ***143.1.3 The Similarities and Differences of Crossover and Co-branding***

The concept of co-branding was put forward by Boone in 1980, and related studies have been studied maturely. We adopt the terminology used by Simonin and Ruth (1998), which involve a short-term or long-term association or combination among two or more individual brands, products, and/or other distinctive proprietary assets (Simonin and Ruth 1998). These brands or products can be represented physically (e.g., bundled package among two or more brands) or symbolically (e.g., an advertisement) by the association of brand names, logos, or other proprietary assets of the brand. There are many similarities between co-branding and crossover in their definitions. The common is that their participants are multiple brands, but crossover strategy pays more attention to cooperation in different fields. These different fields can be considered as various industries or target consumer groups. The aim of crossover strategy lays emphasis on expanding its brand to other areas.

According to diverse product categories that partner brands participated in co-branding, Fang and Mishra divided co-branding into similar brand alliances and heterogeneous brand alliances. From this classification approach, crossover is similar to the heterogeneous brand alliance. Blackett and Boad (1999) classified

co-branding into contact/cognitive brand alliance, value recognized brand alliance, elemental composition brand alliance and ability complementary brand alliance (Blackett 1999). This classification based on creating common value ranging from low to high was accepted universally. Due to crossover partner brands from different industries, it is difficult to in-depth make use of their resources in two enterprises, so the majority of crossover strategy cases integrate partner's brand concept and enterprise culture into own brand through joint advertisement between partner companies. This style is belonged to low common value creation. Therefore, in the strict sense, crossover strategy is part of co-branding, or a special form of co-branding. The success of applying crossover strategy depends on the consumer's acceptance with new things, so crossover always take place in fashion industry with high fashion involvement and luxury products with high added-value.

## **143.2 Factors Affecting Consumer Evaluation to Crossover Products**

In the study about co-branding evaluation factors, Simonin and Ruth's brand alliance evaluation model is the most classic assessment model. In this model, by analysis the brand alliance of automobile and computer chip, this experiment confirmed that the partner brands' previously attitude, brand fit and product fit were the main factors influencing consumer evaluation and brand familiarity was the conditioning factors. Other scholars expanded and perfected S&R evaluation model's factors. In this paper, we have proved crossover strategy is belonged to co-branding, so the S&R evaluation model is also the fundament of crossover strategy evaluation research. But the crossover strategy has its unique features and we will elaborate it in this article.

### ***143.2.1 Customer-Based Brand Equity***

Customer-based brand equity is defined as the differential effect of brand knowledge on customer response to the marketing of the brand (Aker 1991). That is, customer-based brand equity involves customer's reactions to an element of the marketing mix for the brand in comparison with their reaction to the same marketing mix element attributed to a fictitiously named or unnamed version of product or service. It reveals how consumers understand the connotation of the brand. Most of the current studies measure brand alliance evaluation from single dimension of perceived quality, brand awareness or brand attitude, lacking of comprehensive and science. Brand equity has multiple dimensions including brand

awareness, associations, loyalty and quality perception. Compared with the previously attitude of partner brands in S&R model, brand equity exposit customer's view to partner brands comprehensively, therefore, it is more reasonable to evaluate brand alliance from customer-based brand equity brand equity.

According to the stimulus generalization theory based on Affect Transfer Model, when partner brand with high brand equity have established positive conditioned reflex as the initial stimulus, another brand with low brand equity appearing as a secondary stimulus still can generate positive conditioned reflex as the same as previously high brand equity brand. Washburn, carried out an experiments combining two brands with high brand equity and low brand equity, and founded that brand with low brand equity can improve own evaluation significantly by jointing with brand of high brand equity (Washburn et al. 2004). Besharat (2010) studied brand alliance benefit by comparing consumer attitudes, quality perception and purchase intention of new product in co-branding, and found that if want to significantly affect the consumers' evaluation to brand alliance, we need at least a high brand equity brand (Besharat 2010). The steady high product quality and good reputation of high brand equity brand provides credit guarantees and quality assurance, so customer-based brand equity has a positive correlation with and crossover strategy evaluation.

### ***143.2.2 The Relationship of Partner Brands in Crossover***

It is not any two brands have the ability to success in crossover. Crossover strategy must in appropriate conditions. We defined joint matching as suitability in logical between two brands. Joint matching affect crossover strategy by two dimensions of product fit (product level) and brand fit (brand level).

Consumers' perception of "product fit," or the extent to which consumers perceive the two product categories to be compatible, is expected to play a significant role in how consumers respond to the crossover strategy. Aaker and Keller (1990) from three dimensions to measure the product fit, namely, the complementarity, substitutability and transferability of products before crossover (David 1990). The complementary refers to the product of cooperation brand can be combined use. The substitutability refers to cooperation brand products can interchange with each other. Transferability refers to the cooperation brand products have ability to support each other in technology. Wu and Lu (2010) simulate crossover strategy by the experiment about milk with cereal and milk with computer, proved that the joint matching has two dimensions, in addition, the influence of product fit is greater than brand fit in crossover strategy (Wu and Lu 2010).

Brand fit mainly means the matching extent in brand image and reputation about the cooperative brand. Simonin joined the concept of brand fit into the brand alliance evaluation model for the first time. Brand fit have four aspects including brand image, brand association, brand personality and brand reputation. From the product

level, Park thought the cooperative brand wanted to transmit their information as much as possible must have good fit between each other (Park et al. 1996). In his research, the well-known leading brand combined with well-known but low match modified brand and unknown but high match modified brand. It proved that brand fit has a positive correlation with and crossover strategy evaluation.

### ***143.2.3 Consumer Involvement***

From social judgment theory original, Rothschild (1984) defined that involvement is unobservable motivation, excitement or interested state caused by a particular thing or a special condition (Rothschild 1984). In short, consumer involvement is the extent of consumer paying attention to products. In high involvement situation, consumers will think highly of searching for main information positively and specifically. By multiple screening and information processing, consumers will refute the information different with own faith. While in the low involvement situation, the information be searched is limited, and consumers do not want to spend more effort to seek enough information, so consumers tend to passively accept the information that is inconsistent with their ideas.

Hellyer's (1995) study about how to select high matching or high brand equity brands as partner, found that the main criteria is the consumer involvement (Hillyer and Tikoo 1995). When an unknown brand joins with a well-known brand, in low involvement situation, consumers will weaken the perception of brand fit, making it easier to accepting the unknown brand. While in the high involvement situation, consumers will realize the low-matching of unknown brand and well-known brands, thereby paying more concern about the negative effects bringing by unknown brand. Walchli (2007) considering consumer involvement as adjustment variables, research the relationship between brands fit and brand alliance evaluation in different involvement conditions (Walchli 2007). In this experiment, he discovered that in the case of low involvement, the relationship presented a linear decreasing, but in the case of high involvement, the brand with medium matching has a higher evaluation. So consumer involvement will influence the evaluation of crossover strategy.

### ***143.2.4 Consumer Innovativeness***

Innovativeness is the extent of a person to try new things. In the spread theory, the classification of consumers mainly to the five types: innovators, early adopters, earlt majority, later majority and the laggards (Burt 2009). An innovator is the disseminator of opinions. When innovative consumer show great interest to a product and encourage others to try it, the product is more easily accepted by

public. Crossover strategy is a new concept to consumers. There must be instinctive sense of fear to new things, presenting not dare to try or purchase. A survey covering 2.62 million consumers in 12 cities shows that there are 48 % of people prefer to try new things and pursue fashion in the potential consumer groups of crossover products. According to the characteristics of innovative consumers, we can know that innovative consumers will show greater interest to crossover product. Due to natural sense of pursuing novelty, innovative consumers are more willing to purchase crossover products. Therefore, consumer’s innovativeness is an internal factor to crossover strategy evaluation.

### **143.3 The Significance of Crossover**

Crossover strategy makes additional value. Every excellent brand can accurately reflect one characteristics of the target consumer. But it often influence by external factors especially suffering with similar competitive brand. Crossover strategy makes a breakthrough in the existing industry trade, through taking advantage of other industries’ value. In brief, crossover strategy unites brands or enterprises with similar or complementary character, sharing part of the consumer group and achieving greater benefit.

Crossover strategy expands brand market and reduces business risk. Many companies have a large market share in their field and need to develop new market. But companies must invest a lot of money to open up the new markets following tremendous risk. Crossover strategy provides good solution to this problem. By cooperation in different fields, partner brand’s reputation and experience in this area is an intangible asset that can help enterprise establish their brand image and consumer groups faster in new areas. Partner brand’s reputation is the foundation of the development of own brand.

### **143.4 Conclusion**

As marketing expert Elliott Ettenberg said in his book “4R Marketing”: Co-Marketing will become the major trend of the economic times (Ettenberg 2002). With the emergence of crossover car, crossover dress and crossover art, I believe that the crossover strategy is bound to the major branding strategy in the future. According to actual situation, enterprises have to choose the complementary partner brand, getting the utmost out of partner’s brand equity to promote own fames. Enterprises also need to be subdivided target consumer groups, and make full use of advertisement, avoiding waste of resources in the promotional stage.

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# Chapter 144

## Research the Discipline Construction and Reform of Packaging Engineering Based on the Complete Packaging Solutions

Ying-zhe Xiao, Xi-hai Hao and De-jian Zhao

**Abstract** The shortcomings of the existing professional education in the packaging engineering discipline are summarized in this paper, and the new packaging engineering education method is put forward on the basis of regarding packaging system design and providing complete packaging solution as the guiding ideology after researching and analyzing the education and development situation of packaging engineering domestics and abroad. It is emphasized in this work that modern education should focus on practical teaching link and cultivate the students' awareness of building big project design and system design. These not only make students' professional comprehensive design ability used maximum efficiently by enterprises and market, but also promote the rapid development of packaging industry.

**Keywords** Packaging engineering · Specialty construction · Complete packaging solutions

### 144.1 Introduction

Packaging engineering is a new interdisciplinary science which merges with multiple natural sciences and social sciences on the foundation of packaging science and packaging engineering science. At the same time, it is a system

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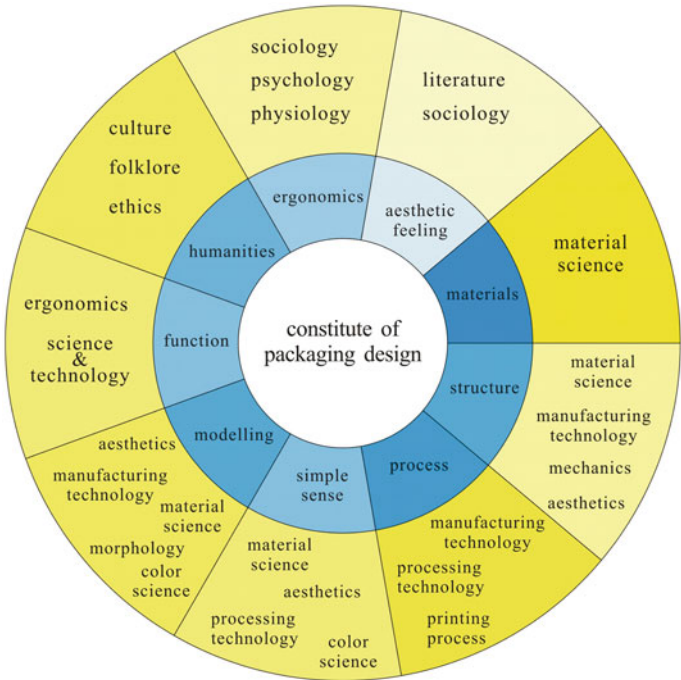
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engineering combining with technology, engineering, art and culture. Its major content includes the theory of various aspects and their application in the packaging field such as packaging materials, packaging containers, packaging decoration, packaging printing, packaging machinery, packaging technology and craft, packaging test, packaging circulation and management, packaging regulations and so on, and is a significant science foundation of the development of packaging industry (Ruomei et al. 2006). With the expansion of the scale of international commodity exchange and the progress of science and technology, human being has a more profound understanding to the serious influence of the commodity packaging to ecological environment. The requirements of the international packaging are more and more strict, and make up harsh and complex regulations. It requires that packaging workers can't only focus on mastering a single skill, but also should start from products, and can have certain cognitive ability and a considerable degree of mastery to the packing used materials, modeling structure, process manufacturing and the whole process of circulation environment that packing goes through. The development of science gives birth to the whole concept of packaging design. It regards the market as the driver, considers customers' demands as driven, provides the complete package solution which covers the whole logistics process in the packaging life cycle for customers, efforts to reduce the impact of products packaging to the environment in using process, try to improve their reusable, and furnish services from professional consulting to complete package solution and the subsequent related services for customers. Obviously, the product concept covers the whole value chain (Wang et al. 2010) (Fig. 144.1).

## **144.2 Analysis of Present Research Situation at Home and Abroad**

### ***144.2.1 The Education of Packaging Engineering Abroad***

Through the early investigation, we know that packaging engineering discipline was built in the 1950s in the developed country, such as School of Packaging in American Michigan State University. It was created in the 1950s and has formed to the complete system of cultivating the packaging engineering bachelor, master and doctor till the 1990s. At present, there are 39 universities that are training the packaging engineering talents at any levels in American, including five universities offering Master Degree and two universities offering Ph.D. (Baofeng et al. 2002). Packaging engineering education in Europe was almost in step with that in US. Several Europe countries, such as Germany, Britain and France, are more developed relatively. Here, the higher education system which trains Bachelors, Masters and Ph.Ds at every level in packaging area is nearly perfect in German, such as Germany Dortmund University, Stuttgart Printing College, Berlin Institute of



**Fig. 144.1** Disciplinary formation of packaging design

Technology, Packaging Technology major of the Leipzig Higher School in Germany and so on. Besides, France has had Packaging College, while there are also packaging engineering in Britain, Italy, Netherlands, Portugal, Australia, New Zealand, South Korea, India and Thailand. The professional education of packaging engineering pays attention to the cultivation of the students’ comprehensive ability in foreign, for instance American universities attaches great importance to the humanities applications and reflects in packaging design, while Germany pay more attention to the practical skills and the teaching of management knowledge needed by enterprise (Graduate student office in Hunan University of Technology 2010).

**144.2.2 Domestic Education of Packaging Engineering**

In China, Jiangnan University is the first to set up the packaging engineering discipline. Since 1962 the packaging engineering course has been started. It began to recruit undergraduate in the name of Packaging Machinery in 1977 and try to set up Packaging Engineering degree in 1984. In the same year, it also began to cultivate graduate students in the direction of packaging technologies and equipment research (Graduate student office in Hunan University of Technology 2010).

At present, since the background that packaging engineering relies on is different in universities and colleges of China, its teaching and curriculum mode are also various, and roughly trend to the following aspects respectively: packaging machinery, packaging decoration, food packaging, packaging and printing, packaging CAD, etc. Due to different emphasis, students cultivated appear to the situation that the guide direction is disordered in the filed of employment, resulting in some students at school have confusion and misunderstanding on the profession, and even start to “mud along”.

The research of our colleges and universities to the course system of integrated packaging design has not been reported. Only Jiangnan University has opened the course of packaging system design, and made a preliminary study of the direction.

### ***144.2.3 Study and Requirements of Packaging Enterprises at Home***

In terms of the enterprise, currently, a great majority of packaging enterprises are the processing factory of packing and printing in China. In generally, according to the needs of customers, they manufacture directly the regularly packaging and printing products. The so-called work that the design and development department needs to do is essentially “copying”. Basically there are not comprehensive designs to characteristics of products. Currently, only two or three companies, such as Nefab (NEFAB) Packaging Engineering Co., LTD, Tokyo holdings Co., LTD and so on, have implemented the research about the complete packaging solutions. Although enterprises hope that colleges can cultivate a group of compound design talents with high comprehensive quality, our graduates are difficult to bear the burden of finishing the complete package solution.

Hence, for the characteristics of professional marginal and cross-discipline of packaging engineering, the personal training should be clear about the location of the output talents in the packaging area based on satisfying the requirements of the job market and social industry. In addition, it's necessary to raise the student's comprehensive ability of engaging in packaging system design and performing the complete package solutions.

## **144.3 Teaching Characteristics and Existing Problems of Packaging Engineering**

In China packaging engineering is an emerging interdisciplinary and comprehensive profession. Although its development speed is quick and has made great progress, many courses still use directly the theory system of the related subject because of the short time of running school and the relatively weak foundation.

This is why packaging professional students have a heavy burden of course, the weak theoretical knowledge and general professional features. At present, the teaching content of packaging engineering mainly has the following characteristics in China (Zhiwei 2003):

First, although it involves more than the subject system, the main core is packaging design.

Second, there are lots of course, and time is tight. The support that some professional class, or basic course and leading class provide is insufficient. To achieve the purpose of teaching, professional classes have to give consideration to the foundation and related interdisciplinary subjects. Meanwhile, the new technology is developing very quickly and needs to be reflected to the course in time. Besides, a contradiction of class tight is more outstanding.

Third, these involved problems are in a wide range with strong practicality. This is accepted by public in the industry. The former reflects interdisciplinary characteristics, while the latter incarnates the characteristics of modern packaging industry.

From the point of view of curriculum system, there are the following problems (Ruomei et al. 2007):

1. The curriculum system of packaging engineering is lack of integrity. The consistency of arrangements between a course and another related course is inadequate. Furthermore, there is a repeated phenomenon in part of the course content.
2. There are more prominent contradictions between the reduction of professional class hours and the large capacity of packaging engineering courses.
3. We are lack of case analysis teaching materials of packaging engineering design with strong comprehensive performance.
4. The practical teaching links don't continue to keep up with because of equipment, supplies and another reason.
5. The traditional teaching method can stimulate the students' autonomous learning. Students' innovative consciousness and ability can't be developed.

## **144.4 Basics Idea of the Profession Construction**

### ***144.4.1 Establish the Central Link of the Specialty Construction and Reform of Packaging Engineering***

According to demands of packing industry and market for the integrated design talents of packaging engineering, it's time to adjust the course system. We should restructure the course structure, optimize the teaching plan integrally the core curriculum and the corresponding teaching outline, and determine the practical teaching requirements and the teaching outline of practical course on account of

the needed knowledge, ability and quality structure. Moreover, we would research the training target and plan of creative realization for packaging engineering professional comprehensive design talents based on the complete packaging solutions, and reform the existing teaching methods and means. It is also necessary to organize to write and public the supporting professional teaching materials or handouts.

#### ***144.4.2 The Core Ideas of Teaching Reform***

1. Establishing thoughts of the complete packaging solutions in the course system.
2. To perfect teaching system and curriculum system.

Through the teacher's teaching reform and practice, the teaching system of packaging engineering course should be revised and perfect in order to let it suit the education law better. At the same time we ought to make it satisfy the demand of enterprises and times. Besides, the course relating to the complete packaging design should be optimized and integrated. The course system could be further improved. And students' comprehensive engineering design ability and the basic skill training need to be strengthened.

3. Deepening and perfecting the joint training of universities and companies

Through the strengthening of the combination of production, study and research, the students' participation could be cultivated so that students can have an opportunity to participate the development of products packaging in enterprises, and finish project design systematically and independently which is closely with the market. So we can cultivate compound design talents for enterprises, and improve the employment rate of graduates; meanwhile we will further deepen and perfect the joint training of universities and companies based on the all-round teaching reform about the complete packaging solutions.

### **144.5 Key Problems of Professional Construction and Education Reform**

#### ***144.5.1 Clear About the Core Content of Packaging System Design and Complete Packaging Solutions***

Packaging system thinking mode comes from the way of modern system thinking. For the sake of making up for shortcomings of a single discipline and profession, we usually carry out the integrated design which is active, interdisciplinary and cross-major by systematic thinking methodology (Hongmin and Zubin 2008).

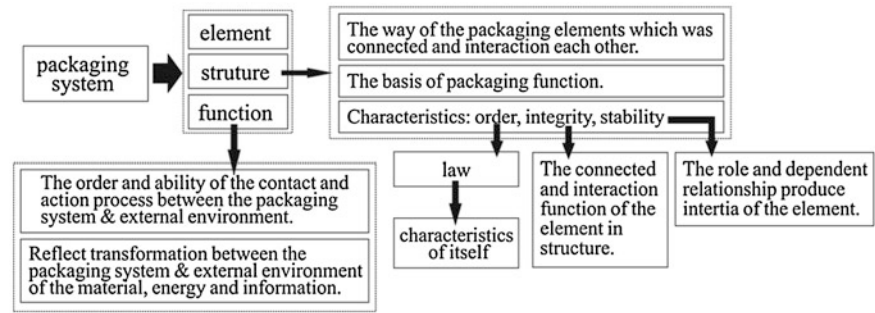


Fig. 144.2 Composition of packaging system

Generally speaking, the packaging system consists of elemental composition, structure components and function constitute (as the Fig. 144.2).

The complete package solutions applies the marketing idea to the packaging industry, and is a set of system services which packing suppliers (manufacturers) provide from the selection of packaging materials and suppliers, to the packaging design and production, to logistics and distribution until the end-user (Zubin and Hongmin 2009). This is the more widely consideration category of packaging system design (Fig. 144.3).

In the process of the teaching reform, first of all thoughts of complete packaging solutions should be established clearly. Then teachers should guide students to change traditional and inherent concept in packaging design, and train students' design thinking mode in view of system design and the great engineering design. It ought to be treated as a key point to train students' practical ability. And the classroom learning should be combined with practical problems as far as possible. We should train students' practical ability; at the same time it is necessary to strengthen their independent creative realization. On the basis of understanding the basic production mode of packaging industry, it should be done to constantly

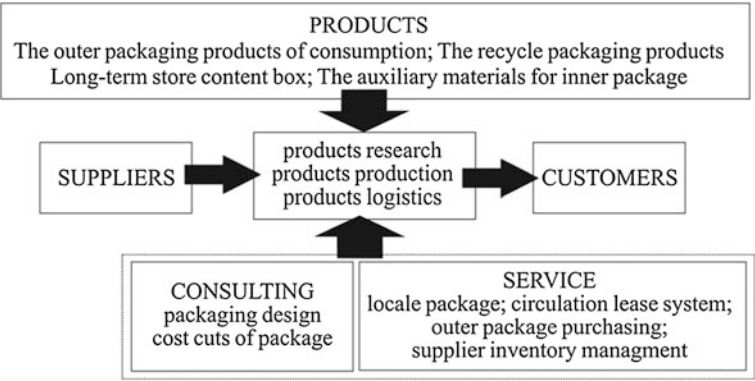


Fig. 144.3 Basics workflow of the complete packaging solutions

develop students' creative thinking, put forward own views and the feasibility creative design from multiple angles such as packing structure and modeling, protection, logistics and distribution, sale mode, market management, etc., (Qingjie 2011) and cultivated students' adaptability for change in the market or the design process.

### ***144.5.2 The Optimization and Integration of Courses***

In accordance with requirements of packing system design and the coverage of complete packaging solutions, the main professional course will be optimized and integrated (as the following picture) (Guoxun and Ying 2007). The teaching status is able to be established about a series of courses of packaging system design and complete packaging solutions. And students' interest to learn and participate should be improved. We expect to be able to finally improve the teaching result through the flexible and various teaching methods (Yingzhe et al. 2006). The main means include:

#### **1. The comparison and analysis of excellent cases**

Through showing the videos of excellent design cases at home and abroad for students, we should guide students to participate in the discussion on the basis of analyzing the integrated design process. All kinds of basics design theory will be combined with design practice in the interactive classroom atmosphere. And let students feel that the comprehensive engineering design is not far away from him.

#### **2. Deepening practice operation further**

The teachers should understand all kinds of information in time. According to the existing condition, teachers can also set some actual or virtual packaging design topic for students, and encourage them to practice and apply all sorts of design knowledge that has been learned to the subject. Meanwhile they are able to weave together the content involved in every link of the whole package together, guide the students to become familiar with the actual operational program of packaging production. There's no doubt that it will make students leisurely as they need to deal with practical issues of production which may be encountered in future work (Fig. 144.4).

### ***144.5.3 Broadening the Students' Horizons***

It can be done to introduce the education mode of the international advanced packaging design, such as paying attention to train students' comprehensive

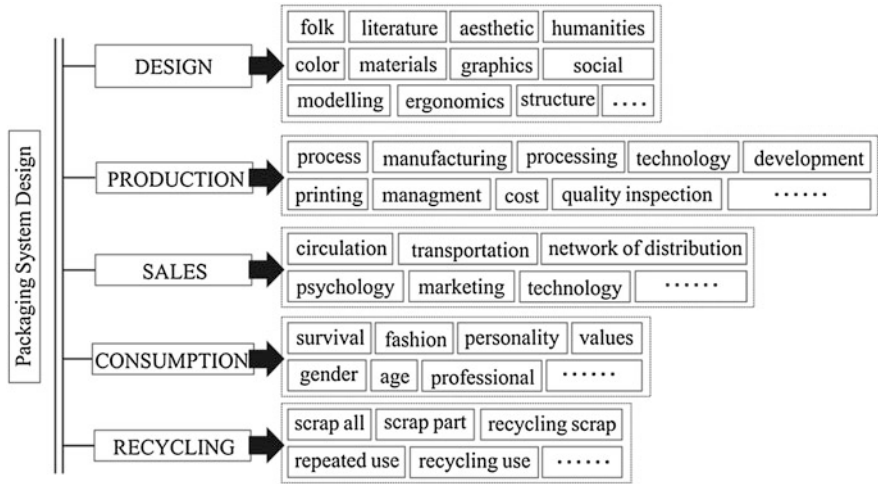


Fig. 144.4 Course system satisfying the packaging system design and overall solutions

ability, attaching importance to the application of the humanities in packaging design, emphasizing to train the practical skills and management knowledge, ect.

144.6 Conclusion

During cultivating students’ ability of designing comprehensive system and finishing the complete packaging solutions, the key is that students should set up the awareness of the great project design and system design. In addition, it is also very important that we are involved in the practical base as much as possible. We can use all effective ways, such as practice, practice base projects, enterprises’ production videos’ analysis, classroom cases’ discussion, course design, graduation design and so on, to gradually strengthen and train the students’ practical ability step by step.

Under the guidance though of the complete packaging solutions we should formulate the talent training scheme, meet the need of the market and enterprises; According to these needs, the students should be trained as enterprise-order-form. These not only make students’ professional comprehensive design ability used maximum efficiently by enterprises and market, but also promote the rapid development of packaging industry and provide the helpful reference for the national education reform.

**Acknowledgments** The work was Supported by Education Reform and Research Project of Hunan Provincial Education Department (Xiangjiaotong (2010) Number 243–258).

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# Chapter 145

## Negative Information Communication: What Can Leaders Do

Qiong Bu, Steven Ji-fan Ren and Ming-jian Zhou

**Abstract** This paper explores a relatively new subfield of the communication in the organization: negative information communication. We define negativeness of negative information communication. Through case study analysis, we identified several factors which managers may consider important for negative information communication, named explanation, fix and occasion. We also examined how the leadership style of leaders (as senders) influences those three factors. Besides, we proposed the moderating effect of the negativeness on the relationship above. Implications and future research are discussed.

**Keywords** Communication · Leadership style · Negative information communication

### 145.1 Introduction

It may be an unpleasant but necessary part of managers' job to deliver bad news to their subordinates (Fulk 1986). An improper method dealing with this could cause enormous damage, including the negative moods (Schuster et al. 1990), actions and the consequent decrease of performance (Sparrowe et al. 2001). One of the famous cases is Neal L. Patterson's case. Patterson is CEO of Cerner Corporation, a Kansas City-based medical software corporation. Patterson is infamous for his e-mail flaming managers for not coming to work before 8 am and leaving before 5 pm.

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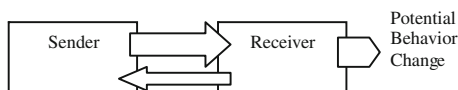
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**Fig. 145.1** The asymmetric process of communication



In the e-mail, originally sent to some 400 managers at the company's headquarters, he complained managers were not working hard enough. He said: "As managers, you either do not know what your EMPLOYEES are doing or you do not CARE. You have created expectations on the work effort that allowed this to happen inside Cerner, creating a very unhealthy environment. In either case, you have a problem and you will fix it or I will replace you". Later on one of the 400 managers posted the e-mail to Yahoo, and the company's stock price fell by over 22 % from a high of \$1.5 billion USD (Nancy Flynn 2003).

The negative information, the content of which has potentially negative consequences for the recipient, weighs more heavily comparing with other information (Ito 1998). That means people spend more attention on negative information than neutral or positive information. However, the definition and the measurement of the negativeness of the negative information are rarely mentioned in previous literatures.

During the process of negative information communication, the sender is and should be responsible for the negative information communication. In most common situation, the sender holds the information which is important to the receiver, while the receiver hardly knows that. That is, the process is an asymmetric one, as shown in Fig. 145.1 (Sussman and Sproull 1999). The information sender is in a dominant position before and during the interaction. In the context of the organization, the sender is usually the leader. He/she has the authority of choosing almost every changeable factor. However, the role of leader and his/her leadership style is also rarely found in former literature.

Thus, by the case study, we will:

1. offer the definition and measurement of the negativeness of the negative information;
2. examine what factors the leader will choose to reduce the predicted negative reaction of the subordinates;
3. examine if the leadership style can influence the importance of the factors to the leaders;
4. propose the moderating effect of the negativeness on the relationship above.

## 145.2 Literature Review

### 145.2.1 Negative Information Communication

Current studies in the field of communication are mainly focus on the media (Joon Soo Lim 2011; Markus 1994), the communication satisfaction (Pornsakulvanich

et al. 2008) and so on. Other literature which discuss the negative information communication disperse in the field of marketing (Laczniak et al. 2001) or psychology (Sher et al. 1990). However, literature which studied the negative information communication as a single subfield of communication research are rarely found except the study of Sussman and her colleagues (Sussman and Sproull 1999). They examined which medium could increase honesty and accuracy during bad news delivering process. Their focus is on message distortion and found that e-mail is the most effective medium to reduce distortion. Their study has given insights on how electronic medium can help when delivering bad news.

But they didn't provide the specific roles of the sender and the receiver. Their experimental research on the undergraduate makes the conclusion not very convictive in the context of the practical organization, especially when the sender who dominates the communication is the leader instead of the schoolmate. We believe that, the leaders and their leadership styles also play a critical role to influence the communication.

### ***145.2.2 Leadership Style***

There are multiple researches on the leadership and leadership style. The famous scholars have their own standards on the classification of leadership, any of which can describe one of aspects of the manager. Considering communicating with people is a part of emotional capabilities, we choose the Daniel Goleman's six leadership styles (Goleman 2000).

Daniel Goleman proposed that emotional capabilities are more important for leadership than intellectual capabilities. He identified six leadership styles, namely coaching, pacesetting, democratic, affiliative, authoritative, and coercive. This order of styles moves from very democratic via supportive to authoritative. Pacesetting and coercive is only suggested in cases of emergency, because of their inherent threat for long-term relationship between leader and follower (Goleman 2000).

Leaders may have more than one style, but the Affiliative and authoritative style are two typical leadership styles in practice. Affiliative leaders care about the subordinates, and are willing to develop a warm relationship with them. In another hand, authoritative leaders care the performance more than people. They probably order the subordinates instead of take counsel. Thus, studying about these two styles is representative and can be expanded to the other styles.

The leadership styles offer the principles of the leaders' activities but can't be specific to communication field. Therefore, the clarification of the role of the leadership style in the process of communication is necessary for the both fields of communication and leadership style.

145.3 Methodology

The lack of related literature indicates that the study of negative information communication in organization is in its early stage, which is quite suitable for case study. This method of study is useful to deal with the complex information such as documents and interviews, and expand the explanatory and predictive power of the studied theory.

Eisenhardt (1989) points out that the outstanding and extreme cases should be chosen as the objects of case study, in order to extend existing theory. Following this principle, we choose Firm A as the background organization.

Interviews in Firm A were conduct two rounds. The first round tried to collect the comprehensively related information. Therefore, most part of the interviews was free talk. Then the second round of interview was conduct to confirm some propositions extracted from former interview by focusing on some specific cases. Besides, the interviewees were also asked to fill some necessary questionnaires. All interviews were recorded to audio files.

145.4 Case Background

Firm A which is seated in the north of China is a support center to deal with clients' computer stoppage, belonging to a multinational corporation. Their remote consult engineers (RCE) are at the first line which can connect with clients. Each team leader is responsible for at least one support team servicing a unique product or area.

We choose two managers and three cases as the objects. The situation of cases and managers is shown in Table 145.1.

145.4.1 Managers

Managers as interviewees were chosen carefully. Firstly, we interviewed some subordinates privately, asking their impression about their leaders. According to this, we focused on three managers. To confirm the leadership styles of managers, then we send the questionnaires which based on Daniel Goleman's paper

Table 145.1 The situation of managers and cases

Managers		Manager A	Manager B
Manager style		Affiliative	Authoritative
Negativeness of cases	High	Case A	Case B
	Low	Case C	

(Goleman 2000) to managers and their subordinates. And finally two typical leaders were chosen.

1. *Manager A*: He is described as “a nice people”, he cares about the relationship with subordinates, and easy to get along. His and his subordinates’ questionnaires show that he is willing to create harmony and builds emotional bonds, and his own summary about his leadership style is “People come first.”
2. *Manager B*: He is a complex leader. His own questionnaire and some subordinates’ indicate he is democratic, pacesetting, coaching and authoritative, however, almost every subordinate’s questionnaire contains one sign of authoritative leadership style. Thus, we consider him as an authoritative manager.

### 145.4.2 Cases

We select three typical cases in different levels of organization and the information conveyed in these cases has the different level of negativeness.

1. *Case A*: It’s a technology support team for a data warehouse (DW) software. Because the client group continued losing, this DW software has exited the market in the year of 2010, and corresponding support will finish at the end of 2013. Manager A is responsible for this team. While communicating with his subordinates, he emphasized they could get another position as soon as this team is dismissed, and the training plan was executed.
2. *Case B*: During the financial crisis in 2008, the decision of cost control was executed in Firm A. However, the policy didn’t work well. At the end of next year, an e-mail was sent to every employee, in which the employees were asked to sign a voluntary agreement about pay cut. Employees who weren’t willing to sign this agreement were persuaded by the direct manager and finally agreed. Manager B reports some subordinates of him couldn’t accept this at that times, therefore he talked to them separately. He chose a proper occasion, including single room in the company, smoke point and the restaurant. He prepared the explanation about the situation, and encouraged the subordinates worked through the hard time with the company.
3. *Case C*: There is a performance assessment each month and quarter in Firm A. Managers usually need to talk to the employees whose performance wasn’t desirable. Manager A and B conduct the communication in the similar way. The conversation is usually in a single room, just the manager and one subordinate. The subordinate is asked to talk about his/her recent performance, following optional praise. Then the manager shows the data of performance, and tries to figure out the reason of the undesirable consequence. The communication usually ended with the encouragement and the suggestion to improve.

145.5 Case Analysis

145.5.1 The Measurement of Negativeness

The word “negativeness” here means how negative the negative information is. We believe that the negativeness is the property of negative information. However, there isn’t a systematic measurement of the negativeness at present. According the interviews and case study, we summarize some measuring standard, as shown in Table 145.2.

- 1. *Duration*: We summarize this measurement from the cases. In Case A, the dismissing of the team lasts forever, that means the consequence of the negative information continuously exists. In Case C, the consequence mostly is mental and variable depending on the receiver. But in general, it lasts shortly. Case B is complex, because the pay cut is a one-off activity, it lasts until the next pay rise, which is difficult to measure. Duration indicates an aspect of negativeness: the duration of the negative consequence, the longer the duration is, the higher the negativeness is.
- 2. *Time to take effect*: We summarize this measurement from the cases. In Case B and C, the time from the communication happened to the consequence take effect is short. In another hand, the team members from Case A have three years to think about their future career. The concept of time to take effect indicates the time span from the communication to the consequence. The larger the span is, the lower the negativeness is.
- 3. *Seriousness*: The concept of seriousness has two meaning: boundary and damaged benefit, which are considered by most interviewees. Boundary means the individuals or groups involved, from individual to organization. As stated before, Case A is related to a team, while Case B is an organizational activity. Case C only involves the subordinates who don’t perform well. Thus their respective boundary is middle, large and small. Another aspect of seriousness is damaged benefit, which sounds a little subjective. Although people value something in their own opinion, the benefit damaged can’t be changed. We get the result about benefit damaged from subordinates, in the assumption that substance or financial benefit weights more.

Table 145.2 Measurement of negativeness

Measurement		Source	Measurement in cases		
			Case A	Case B	Case C
Duration		Case	Long	N/A	Short
Time to take effect		Case	Long	Short	Short
Seriousness	Boundary	Interview	Middle	Large	Small
	Damaged benefit	Interview	Large	Large	Small

The weight of the measurements is different: the interviewees care the seriousness more. However, the quantitative relationship is not available in this case study. But we can get an equation with undetermined coefficients as in (145.1).

$$N = \alpha_1 D + \alpha_2 T + \alpha_3 (\beta_1 B + \beta_2 DB) \tag{145.1}$$

All coefficients in this equation are between 0 and 1, and  $\alpha_3$  is greater than  $\alpha_1$  and  $\alpha_2$ .  $N$  stands for negativeness,  $D$  stands for duration,  $T$  stands for time to take effect,  $B$  stands for boundary,  $DB$  stands for damaged benefit. The specific value of negativeness depends on the scale is five-point or seven-point.

**145.5.2 The Leadership Style Influences the Importance of Factors to the Leader**

We got several factors which are considered by managers before the communication, listing in the Table 145.3.

- 1. *Explanation*: it contains the reason and the source of the information, the detail, the situation of others if it is accessible and the data which can confirm the information, such as a rank of monthly performance.
- 2. *Fix*: the compensation in another way, or the suggestion to improve, such as a promise of further promotion after the pay cut.

**Table 145.3** The list of factors

Factors	Sources	Description
Explanation	Manager A and B	“You should make your pronunciation reliable, so I will prepare some numeral data to explain the source of the information” “I will explain the fact in detail and expect the acceptance”
Fix	Manager A	“There is a factor which I can’t summarize it to a word. It contains but not only limited to the compensation; it also refers to the suggestion and possible help about the further work”
Occasion	Manager B	“According to the specific information, I choose different occasions, which are different from the media. They could be all face-to-face, but in different places and time, like meeting, personal interview, conversation at the smoking point or a restaurant”
Expression	Manager A and B	“The expression is important, variable by the specific circumstance” “I pay attention on the expression and keep my eyes on the subordinates’ reaction”
The character of subordinates	Manager A and B	“I must consider the endurance of the subordinates, to decide the expression” “Understanding the feeling of the subordinates is important”

**Table 145.4** Factors in cases

Factors	Case A	Case B	Case C
Explanation	○	○	○
Fix	○		○
Occasion		○	

**Table 145.5** The importance of the factors to leaders

Factors	Manager A	Manager B
Explanation	○	○
Fix	○	
Occasion		○

- 3. *Occasion*: the composite concept related to the participant, the time and the place, such as the meeting, chat in the company or in a restaurant.
- 4. *Expression*: the tone, wording or the nonverbal language and so on.
- 5. *Character of subordinates*: the temporal mental state, the endurance, the emotional intelligence and so on.

The character of subordinates is critical for the successful communication. However, it’s not a factor which can be controlled by the manager. The expression is controllable, but it’s the dependent variable, depending on the other factors like the character and the relationship. Thus, we choose the remaining factors and imply them in the cases, as shown in Table 145.4. The circle in the table means that the factor is considered in the responding case.

By the interview, we also find that the leadership style can influence the importance of factors to the leader. The difference is shown in Table 145.5. When the communication isn’t related the specific cases, both A and B care about the explanation. But Manager A didn’t mention the consideration on the occasion. Manager B did mention the fix, but only few times. According this situation and their different leadership styles, we suggest the proposition below:

*P1: the leadership style influences the importance of factors to the leader.*

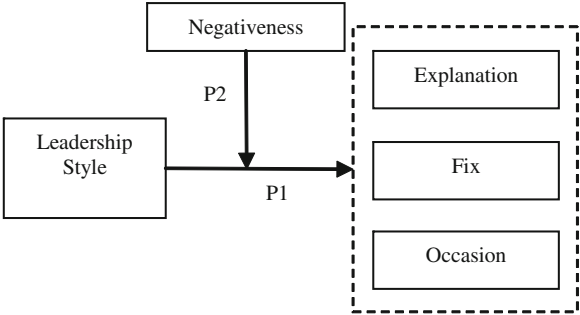
**145.5.3 The Moderating Effect of the Negativeness**

Managers were asked to sort the factors in the order of the importance in the different situation of negativeness. The result (Table 145.6) shows that when the negativeness is high, the factors which managers valued are distinguishingly influenced by the leadership style, but this difference becomes non-significant when the negativeness is low. The order is also confirmed by the cases, which can support the moderating effect of the negativeness empirically.

**Table 145.6** The importance array under different negativeness

Negativeness	Manager A	Manager B
High	Fix Occasion Explanation	Occasion Fix Explanation
Low	Explanation Occasion Fix	

**Fig. 145.2** The proposed model



Thus, we suggest the proposition below:  
*P2: the negativeness of the negative information has the moderating effect to the relationship between leadership style and the importance of factors to the leader.*  
Summarizing the propositions above, we propose the model, shown in Fig. 145.2.

145.6 Discussion

Previous research suggests that the sender distorts the negative information more largely if the media is face-to-face (FTF) (Sussman and Sproull 1999). But the phenomenon in this study is not supportive. Managers in Firm A choose to explain the information as clearly as possible, instead of distort. That is probably because of the organizational culture (Schall 1983) or the quality of professional managers. Whether or not, that shows the different conclusion in an experimental or empirical environment.

Another conclusion that may challenge the current theory is about the media choice. Scholars suggest media choice theories like media richness (Daft and Lengel 1986) and social presence (Gunawardena and Zittle 1997). But the study shows that when the information is negative, leaders unlikely choose a single media except the face-to-face. They consider the other media such as e-mail may cause confusion or make the perceived negativeness higher. In another word, the negative information is conveyed by face-to-face in all possibility.

## 145.7 Limitation and Further Research

Negativeness is an objective concept. It only relates to the information itself and some macroscopic factors like the culture. However, even the information with the same negativeness can lead to different reaction according to the receiver's personality. Thus, the concept of perceived negativeness is also necessary for the further research of the reaction of subordinates.

In this study, we didn't check all six leadership styles, but focused on two typical styles. That offers a direction for future researches to check more styles and related factors. Besides, the study is conducted in a single firm, lacking of comparison with other companies. Although the cases and managers we choose are representative, the study about multiple firms is still necessary. As shown before, we didn't get the accurate coefficients in (145.1) in the situation of interview. Confirm these numbers will be the next step of research.

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# Chapter 146

## Product Life Cycle Assessment and Environmental Efficiency Assessment

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**Abstract** With growing human demand for a variety of economic, resources and environment exerting a profound human impact on the environment, in order to deal with economic, resource and environment relationship, life cycle assessment (LCA) and environmental efficiency evaluation are widely used. In order to more accurately conduct the environmental assessment of the product, it is needed to rationally utilize life cycle assessment and environmental efficiency evaluation, put accurate environmental load data into effective use of the evaluation of environmental efficiency, in which environmental efficiency indicators and the performance factor index correctly reflects the value of the product enhancement and mitigation of environmental load.

**Keywords** LCA · Environmental efficiency · Performance factor

### 146.1 Introduction

With the international market issued by the WEEE Directive, ROHS Directive and the EUP Directive, more and more foreign enterprises take the initiative to provide its product life cycle environmental information, such as product carbon

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footprint, water footprint, product ecology files. At present, all of the environmental engineering research must support the report of the life cycle assessment, according to framework program 7 in EU Science Plan in order to ensure that it will not cause the transfer of the environment problems when solving environment problems.

Therefore, life cycle assessment has been the key of research in the field of international sustainable development and the protection of the environment, the main is to research the relationship between the industry activity and the environment impact.

Since the human being was in a complex economic-environment-sociality system, in order to reflect more clearly the relationship of the economic, resources and environment, the new concept named environmental.

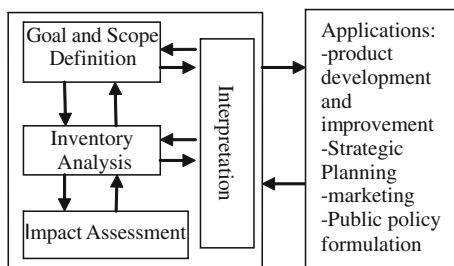
effect came out combining the economic benefits and the environment benefits then the ecological efficiency appeared, showing not only the impact of the research object but also evaluation the economic value. Then the way of environment efficiency also become the key to research.

At present, the countries and company all over the world are trying their best to find the way of how to use the life cycle assessment to know the product life cycle caused environment carrying capacity in every moment, try to use the data of environment carrying capacity to evaluate the environment efficiency though the environment efficiency index and the performance factor to reflect the improvement of the product or service and the efficiency of the devolution of environment carrying capacity.

## 146.2 Life Cycle Assessment

The life cycle assessment (LCA) first appeared in the US. Though the development of a few years LCA has been the main technique to evaluate the product's environment factors and potential impact, and also used in product design, product development and improvement, pollution perfection, strategic planning, evaluate and improve the environmental laws, personal and organization's purchasing, environmental label, the strategy of market development, environmental management system and so on.

International organization for standardization (ISO) gives the definition of LCA. Life Cycle Assessment (LCA) is a method developed to evaluate the mass balance of inputs and outputs of systems and to organize and convert those inputs and outputs into environmental themes or categories relative to resource use, human health and ecological areas. LCA contain four parts: Goal and scope definition, Inventory analysis, Impact assessment, and Interpretation as illustrated in the Fig. 146.1.

**Fig. 146.1** LCA framework

At present, the way of inventory analysis is ripe. But the impact assessments are on the stage of study and exploration, and the way to research the interpretation are seldom. So the key problems of life cycle assessment are the definition of product; data changing with different time and space in life cycle impact assessment, data's reliability problems, and the comprehensive evaluation weights problem and so on.

In a word, the life cycle assessment can evaluate all the part of the product life cycle, but it is hard to evaluate the product value. Therefore, the ISO organization promoting the standardization of environmental efficiency and make it helpful to the economic-environment-society.

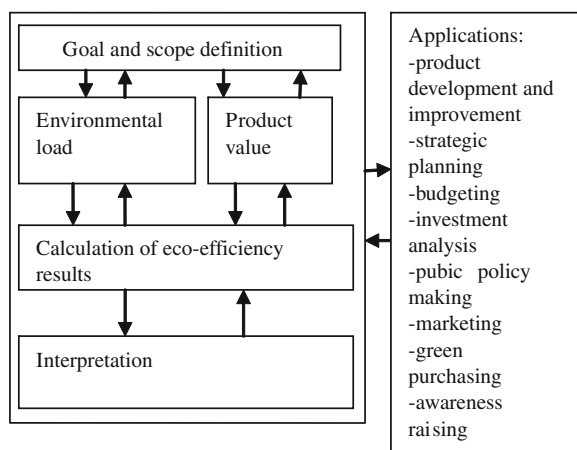
### 146.3 Environmental Efficiency

Environmental efficiency based on environment and economic activities of the social system led or realize enterprise management is one of the foundation, it is the product of the environment load determination standards, and is the flexible use of sales strategy management index, it is to improve product or the value of services upward and reduce the effectiveness of the environment load index, meanwhile it is to promote the product or service environment harmonious performance indispensable for communication tools.

WBCSD (World Business Council for Sustainable Development) in Earth Summit in Rio held in 1992 proposed the definition of environmental efficiency, which is the ratio of the value of the products or services to the environment load, namely the value generating by unit environment load. The production activities by the environment load is small, the economic value created is larger, and environmental efficiency is higher.

Japanese industry management association gives the framework of environmental efficiency, as shown in Fig. 146.2. From Figs. 146.1 and 146.2 we can see the main differences between the LCA and the environmental efficiency that the LCA give the explanation in each stage, but the environmental efficiency only give the explanation to the result of the environment load and the value evaluation.

**Fig. 146.2** Phases of an eco-efficiency assessment



Domestic and overseas scholars have researched widely from the different area such as country, region, and enterprise, such as the foreigner Sturm and Landmark's research (Sturm and Waekernage 2003; Lindmark and Vikstrm 2003), regional ecological efficiency research (Seppala et al. 2005; Ma et al. 2007; Wang et al. 2010; Zhi 2010), the business enterprise research (Björn 2001; Tyteca 1996; Pekka and Mikulas 2004; Milka and Timo 2005) and industrial research (Charles and Michael 2003; Li and Han 2008; Li and Rao 2011; Zhang 2009; Wang 2001; Wang and Zhang 2000), but there are a little research on environmental efficiency assessment.

With the in-depth study of the environmental efficiency evaluation method at home and abroad, international developed countries has proposed more detailed evaluation index for environmental efficiency. Germany WUPPERTAL research institute suggested that in order to realize the sustainable development of social economy, developed countries should improve the productivity of resources (the unit of the facility resources products, services output) for 10 times in the next 50 years. In 1999 Japan announced the environment white paper, which on building the sustainable development of the economy and society about the direction of industrial activity, introduced the "10 factors" and made a positive activity requirements for the enterprise. From then on many big research institutions and manufacture enterprises, especially the electronic enterprise took part in the discussion and technical development of environmental efficiency and performance and employed them for customers to easily compare conservation of resources of new products with the old. Thought the national development and reform commission jointly with relevant departments drawn up «Evaluation index system of circular economy», but the system was made up from the macroscopic level and industrial park respectively, rather than the detailed evaluation index; It focused on resources and energy output, consumption of resources, comprehensive utilization and the waste in the emissions, rather than the bad impact on the environment.

The implement of environmental impact assessment from technical guideline in 2012 has some guiding index, not including the detailed evaluation index.

## 146.4 Product Environmental Efficiency Assessment

In order to do the product eco-efficiency assessment better, it is needed to prepare the accurate life cycle assessment resources data and the environment impact data, make full use of environmental efficiency evaluation model analysis, determine product environmental efficiency and performance factor.

Environmental efficiency index characterizes the ratio of the value of the product or service improvement to the reducing environmental impact. Therefore environmental efficiency evaluation formula is as follows:

$$\text{Eco efficiency} = \frac{\text{functional value of the product}}{\text{environmental impact of the product}} \quad (146.1)$$

$$\text{Eco - efficiency} = \frac{(\text{fundament function})(\text{utility duration})}{\text{amount of greenhouse gas emissions over the life cycle of the product}} \quad (146.2)$$

$$\text{Common factor} = \frac{\text{eco - efficiency of the evaluated product}}{\text{eco - efficiency of the same type of product for the reference year}} \quad (146.3)$$

As the table showed, this article utilized the resources consumption of oil-immersed transformer, which was announced by Japanese manufacturing enterprises. After conducting environmental efficiency evaluation, we got Table 146.1.

**Table 146.1** Environment data

		Reference product	Evaluated product
M	(1) Product weight (kg)	2,725	3,808
	Iron (Kg)	1,790	2,256
	Cuprum (kg)	2	965
	Aluminum (kg)	207	
	Resin (regeneration) (Kg)	0	0
	Resin (Non-renewable) (kg)	0	0
	Other (kg)	726	587
	(2) weight of the regeneration material (Kg)	664	905.4
	(3) weight of recycled components (kg)	0	0
	(4) weight of the 3R material $\ll(2) + (3)\gg$ (kg)	664	905.4
	(5) resource consumption $\ll(1) - (4)\gg$ (Kg)	2,061	2902.6
	(6) Can 3R weight (kg)	2,665	3,733
	(7) Can not 3R weight $\ll(1) - (6)\gg$ (kg)	60	75
E	Consumption of electric power (kwh)	4.853	2
T	Chromium weight (g)	74	0

**Table 146.2** Eco-efficiency assessment

		Environmental load			Product value	
		M	E	T		
Reference product	1990 year RA-T	1	1	1	1.732	1
Evaluated product	2006 year RA-TS	1.4	0.426	0	1.463	1.184
A	(1/Environmental load of evaluated product)/(1/Environmental load of reference product)				1.184	
B	(Evaluated Product value)/(Reference product value)				1	
A*B	(Evaluated Product value/Environmental load of evaluated product)/(Reference product value/Environmental load of reference product)				1.184	

In Table 146.2 the environment load is reflected by MET index. Among them Material (M): the resource consumption; Energy (E):energy consumption; Toxicity (T) :hazard substances. Therefore, the product environment load calculation is according to the formula (146.4) to calculate.

Product environmental load =  $\sqrt{M^2 + E^2 + T^2}$  (146.4)

Product environment load calculation method by the Japanese company simplified the life cycle assessment method. In order to accurately calculate more natural resource consumption and global warming environment load, the life cycle assessment by Japan Seizo Kato in Sweden EPS method based on the development of NETS method, the accurate numerical formula is as follows:

$Ecl = \sum_{i=1}^n (Lf_i * x_i)$  (146.5)

$Lf_i = \frac{AL_i}{p_i} * R_i$  (146.6)

Ecl: is the environment load value or any industry process of the whole life cycle caused by the environment load value;  $Lf_i$ :the basic environment load factor;  $x_i$ : the whole process of the first a processes input or output the raw material and a number of pollutants;  $p_i$ :considering the bearing capacity of the earth capacity, the output of the measurement, such as fossil fuel reserves and CO<sub>2</sub> emissions, etc.;  $AL_i$ : the earth can load value;  $R_i$ : the weight factor.

146.5 Conclusion

Through the environmental efficiency evaluation of transformer product manufactured by Japanese enterprises, the transformers’ environmental efficiency and performance factors are calculated to facilitate the consumers understanding

products' performance, and to promote the products or services' environmental coordination.

The research on the eco-efficiency pays attention to the country, region and enterprise in our country, focusing on environment impact, other than the product. In order to operate the economic-environment-society system, we need to draw lessons from Japan's experience, make suitable environmental efficiency index and performance factor index fitting China's national conditions.

Total life cycle assessment and environmental efficiency evaluation should proceed from product design stage. In order to make products consume the least resources, impact the environment and achieve the highest value in the whole life cycle, the products which can't meet the requirements should be renewed for the environmental design.

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# Chapter 147

## Municipal Solid Waste Characteristics and Management in Kolkata, India

Swapan Das and Bidyut Kr. Bhattacharyya

**Abstract** This paper presents a general over view of the current municipal solid waste (MSW) management in Kolkata province, India. In order to characterize the solid waste stream in the Municipality of Kolkata, a long-term study was conducted over a 56-week period between the winter of 2010 and the winter of 2011. In this study, percentage of components and specific weight of the MSW, the composting parameters (moisture content, total organic carbon, total nitrogen and pH), organic matter content, calorific value and heavy metal concentrations (Cd, Cr, Cu, Ni, Pb, Zn, Fe, Mn, Co) of the compostable waste sorted from the mixed MSW were determined and evaluated. Kolkata city generates approximately 5114.76 ton/d i.e., 1.10 kg/cap-d of MSW daily. Approximately 700 ton of MSW were collected and stored in every day. Approximately 30 % of the MSW generated is compostable wastes and yearly mean moisture content, organic matter content, C/N ratio and pH of these are 46 %, 31.81 %, 21.6 and 8.07, respectively, and approximately 15 % of the MSW consists of recyclable materials. The recommended system deals with maximizing recycling and minimizing landfilling of the MSW.

**Keywords** Physical and chemical characteristics • Recommended model • Waste analysis

### 147.1 Introduction

In most parts of the world today, solid wastes are disposed of either in open dumps or sanitary landfills, or by incineration. As incineration and sanitary landfilling are expensive, both in initial investment and throughout their operation, their use is mostly confined to developed countries, while open dumping is the method used in

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economically developing countries, mainly due to its simplicity and low cost. India's tradition means of disposing of solid waste has been to dump it at these open sites, which are 2020, or at sea.

Solid waste management has become a considerable issue, in addition other environmental problems, especially for densely populated cities in developing countries (Zotos et al. 2009). Therefore, augmentation of the solid waste management facilities and their operation & maintenance in a sustainable manner by urban local bodies would require huge capital investment, introduction of latest technologies which are cost effective (Emery et al. 2007). Public–Private Partnership (PPP) in waste management and introduction of appropriate waste management practices are needed in order to prevent urban waste causing environmental pollution and health hazards (Chung et al. 2010; Yañez et al. 2010).

## 147.2 Description of Kolkata Province

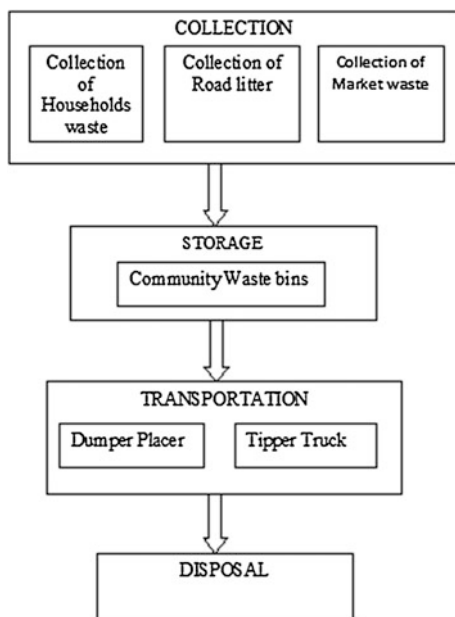
Kolkata is located in the eastern part of India at 22°49'N 88°12'E 22.82°N 88.20°E. It has spread linearly along the banks of the Hooghly River. The Kolkata Municipal Corporation has an area of 185 square kilometres. The city is near sea level, with the average elevation being 17 feet. The whole area is in the Ganges Delta and is monotonously plain. As Kolkata is near the sea, the city has uniform temperature throughout the year. The temperature ranges from 14–25 °C in the winter and 23–36 °C in the summer. Annual rainfall is around 160 cm. Humidity level can be very high in the summers (Zhang et al. 2010). As a growing metropolitan city in a developing country, Kolkata confronts substantial urban pollution, traffic congestion, poverty, overpopulation, and other logistic and socioeconomic problems.

## 147.3 Current Waste Management Practice in Kolkata Province

Kolkata province consists of three municipalities: Kolkata municipality corporation, Bidhan Nagar Municipality Corporation, Dum Dum Municipality Corporation (Daskalopoulos et al. 1998a). All operations of solid waste management (SWM) in this area are performed under four heads—sweeping, collection, transportation and disposal—and are shown schematically in Fig. 147.1 (Albrecht et al. 2010; Ali and Abbas 2010)

In the city area, street cleaning and collection involves collection of MSW from the streets (road sweeping) and households in handcarts. Thereafter, the waste is dumped at one of the 664 collection points (primary collection). MSW is then loaded into transportation vehicles (trucks) (secondary collection), which transport the waste (transfer) to disposal sites (Daskalopoulos et al. 1998b). In Kolkata province

**Fig. 147 1** Schematic representation of solid waste management in Kolkata



and its towns, open dumping is the only option that is presently used for the management of the MSW. The solid waste collection method used in Kolkata is primary collection and secondary collection method. Kolkata's municipal solid waste generally consists of waste generated from residential, commercial and institutional areas, parks and streets, and is not sorted at the source, but stored in the same waste containers. The dimensions and numbers of containers vary according to the width of the street and the quantity of the waste generated. The total number of waste bins in Kolkata is 664. Solid wastes stored in waste bins are collected and transported to the open dump area by vehicles belonging to the municipality of Kolkata.

## 147.4 Materials and Methods

### 147.4.1 Sources and Quantities of M S W

Major sources of MSW in the KMC area are residential areas, commercial/market areas, offices and institutions. Field surveys were carried out by KEIP in 2005 and by KMC in 2010 to assess the status of MSW generation in the KMC area. Kolkata city generates approximately 5114.76 ton/d i.e., 1.10 kg/cap-d of MSW daily. KMC has estimated the amount of MSW generated from various sources in the city, shown in Table 147.1.

**Table 147.1** Municipal solid waste generation in Kolkata during January 2010 to January 2011

Month	Garbage (Ton)
Jan'10	107,144
Feb'10	106,944
March'10	138,238
April'10	135,540
May'10	150,301
June'10	136,890
July'10	142,532
Aug'10	146,232
Sept'10	140,984
Oct'10	148,157
Nov'10	134,469
Dec'10	140,453
Jan'11	153,443

Garbage weight in Ton

**Fig. 147.2** Percent Distribution of solid waste

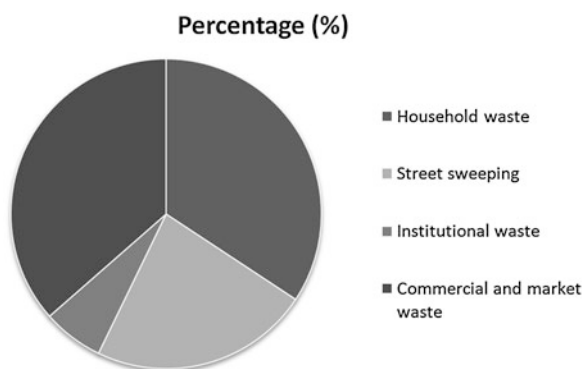


Figure 147.2 shows the percent distribution of solid waste from various sources such as maximum municipal solid waste generate from commercial and market areas around 36.37 %, minimum from institutions around 6.32 %, household waste generate around 34.20 % and from street sweeping 22.80 % of municipal solid waste.

#### ***147.4.2 Physical and Chemical Characteristics of City Refuse***

Refuse characteristics vary not only from city to city but even within the same city, as it depends on factors such as the nature of local activities, food habits, cultural traditions, socio-economic factors, climatic conditions, and seasons. The physical

**Table 147.2** MSW composition in Kolkata during 1995 & 2010 (NEERI, 2010)

Parameters	1995	2010
Biodegradables	44.29	50.56
Green coconut shells	8.51	4.5
Paper	4.64	6.07
Plastics	3.22	4.88
Metals	0.43	0.19
Glass & Crockery	1.72	0.34
Coal	3.10	–
Inert	26.82	29.6
Others	7.27	3.86

All values are in percent by wet weight

**Table 147.3** Ariation of chemical characteristics of Msw at Kolkata (NEERI, 2010)

Parameters	1995	2010
Moisture	61.57	46
pH	6.33	0.3–8.07
Loss on ignition	46.78	38.53
Carbon	25.98	22.35
Nitrogen as N	0.88	0.76
Phosphorous as P <sub>2</sub> O <sub>5</sub>	0.58	0.77
Potassium as K <sub>2</sub> O	0.93	0.52
C/N ratio	29.53	31.81
Calorific value kJ kg <sup>–1</sup>	2717	5028

All values are in percent by dry weight basis except pH, C/N ratio and calorific value

and chemical characteristics aid in deciding the desired frequency of collection, precautions to be taken during transportation, and methods of processing and disposal. Variation of physical composition and chemical characteristics of MSW in Kolkata during 1995, and 2010 are presented in Tables 147.2 and 147.3, respectively.

Table 147.2 shows an increasing trend for the biodegradable fraction, and also shows an increase in the day-to-day use of plastic and paper. A decrease in the coal fraction is reflected due to an increase in the utilization of domestic gas. The amount of paper and plastics, including materials such as food containers and wrapping materials, is noted to be much lower than in developed countries such as the USA (65 %) and Western Europe (48 %). Waste in developing cities generally has a high organic content (more than 50 %) and a low energy value (around 3,350–4,200 kJ kg<sup>–1</sup>). Biological treatment processes such as composting and biogasification are thus well suited for such wastes.

\*Bio-resistant and synthetic material.

The chemical characteristics listed in Table 147.3 show an increasing trend in moisture content. This is most likely due to the presence of a higher proportion of fresh and unprocessed vegetable waste. Although the calorific value of waste has

risen substantially in the year 2010, it is still not in the range 'suitable for incineration'. The calorific value reported is on the higher side for the type of waste composition reported and should be further analyzed. The carbon/nitrogen (C/N) ratio is within the ideal range (26–31) for composting.

### 147.4.3 Leachate Quality

The quality of natural leachate, sampled from the existing MSW disposal site at Dhapa, shows that concentrations of solids, BOD, COD, and chloride are much higher than those allowed for discharge into inland surface water. The concentration of toxic elements such as As, Hg, Pb, Cd, Cr, Cu, Zn, Ni, and fluoride are reported to be lower than those allowed for discharge in inland surface water. The quality of wastewater in the canal at the Dhapa area shows that concentrations of TS, BOD, COD, and Cr are high. Similarly, large water bodies in the Dhapa area also have high BOD and COD. The major parameters of leachate quality are shown in Table 147.4

### 147.4.4 Subsurface Lithology

The soil strata can be grouped into two horizons. The first horizon in the Dhapa landfill area is characterized by soft and gray clay having a lower 'N' value (standard penetration value). The upper part of the second horizon is characterized

**Table 147.4** Parameters of leachate quality

Parameter	Concentration
pH	7.48–8.0
Alkalinity	2900–3590
Total solids	10051–14727
Total organic solids	2750–7000
Total inorganic solids	7543–7785
BOD5 20 °C	2075–7000
COD	3427–16000
Chloride	1234–3408
Nitrate	2. 16–3.31
Arsenic	0.005–0.009
Mercury	0.002–0.009
Lead	0.07–0.08
Cadmium	0.04–0.05
Total chromium	0.43–0.85
Copper	0.06–0.28
Zinc	0.16–0.85
Fluoride	0.36–0.86

All concentrations are expressed in mg/L, except pH

by stiff and brownish clay with a higher 'N' value and also by the presence of gravel. However, the permeability values of clay layers in these two horizons do not distinctly change and lie in the range of  $1 \times 10^{-6}$  to  $1 \times 10^{-8}$  cm s<sup>-1</sup>. The lower part of the second horizon is represented by the first sand layer, which occurs at a depth of about 22–30 m. It has an 'N' value greater than 50, and permeability is in the range of  $1 \times 10^{-3}$  to  $1 \times 10^{-5}$  cm s<sup>-1</sup>. An analysis of clays present within 25 m of drilling clearly reveals a clear decreasing trend in concentrations of heavy metals (Ni, Cr, and Pb) and cations (K<sup>+</sup>, Ca<sup>2+</sup>, and Mg<sup>2+</sup>) from shallow to deeper levels, i.e., from 5 to 20 m depth. However, anions such as Cl<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, and NO<sub>3</sub><sup>-</sup> and the cation Na<sup>+</sup> show an initial decreasing trend with depth (10–15 m) but their concentrations increase at greater depths. The concentration of Fe varies independently of depth, and the pH of the soil becomes more alkaline at greater depths.

## **147.5 Recommended Solid Waste Management for Kolkata Province**

### ***147.5.1 Recommended Handling System***

One of the main components of this management system is recycling and to make it feasible, it is important to plan a better handling system. Different steps are shown in Fig. 147.3 for recommended solid waste management for Kolkata province (Erkut et al. 2008). As such, the following handling system is proposed.

### ***147.5.2 Recommended Collection System***

Organising house-to-house collection of municipal solid wastes through any of the methods, like community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings and scheduling by using bell ringing of musical vehicle (without exceeding permissible noise levels) (Moya et al. 2008; Jianguo et al. 2010). Devising collection of waste from slums and quarter areas or localities including hotels, restaurants, office complexes and commercial areas. Wastes from slaughter houses, meat and fish markets, fruits and vegetable markets, which are biodegradable in nature, shall be managed to make use of such wastes. Collected waste from residential and other areas shall be transferred to community bin by hand-driven containerised carts or other small vehicles. The municipal authority shall notify waste collection schedule and the likely method to be adopted for public benefit in a city or town (Larsen et al. 2010).

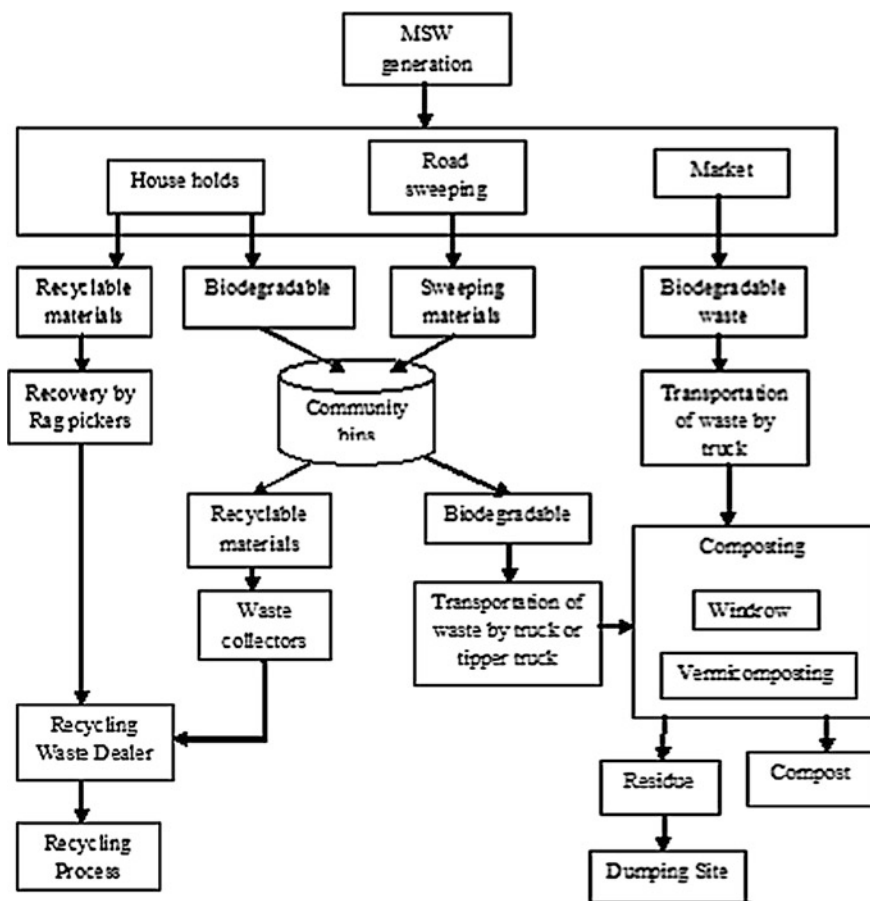
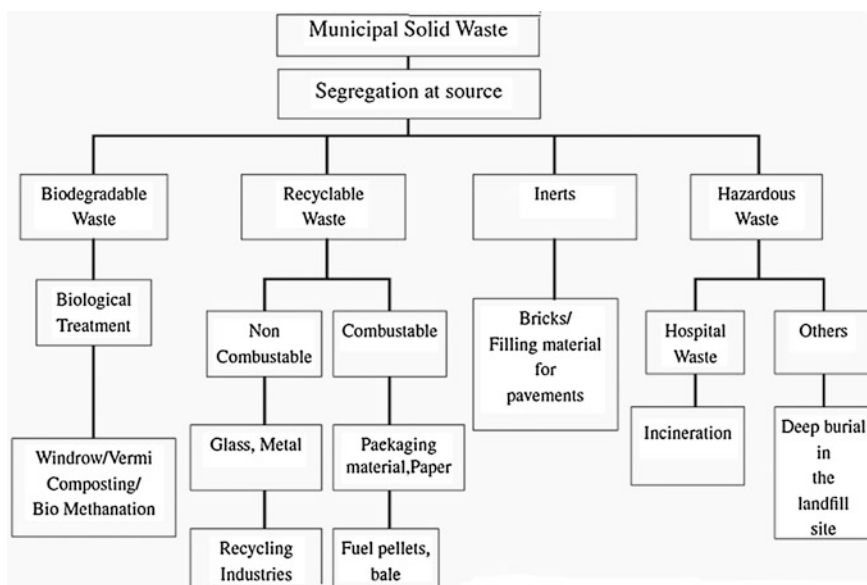


Fig. 147.3 Proposed model for MSWM

### 147.5.3 Recommended Segregation System

Segregation of recyclable waste at source is thus not seriously practiced by households and establishments, who throw such waste on the streets or in the municipal bins unsegregated. At least 15 % of the total waste can conveniently be segregated at source for recycling, which is being thrown on the streets in absence of the practice of segregation of waste at source. Part of this waste is picked up by rag-pickers in a soiled condition and sold to middle men at a low price, who in turn pass on the material to the recycling industry at a higher price after cleaning or segregation and the waste that remains uncollected finds its way to the dumping grounds. Figure 147.4 shows the types of materials we can segregated from the sources.



**Fig. 147.4** Schematic of solid waste segregation at source

#### ***147.5.4 Recommended Transportation System***

Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering. The storage facilities set up by municipal authorities shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing. Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided.

#### ***147.5.5 Recommended Treatment System***

Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill. The biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes. Mixed waste containing recoverable resources shall follow the route of recycling.

### ***147.5.6 Recommended Recycling System***

Recycling refers to the collection and reuse of waste materials such as empty beverage containers. The materials from which the items are made can be reprocessed into new products. Material for recycling may be collected separately from general waste using dedicated bins and collection vehicles, or sorted directly from mixed waste streams. The most common consumer products recycled include aluminum such as beverage cans, copper such as wire, steel food and aerosol cans, old steel furnishings or equipment, polyethylene and PET bottles, glass bottles and jars, paperboard cartons, newspapers, magazines and light paper, and corrugated fiberboard boxes.

### ***147.5.7 Recommended Disposal System***

Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing.

## **147.6 Conclusion**

Sample from the open dumping area in Dhapa landfill site were collected weekly over a one year period (January 2010 to January 2011), the current uncontrolled disposal activity was evaluated, and the composition and characteristics of the MSW were determined (su et al. 2007).

The present disposal method, open dumping, must be immediately abandoned. The present sorting process is not effective. Ideally, all of the valuable materials should be collected separately at the source and transported to the recycling/recovery centre in order to increase the economic benefit. Educational programs, which will be hopeful to decrease the waste loads for solid waste collection, separation and recycling may be conducted.

The municipal corporation certain modifications and improvements to solid waste management services have been done, this is still not sufficient to mitigate the present and future problems of solid waste management in Kolkata (Suocheng et al. 2001). To achieve a target of 100 % collection, transportation, treatment, and disposal, Municipal Corporation would first need to prepare a macro plan which would identify the quantity of waste generated in the municipality and the broad strategy to be adopted to manage the system. This should be followed by a micro or locality-based plan, which would provide details as to routes, timing, equipment, and manpower deployment.

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# Chapter 148

## Research on Comprehensive Evaluation of Energy Intensity

Yong Yang

**Abstract** All the countries pay more attention toward the low carbon constraint mechanism, and the energy intensity evaluation is the key step to develop with low carbon. Grey relational theory is introduced into the traditional fuzzy evaluation method, to improve the membership confirmation of the model, and the new fuzzy evaluation model is constructed, and evaluation procedure is proposed, so as to improve the traditional method. Case study on energy intensity of three stages in Tianjin is made based on the improved fuzzy evaluation model, which has shown the new method can make energy intensity evaluation more objective, and the new method is more scientific and applicable.

**Keywords** Dynamic grey relations · Energy intensity · Fuzzy comprehensive evaluation · Low carbon

### 148.1 Introduction

Currently, carbon constraint has become the bottle-neck for the development of the country. How to evaluate energy intensity scientifically, so as to find advantages and disadvantages of energy use, propose energy development policy, and race to control the commanding point, which is the most important subject to solve (Jintao 2009; Chen et al. 2007).

Fuzzy evaluation method was firstly proposed by professor Zade in 1960s (Sadegh-Zadeh 1999; Borges 2003), which plays an important role in the field of economy, politics, and military officials (Moon et al. 2010; Vaneqas and Labib 2001) however, traditional fuzzy method is scarce in objectivity, so as to has a

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negative effect on the result of the evaluation. The paper focuses on improving of fuzzy comprehensive method, and grey relation theory is introduced into the method, and new improved fuzzy comprehensive method is constructed, and case study on energy evaluation by using the new method is made.

### ***148.1.1 Definition***

Energy intensity is the energy consumption level of per GDP. On the side of nation, energy intensity equals total GDP divided by energy consumption; on the side of industry, energy intensity equals industrial added value divided by energy consumption (Liu and Ang 2007). Stress in this paper: energy intensity is the added value per unit, which overcomes the negative effect of repeated calculation. In this paper, energy consumption is final energy consumption, the loss of conversion and transportation are not included, what is more, energy in this paper is defined as commercial energy, non-commercial energy such as firewood and straws is not included.

## **148.2 Modeling**

### ***148.2.1 Improving Thinking***

Energy intensity evaluation is sophisticated, hierarchical, and dynamic, and the relations among all the factors are uncertain. Confirmation of membership in traditional fuzzy method depends on objective judgment of the experts, and evaluation results are generally partial. Thus, grey relation theory is introduced into the process of the fuzzy comprehensive evaluation, on the basis of which, membership of the factor is confirmed, so as to improve the energy intensity comprehensive evaluation effects.

### ***148.2.2 Improved Fuzzy Comprehensive Method***

In the process of energy evaluation, suppose evaluation set,  $A = (a_1, a_2, \dots, a_n)$ ; factors set,  $Y = (y_1, y_2, \dots, y_m)$ ,  $y_i (i = 1, 2, \dots, m)$  is the  $i$ th factor index. Given  $a_j$ , which can be denoted as vector,  $a_j = (y_{1j}, y_{2j}, \dots, y_{mj})$ ,  $y_{ij} \in y_i$ , ( $i = 1, 2, \dots, m; j = 1, 2, \dots, n$ ). Fuzzy decision function on single aim can be formed on the indicator,  $y_i$  (Narender Singh et al. 2004), that is

$$f_i = y_i \rightarrow [0, 1], i = 1, 2, \dots, m$$

Given set,  $A = (a_1, a_2, \dots, a_n)$ , function value,  $f_i(a_j) = f_i(y_{ij})[0, 1]$ , denotes the situation of energy intensity,  $a_j$ , for factor indicator,  $y_i$ , let

$$\eta_j(i) \triangleq f_i(a_j) \triangleq f_i(y_{ij}), (i = 1, 2, \dots, m; j = 1, 2, \dots, n)$$

Then, a fuzzy relation matrix can be defined as

$$R = \begin{bmatrix} \eta_1(1) & \eta_2(2) & \cdots & \eta_n(1) \\ \eta_1(2) & \eta_2(2) & \cdots & \eta_n(2) \\ \vdots & \vdots & & \vdots \\ \eta_1(m) & \eta_2(m) & \cdots & \eta_n(m) \end{bmatrix}_{m \times n}$$

$R$  is comprehensive evaluation set, each component,  $\eta_j(i) (i = 1, 2, \dots, m; j = 1, 2, \dots, n)$ , is the relation degree for the  $j$ th year ( $a_j$ ),  $i$ th factor indicator ( $y_{ij}$ ), and  $i$ th optimal indicator (virtual year)  $y_i$  of the  $i$ th linear vector,  $R = [\eta_1(i), \eta_2(i), \dots, \eta_n(i)] (i = 1, 2, \dots, m)$ .

the role of factors,  $Y$ , are different, set,  $P = (P_1, P_2, \dots, P_m)$ , is used to denote the weights of factors, where,  $P_i \in [0, 1]$ ,  $\sum_{i=1}^m P_i = 1$ . Then, evaluation model of energy intensity can be defined as

$$\tilde{B} = \tilde{P} \circ \tilde{R}$$

where,  $\tilde{B}$  is the reduction degree in the  $j$ th time serial of energy intensity,  $a_j$ , and  $b_j \in [0, 1]$ , ( $j = 1, 2, \dots, n$ ).

Thus, evaluation model for energy intensity is completed.

## 148.3 Algorithm

### 148.3.1 Confirmation of Membership

In the model, membership,  $\eta_j(i)$ , can be gained by constructing membership function, in this paper,  $\eta_j(i)$  can be gained by calculating correlative coefficients, that is the correlative degree between the factor indicators,  $y_{ij}$ , and virtual optimal indicators,  $y_i^*$ , the steps of which are as follows:

*Step1:* optimal indicator set  $y_i^*$

$$y^* = (y_1^*, y_2^*, \dots, y_m^*)$$

where,  $y_i^* (i = 1, 2, \dots, m)$ , is the optimal vale for the  $i$ th factor in each time serial. Then, primary matrix,  $E$ , can be gained as

$$E = \begin{bmatrix} y_1^* & y_2^* & \cdots & y_m^* \\ y_{11} & y_{12} & \cdots & y_{1m} \\ y_{21} & y_{22} & \cdots & y_{2m} \\ \vdots & \vdots & & \vdots \\ y_{n1} & y_{n2} & \cdots & y_{nm} \end{bmatrix}$$

where,  $y_{ij}$  denotes indicator value for the  $i$ th factor in  $j$  year.

*Step2: Non-dimensionalization of indicator*

Because indicator's values have the different dimension, and is hard to compare, so, it is very essential to non-dimensionalize for the primary indicators. Given minimum value, Suppose the  $i$ th factor indicator's minimum value is  $y_i^{\min}$ , and the maximum value is  $y_i^{\max}$ , let

$$C_{ji} = \frac{y_{ji} - y_i^{\min}}{y_i^{\max} - y_i^{\min}}, \quad (i = 1, 2, \dots, m; j = 1, 2, \dots, n)$$

*Step3: Grey relation degree*

After non-dimensionalization, optimal indicator set,  $C^* = (C_1^*, C_2^*, \dots, C_m^*)$ , is taken as data comparative sequence, and each year's indicator value,  $C_j (j = 1, 2, \dots, n)$ ,  $C_j = (C_{j1}, C_{j2}, \dots, C_{jm})$ , is taken as compared sequence, then, correlative coefficients,  $\eta_j(i) (i = 1, 2, \dots, m, j = 1, 2, \dots, n)$ , can be defined as

$$\eta_j(i) = \frac{\min_j \max_i |C_i^* - C_{ji}| + \rho \max_j \max_i |C_i^* - C_{ji}|}{|C_i^* - C_{ji}| + \rho \max_j \max_i |C_i^* - C_{ji}|}$$

where,  $\rho$  is identification coefficient,  $\rho \in [0, 1]$ , generally,  $\rho = 0.5$ , and correlative coefficients gained by this method is called membership.

### 148.3.2 Weights of the Indicator

According to linear element method and Delphi method, and weight vector,  $P = (P_1, P_2, \dots, P_m)$ , can be easily gained.

Taken factors,  $y_k (k \in i)$ , as comparative criteria, and other factors,  $y_i (i = 1, 2, \dots, m)$ , scale vale,  $U_{ik}$ , can be calculated by

$$P_i = P_k \times U_{ik}, \quad (i = 1, 2, \dots, m; k \in i)$$

According to the experts' opinions, taking the least important factor as criteria factors,  $y_k$ , and other factors are compared with it, importance degree is scaled as  $1 \sim 9$ , factors,  $y_i (i = 1, 2, \dots, m)$ , are compared with factors,  $y_k$ , important scale vale is  $U_{ik}$ , let

$$\sum_{i=1}^m P_i = 1$$

thus

$$P_k = \left( \sum_{i=1}^m U_{ik} \right)^{-1}, \quad (i = 1, 2, \dots, m)$$

148.4 Case Study

Since the ninth Five-year Plan, Tianjin city stresses to adjust energy structure, focus on technical improvement, energy saving and emission reduction, so as to reduce energy intensity steadily, to illustrate the evaluation model, according to experts' opinion, based on Statistical Yearbook of Tianjin, GDP, primary industry, technology, construction industry, and tertiary industry totaled five indicators are selected to evaluate energy intensity, Table 148.1 is the base data.

Data is from Statistical Yearbook of Tianjin, 2011, and yearly energy balance sheet.

From the Table 148.1, we can get,  $Y = \{y_1, y_2, y_3, y_4, y_5\}$ ,  $A = \{a_1, a_2, a_3\}$ . next, energy intensity evaluation of Tianjin city is made from the ninth Five-year plan to the eleventh Five-year plan.

148.4.1 Weight Confirmation

Taking factor,  $y_2$ , as criteria, compared with factor,  $y_2$ , comparative scale values of other factors,  $y_1, y_2, y_3, y_4, y_5$ , is listed on Table 148.2.

According to the method proposed above, weight vector can be gained as

Table 148.1 Yearly reduction velocity of E energy intensity in Tianjin (%)

Time serial	GDP	Primary industry	Technology	Construction industry	Tertiary industry
1996–2000	8.65	8.15	9.76	22.76	5.79
2001–2005	5.20	0.90	6.87	1.89	6.30
2006–2010	6.67	1.93	7.54	0.00	10.79

Table 148.2 Important comparative scale values of factors

$y_i/y_k$	$y_1/y_2$	$y_2/y_2$	$y_3/y_2$	$y_4/y_2$	$y_5/y_2$
$U_{ik}(1 \sim 9)$ scale	2	1	3	2	2

$$P_{\sim} = \left( \frac{2}{16}, \frac{1}{16}, \frac{3}{16}, \frac{2}{16}, \frac{2}{16} \right)$$

**148.4.2 Membership Confirmation**

Based on the significance of all kinds of factor indicators, the bigger of the factor ( $y_1, y_2, y_3, y_4, y_5$ ) value is, the better the factor is.

From 148.1, primary matrix can be gained as

$$E = \begin{bmatrix} 8.65 & 8.15 & 9.76 & 22.76 & 10.79 \\ 8.65 & 8.15 & 9.76 & 22.76 & 5.79 \\ 5.20 & 0.90 & 6.87 & 1.89 & 6.30 \\ 6.67 & 1.93 & 7.54 & 0.00 & 10.79 \end{bmatrix} \leftarrow y^*$$

after non-dimensionalization, we can get

$$C = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0.08 & 0.10 \\ 0.43 & 0.14 & 0.23 & 0 & 1 \end{bmatrix} \begin{matrix} \leftarrow C_0 \\ \leftarrow C_1 \\ \leftarrow C_2 \\ \leftarrow C_3 \end{matrix}$$

Furthermore

$$\eta_j(i) = \frac{0 + 0.5 \times 1}{|C_i^* - C_{ji}| + 0.5 \times 1} = \frac{0.5}{0.5 + |C_i^* - C_{ji}|}$$

Finally, we can get

$$\begin{aligned} R_{\sim} &= (R_1, R_2, R_3) \\ &= \begin{bmatrix} 1 & 0.33 & 0.47 \\ 1 & 0.33 & 0.37 \\ 1 & 0.33 & 0.39 \\ 1 & 0.35 & 0.33 \\ 0.33 & 0.36 & 1 \end{bmatrix} \end{aligned}$$

**148.4.3 Evaluation and Results Analysis**

$$B_{\sim} = P_{\sim} \circ R_{\sim} = (0.54, 0.21, 0.32)$$

that is,  $b_1 \succ b_3 \succ b_2$ , according to the evaluation results, from the ninth “five year” plan to the eleventh “five year” plan totaled three “five year” plans, energy intensity has been declined steadily, energy saving and emission reduction has gained extraordinary performance. Generally, energy intensity in the ninth “five year” plan declined most quickly among three “five year” plans, and the eleventh “five year” plan of which is more quickly than the tenth “five year” plan. Specifically, during three “five year” plans, the energy intensity of GDP, Primary industry and technology coincide with the law of the overall energy intensity. Energy intensity of construction industry declined continuously, but the velocity of which is declined. Energy intensity of tertiary industry declined continuously, and the velocity of which is increased. Since the ninth “five year” plan, Tianjin has transformed the development way, adjusted the industry structure, promoted the development of tertiary industry, so as to accelerate energy intensity to decline quickly continuously, especially during the period of the ninth “five year” plan and the eleventh “five year” plan, with the effect of world economic crisis, economy transformation and industrial structure optimization is accelerated, so as to promote energy intensity decline more quickly.

## 148.5 Conclusions

Owing to the shortcoming of the traditional fuzzy evaluation method, grey theory is introduced into the method, to confirm the membership of the factor, and improved fuzzy comprehensive evaluation model is proposed, case study is made to illustrate the application of the method, and the results have shown the improved method is reasonable, easily to use and extend. The improved method is based on solid argument, and provide a new solution to the evaluation of the energy intensity, what's more, the improved method is also can be used in other fields such as economic or social evaluation.

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# Chapter 149

## Study on Development Model of Ecological Economy in Shiyang River Basin

Hui Ding and Hui-chun Shi

**Abstract** The ecological environment problem caused by the shortage of water resources in the Shiyang River Basin is serious. It has deeply affected the basin sustainable development of the economy and society, and has threatened the Northwest and North China's ecological environment. Therefore, it is important to find reasons for the deterioration of the ecological environment. This paper provides some ways to achieve a healthy development of the ecology and the economy, such as building water-saving society, the implementation of intensive production, the implementation of greening engineering, ecological migration and watershed ecological compensation, and builds a development model of the ecological economy in the Shiyang River Basin.

**Keywords** Ecological environment • Model • Shiyang river • Water resource

### 149.1 Introduction

The Shiyang River Basin is one of the three major river systems in Hexi Corridor of Gansu province. It is located in the east of Hexi Corridor of Gansu province, and situated on the transitional zone of the Loess Plateau, the Qinghai-Tibet Plateau and the Mongolia-Xingjiang Plateau. The Shiyang river flow through some areas,

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including Wuwei city and Jinchang City, Minqin oasis in the river's downstream located between the Tengger Desert and Badan Jilin desert. It is surrounded by desert, and its ecological position is very important. However, the ecological environment has been deteriorated by climate change and human activities (Larson Joseph 1994). This is illustrated by a number of phenomena such as the decline of natural vegetation, frequent dust storms, expansion of areas of desertification and increasing water pollution. So that resources are unsustainable use and ecological environment is unsustainable development. Not only is the local economic and social development threatened but the survival of people in the province is also seriously affected.

## 149.2 Performance

The Shiyang River basin is an inland river basin in the Hexi Corridor of Gansu Province, Northwest China.

Its high population density, deep development and utilization of the water resources, most prominent contradiction of water used, and serious ecological environment problems, results in deep influence of the economic development and society stable.

### *149.2.1 The Great Contradictions Between Supply and Demand of Water Resources*

Shiyang River Basin is situated in the hinterland. It has a temperate continental arid climate. There is more evaporation than precipitation. Average water resources per person are 1/3 of the whole China. Average resources per acre of land are 1/4 of the whole china. These amounts are significantly lower than the international standard of water resources. In recent years the population has increased by 34 %, irrigative area of farmland has increased by 29 %, grain production increased by 45 %, GDP is approximately 6 times more than previously, and the quantity of water resources not only did not increase but decreased by 1 %, the load of basin water resources is continuously rising (Xu and Cheng 2000). Therefore, it is inevitable that the ecological water is occupied by social and economic water. With economic and social development, the groundwater was exploited without any controls in the downstream region of Shiyang River Basin. This has caused a decline in the groundwater level, a crisis of water resources and an ecological imbalance. On the contrary, the ecological environment deterioration will threat to the survival of mankind.

### ***149.2.2 Soil Salinization***

Repeated consumption and concentration of groundwater which is caused by groundwater overdraft and irrigation activities has led to deterioration in the underground water quality. In the Minqin oasis where the underwater level is very shallow, heavy long-term evaporation has caused salt accumulation in the soil.

### ***149.2.3 Vegetation Degradation***

In the lower reaches of the river, with the reduction of water and the decline of the underground water level, much desert vegetation with shallow roots have died or degenerated. For example, a large number of the natural *populus euphratica* forest shrub has deteriorated in the area of the desert zone. Since the 1970s, wetland plants were replaced by xeric plants, a piece of artificial the *elaeagnus angustifolia* forest, shrub and diesel plants in the edge of the desert have died (Landell-Mills and Porras 2001). Less and less vegetation covers the area.

### ***149.2.4 Serious Water Pollution***

With the rapid development of basin economy, acceleration of urbanization, increasing industrial and domestic water consumption, a large amount of industrial waste and untreated sewage directly discharges into the river. As a result of Shiyang River normal runoff less and short process, the self-purification ability of the river is poor. Surface water which had been polluted and reused caused pollution of groundwater.

### ***149.2.5 Land Desertification***

Water is a decisive factor in maintaining the ecological system of a desert oasis. The serious shortage of water resources, not only broke the natural balance of water resources system, but also seriously damaged the ecological balance. The dry climate and loose soil are the basis of desertification, and it is the root cause of people excessively exploiting water resources in Shiyang River Valley. The upstream and the midstream have expended most of the water, which flows less and less into the downstream Minqin County and the speed of desertification is very rapid in Minqin County (Wunder 2005). Because the green lake has disappeared, the Badan Jilin Desert and the Tengger Desert have handshake, sand storms more frequently.

### ***149.2.6 Increased Poverty***

In the Shiyang River Basin, the poor and vulnerable ecological environment has a very strong correlation. The local social and economic development, forced by poverty and population growth pressure, is falling behind, and people sacrifice the environment for economic development and the improvement of their living standards. But fragile ecological conditions and limited environmental capacity are easily damaged by human activities. There are too many short-sighted behaviors for temporary economic development. For example, deforestation to cultivate virgin land, planting on the steep slopes, in exchange, more serious shortage of water resources has been caused (Lan and Kang 2000). As a result, the land is salinized and desertified and natural disasters are more frequent. It endangers people's basic survival. In return, it will restrict people take off deficient to become rich in Shiyang River basin.

## **149.3 Reasons**

Geography, weather and evaporation are the main natural reasons. Population increase, economic growth, unreasonable industrial structure, water pollution, unreasonable distribution of water resources and low use efficiency are the main contrived factors which lead to the over drafting of groundwater and water crisis.

### ***149.3.1 The Background to Global Climate Change***

In northwest China, since the small glacial period ended about 100 years, the climate is periodically warm and dry. In the past 50 years, western China's temperature rise has been 0.2 °C per decade. Especially in the past 20 years, there was a greater increase in temperature, much higher than in the past century during which the global average rise was 0.4–0.8 °C (Aiye et al.). Meanwhile, there was a significantly reduced trend in the precipitation in Northwest China, a number of river outflows in the northwest arid area descended. Shiyang River Basin is located at the intersection of the westerly and the monsoon. Unique landscapes and fragile ecosystems are very sensitive to global climate change, which is the reason why ecological problems were caused in the Shiyang River Basin.

### ***149.3.2 Water Conservation Forest Atrophy***

The water of the Shiyang River Basin comes from Qilian Mountain. In recent years, due to human sabotage activities in the Qilian mountain area, include

deforestation, overgrazing, mining, excavating herbs and reclaiming wasteland for plantation, vegetation has been destroyed, the snow line is rising, and water conservation capacity is reducing.

### ***149.3.3 The Extensive Mode of Economic Growth***

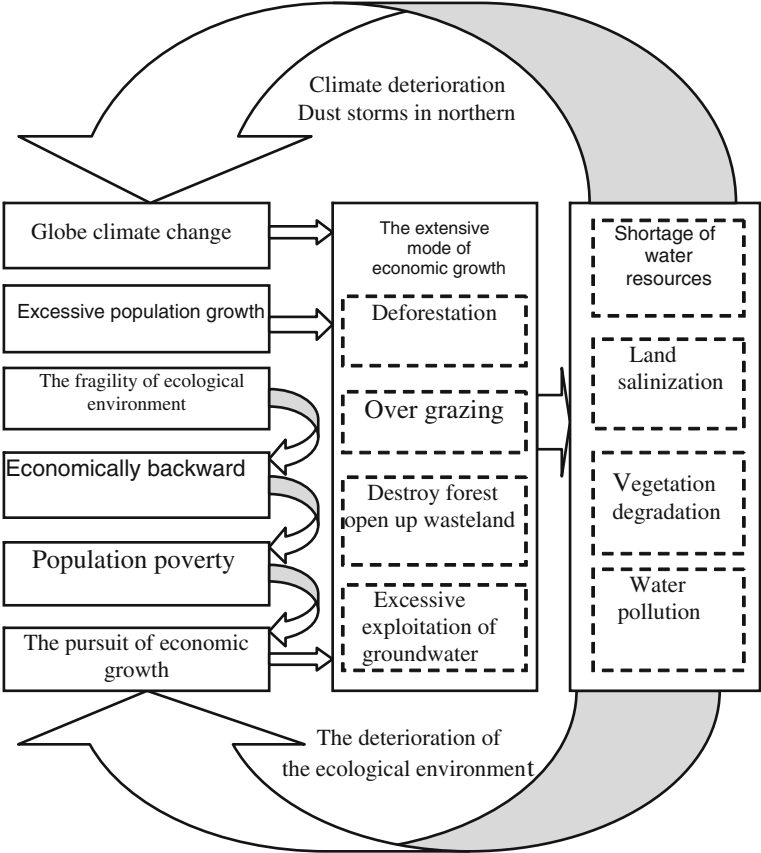
With the process of economic development, people in the area neglect economic sustainable development and attach importance to economic growth. They choose a kind of extensive growth, so a pattern of high input and low output has been formed which consumes a lot of resources for temporary economic growth. Low utilization efficiency, excessive utilization and predatory exploitation of water resources aggravate the imbalance of the ecosystem, causing grassland degeneration, land desertification, soil salinization, and a reduction in soil fertility (Armstrong and Roughgarden 2001). The ecological and environmental problems are very serious.

### ***149.3.4 The Pressure of Excessive Population Growth***

Population growth is an important factor in the deterioration of the regional ecological environment. Population growth in the Shiyang River Basin is high and in the Shiyang River Oasis population density is more than 300 people/km<sup>2</sup>, equivalent to the density of Sichuan province. The proportion of agricultural population is large and there is a large of demand for water resources in the area.

## **149.4 Ways**

Construction and consummation of e ecological and environmental relevant system could provide measures for government to solve the deterioration of the ecological environment. The construction and consummation of law related to the protection of ecological environment is system engineering.



**149.4.1 The Construction of Water-Saving Society**

In Shiyang River basin, ecological problem is a Systems Engineering which is formed by closely relation between upper and lower and mutual influence between person and natural (Balvanera et al. 2001). Its center is water resource. We must promote water conservation and water resources protection and make the public have a habit of saving water and to scientific use water. The government must protect the ecological environment and manage water using laws that make full use of limited water resources.

### ***149.4.2 Intensive Production***

It is most important to increase the efficiency of water in the Shiyang River basin. However the improvement of production methods and the implementation of intensive production are important ways to increase the efficiency of water (Clark et al. 2001). Therefore, the government should guide farmers to change old methods of production, with preferential policies to support efficient agriculture, planting grass and cultivating livestock, establishing a social service system, such as some new marketing mode, technical guidance, and disease prevention and control. High efficiency and water saving agriculture should be developed. Drip irrigation, irrigation and other advanced and practical technology should be encouraged. Also the government should support the technological upgrading of enterprises and the elimination of backward production technology.

### ***149.4.3 Ecological Greening Engineering***

Afforestation is an important means to improve the ecological environment. Natural forest should be protected; destruction of vegetation, such as indiscriminate felling of trees, arbitrary hunting, random cultivation and Chaos to collect should be banned. Pests and fires should be prevented and controlled. People should manage of water conservation forest with science and technology, adhere to the principle of water source protection in the south, establish oases in the central area, and manage sand in the north. In the south, the protection of water conservation forests of Qilian Mountains is the key. In the center, construction of shelter belts, ecological forest is the key. In the north, the construction of desert ecnurturing is the key. Improve the ecological environment requires the joint efforts of basin-wide.

### ***149.4.4 Ecological Migrants***

The ecological problem of the Shiyang River Basin is essentially caused by the imbalance between man and nature. The population has exceeded the carrying capacity of the water resources. A significant increase of the population has resulted in increased demand for food, and thus deforestation, land reclamation, and an increase in arable land. Forest land area is reduced, water demand increases, so that the gap between supply and demand of water becomes more acute. If the Government plans the implementation of an immigration policy, the establishment and opening up new areas to encourage local farmers to emigrate, the region's ecological pressure will be reduced.

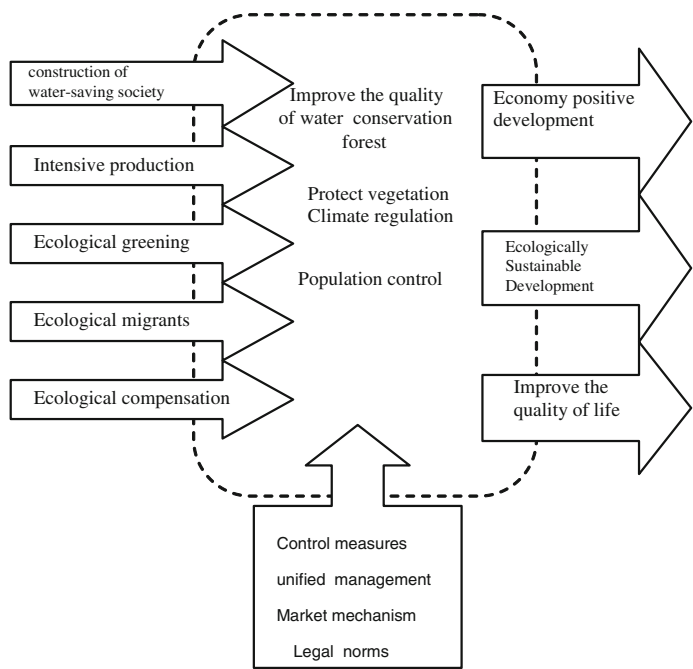
149.4.5 Ecological Compensation

In order to guarantee the ecological safety of the Shiyang River basin and ensure the sustainable utilization of water resources, the government needs to establish an ecological compensation mechanism of river basin. The central finance and the eastern region those get benefits from the ecology should give Western ecological buffer zone compensation. Because water resources are very scarce in the Shiyang River basin, self-improvement functions have been degraded, State compensation should be the most important method and social compensation and self-compensation should be aids.

149.5 Conclusion

149.5.1 The Unified Management of Basin Water Resources

In order to water resource unified planning, deployment, management and use of, we should break administrative division, given the appropriate powers to the management of water resources department to make it truly become authority of a unified and efficient management agencies (Fu et al. 2001). They will arrange and coordinate the implementation of basin-wide water allocation, motor-pumped wells closed, and major water-saving projects and resolutely put an end to the problem of fragmentation, local protection, and waste of resources.



### ***149.5.2 Optimize the Allocation of Water Resources by the Establishment of a Water Rights System***

Water rights refer to the sum of the rights of the people on water resources under the conditions of water scarcity and can ultimately be attributed to the ownership of water resources, the right to operate and use rights. The government can decompose water resources step by step to the county, township Irrigation District, the relevant units and households, to guide farmers to control structure, vigorously develop water-saving and efficient industry. Further we should raise public awareness of water goods, and gradually improve the water market to achieve the efficient allocation of water resources.

### ***149.5.3 Improve Laws and Regulations***

We must establish a legal system for the harmonious development of a sound watershed. In developing a socialist market economy, we should as soon as possible develop local sustainable development laws and regulations, so that the regional economy can harmoniously develop.

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# Chapter 150

## The Study on Public Participation in Environmental Protection

Xiao-liang Xu and Xue-fen Xu

**Abstract** Environmental protection has become an important issue within the development of economy, and public participation has become an important part of the environmental protection, due to its use. Scholars analyze public participation in environmental protection from different perspectives. To understand public participation in environmental protection fully, the paper introduces the related concept of the degree of public participation, and then analyzes it from three points which are breadth, depth and validity of public participation in environmental protection. Finally, the paper proposes the indicator system of public participation, and takes Nanjing as an example to exam the applicability of the indicators system of public participation.

**Keywords** Environmental protection • Index • Nanjing • Public participation

### 150.1 Introduction

The US (1969) firstly established the system of public participation in environment protection (Sheng 1996). With the development of green economy and low-carbon economy, environment protection has been got more and more attention, “environmental Impact Assessment Law” of China regard public participation as an important element system of in environmental protection (Wu 2008). Public

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participation is conducive to safeguard public environmental rights, and also make decisions more scientific.

## **150.2 Public Participation Index**

### ***150.2.1 The Definition of Public Participation***

Public participation is the degree which public use to participate in political life through a variety of ways and means (Wei 2004). For better description of public participation; the paper analyzes public participation by the breadth, depth and validity of public participation in environmental protection. In order to understand public participation fully in environment protection, the paper uses the hierarchical model, proposes three levels of public participation, constructs the index system of public participation, and an empirical study to analyze the indicators the application of rationality (Duan 2006).

The breadth of public participation is extending of public participation in environmental protection, which are both involved the diversity of participatory approaches and participation recurrent (Baumol and Dates 2003). The breadth reflects the adequacy of public participation. The depth of public participation refers to the level and persistence, which reflects the level of public participation; the validity of public participation refers to effectiveness of achieve the degree of public participation, which reflects to improve the level of environmental protection.

### ***150.2.2 The Analysis of Public Participation***

1. The breadth of public participation in environmental protection. The core of public participation is to achieve a rational grasp of government departments through the most extensive expression of the public interest (Slade 1980). Lyle, Wray, and Paul Epstein regard citizen participation as means which citizens involved in the wider sense, including personal, collective, non-profit organizations, and even with the business community as a legitimate citizens as a whole. Carl Cohen said: "The breadth of democracy is the quantity determined by the ratio of the actual or potential participation in decision-making members of the community affected by the policy". Samuel P. Huntington and Joan Nelson and Cohen said: "The breadth of political participation is engaged in the proportion of people who participate in the event of some kind of political" (Caselli and Cunningham 2009).

In this sense, the breadth of public participation refers to whether all the interests of the public are able to participate in the process of environmental protection. Public participation in environmental protection should include the following: (1) urban residents, who are learning, public or citizens residing in the city, are a natural person; (2) legal person, who are related to environmental protection enterprises, is legal in the legal sense; (3) professional and technical personnel, who have the expertise and skilled personnel; (4) neutral third-party organizations, NGO; (5) other relevant personnel (Stern 2007).

2. The depth of public participation in environment protection. Arnstein. SR (1969) first proposed the public participation ladder theory (the “A Ladder of Citizen Participation”), which is a measure of public participation in the extent of the classic, and the theory of public participation divided three levels, eight stage (Brown 2006). According to Arnstein. SR public participation ladder theory, the depth of the public participate is the adequacy and effectiveness of public participation in environmental protection in the expression of opinion.
3. The validity of public participation in environmental protection (Sarf and Hansen 1973). The validity of (Validity) is used to measure the effectiveness of the degree of public participation. The validity of public participation in environmental protection includes two aspects, which are the efficacy of public participation and influence. Efficacy refers to the effectiveness of main body of their own senses and expectations from public participation in environmental protection. The higher the degree of public performance, the higher the validity of public participation, active participation, the stronger.

### ***150.2.3 Public Participation Index***

Public participation indicators should be selected with the following principles.

- (1) Related principle. The indicators should be related with the public closely;
- (2) measurement principle. The indicators should be measurable;
- (3) accessible principle. The indicators should be obtained and the access to channels must be reliable and stable;
- (4) Comprehensive principle. The index should fully reflect the complete picture of environmental protection;
- (5) acceptable principles. The indicators should reflect the needs of various stakeholders;
- (6) independence principle, the index should be able to reflect a particular aspect (Dervis and Robinson 1984).

The paper selects the following indicators (Table 150.1):

Principal Part is the object of public participation. The “public” in public participation has specific features, and this indicator is used to indicate participation in the public clearly. Time is the length of time for public participation. This indicator reflects the number of public participation and the length of time. Form is way of public participation, which includes permit, hearings, surveys, site visits, seminars and other different types. Range is the scope of public participation (Sen 1963). Link is the stage of public participation, such as research, planning and

**Table 150.1** Public participation index

Target	Dimension	Index
The degree of public participation	The breadth	Principal part
		Time
		Form
		Range
	The depth	Link
		Level
	The validity	Guarantee
		Information
		Disclosure
		The level of restoration
		Admission

implementation of multiple stages. The level is the gradation of public participation. Guarantee is the status of public participation, which is the power and obligations of the laws and regulations. Information disclosure is that information involving the public interest is complete (Leontief 1971). The level of restoration is the degree of public organizations. Admission is the adoption and the adoption rate and the extent of reasonable proposals by the public.

150.3 Empirical Study

In this paper, we take Nanjing as a sample of empirical study to analyze public participation in environmental protection. In the process of indicators based on public participation, the paper designs a closed questionnaire, and questionnaire is a percentile system, among which the breadth public of participation is 40 %, the depth and the validity is 30 points. The questionnaires were distributed in Hohai University, Nanjing University, Nanjing Normal University, Southeast University, Xin Jie Kou district, Hunan Road shopping district, Nanjing Urban Planning and Design Institute, Nanjing Public Transport Company, among which are four colleges and universities surveyed 60; street random survey, surveyed 117 people; two enterprises surveyed 23 people; 136 valid questionnaires, a return rate of 68 %. The specific process for the design of the questionnaire, questionnaires, public fill in questionnaires were collected, the results of statistical analysis of the problem and concluded (Round 1979).

For better analysis of impact factors as well as various factors affect the degree of public participation, the paper uses principal component analysis to deal with the questionnaire results.

The basic principle of principal component analysis method is that principal component analysis is to regroup the variables so that it re-composition of a new set of variable, and statistical methods to reflect the original information to extract a small amount of variables (El Serafy 1993).

**Table 150.2** The impact of target layer with rule layer and index layer

Index layer	C11	C12	C13	C21	C22	C23	C31	C32	C33	C34
The impact with target layer	0.064	0.055	0.059	0.055	0.067	0.059	0.062	0.051	0.061	0.051
Rule layer	B1			B <sub>2</sub>			B <sub>3</sub>			
The impact to target layer	B3 > B2 > B1									

According to the calculation of the principal component analysis, Steps are done to collate the raw data to get the following impact table as a basis for analysis (Calculations omitted).

From Table 150.2, we can see  $B_3 > B_2 > B_1$ . The impact of the validity in public participation the greatest, accounting for 38.53 %; the breadth of public participation is 31.99 %; and the breadth of public participation is 30.47 %.

From the view of the breadth in public participation, we can see  $C13 > C12 > C11$ . The impact of the form is most important, accounting for 36.47 %; Time is accounted for 34.70 %; Principal Part is accounted for 28.82 % (Table 150.3).

From the depth of public participation, we can see  $C21 > C23$  is  $> C22$ . The scope of public participation is the greatest impact, accounting for 35.89 %; the level is accounted for 33.47 %; participation part is accounted for 30.63 %.

From the validity of public participation, we can see  $C31 > C33 > C32 > C34$ , In the validity of public participation, public participation to protect the greatest influence, is accounted for 46.91 %; then Reply extent of public participation, accounting for 45.33 %; information disclosure, is accounting for 45.27 %; Finally, the adoption of public participation is accounted for 4.76 %.

In the survey of public participate of Nanjing Environmental Protection, we draw the following conclusions: (1) public participation in the Environmental Protection is professionalism; the main body is wider and need more time; (2) Environmental Protection and is a specificity, in which a small part is involved; and it is difficult to meet the requirements of environmental protection; (3) the validity of public participation needs to be raised; the effect of public participation in environmental protection is not satisfactory; and it is difficult to play a real protective effect on the environment protection; (4) The general level of public participation in environmental protection needs to be improved.

**Table 150.3** The impact of rule layer with index layer

Index layer	C11	C12	C13	C21	C22	C23	C31	C32	C33	C34
The impact to target layer	0.13	0.157	0.165	0.186	0.159	0.174	0.07	0.5818	0.06	0.581
Sequence	C13 > C12 > C11			C21 > C23 > C22			C31 > C33 > C32 > C34			

## 150.4 Conclusions

Environmental protection is getting more and more attention. The public participation in environmental protection can be more effective to improve environmental protection efforts. And because the quantitative research of public participation is too few deficiencies, the paper presents the concept of public participation, and builds public participation in the index system; from three different dimensions to reflect the different conditions of public participation; and finally the paper take Nanjing as an example to verify the applicability of the index system. And the index system in the extent of the actual analysis of public participation in environmental protection has a very high value.

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