Architectural Engineering and Design Management
ASPECTS OF BUILDING DESIGN MANAGEMENT

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Editorial

Stephen Emmitt

This special edition of *Architectural Engineering and Design Management* takes part of the journal’s title, design management, as the theme. The papers published here were originally submitted to a conference held at the Technical University of Denmark, organized by the CIB’s working group W096 Architectural Management. A select number of authors were subsequently asked to revise and extend their papers for inclusion in this special edition. Papers were selected to give a broad view of design management and the variations in approach and style are indicative of the authors’ backgrounds and approach to their subject area. The work reported also has an international flavour with contributors representing Australia, Belgium, Brazil, Denmark, England, Puerto Rico, Scotland and the US. It is hoped that in taking such a multi-faceted approach, the papers will stimulate debate and further research into this rapidly growing field.

In the first paper, Grilo et al provide a useful insight into design management and the performance of construction projects from an international perspective. The case study from São Paulo, Brazil, helps to highlight the cultural differences within international design and project teams and the challenges arising from such temporal configurations. Coordination and management of information features strongly, as does the implication of design changes and late decision making. Cultural norms and socio-technical differences pose significant management challenges to such working arrangements. Indeed, the clearest result from the case study is the need for participants to understand the roles and responsibilities of other stakeholders through appropriate communication. All of which point to the need for better management of the interfaces between project participants.

In the second paper, Tzortzopoulos and Cooper investigate design management from the perspective of contractors working in the UK. With contractors assuming and taking managerial responsibility for the design process in the majority of projects in the UK, the issues of roles, responsibilities and control of design value have taken on increased importance. Two case studies help to identify some confusion over the term design management and the lack of clarity regarding the design management role in practice. The paper raises an important issue about who is best qualified to manage design, and judging from the case study findings it would appear that there is considerable scope for improvement in contracting organizations. Of practical help is the identification of skills necessary for effective design managers. The authors conclude with a plea for greater clarity of stakeholders’ roles in design management with a view to achieving effective processes and best value.

Defining and directing architectural value within industrialized buildings in Denmark forms the thrust of the paper by Beim and Vibæk Jensen. This philosophical, yet pragmatic, attention to core elements of strategic design management helps to outline an approach for achieving architectural quality within an industrialized context. The authors are specific in their aim: to help architectural offices identify the characteristics and specific working methods for industrialized architecture, although the paper does have a wider application. Case studies and examples drawn from interviews with architects help to add some colour to their theoretical model. Similarly,
testing the model in architectural education and reflecting on the results adds further to the authors’ argument. This is a paper about empowering the architect and helping to improve architectural quality.

In the fourth paper, Gray and Al-Bizri attempt to model the not inconsiderable amount of information production by trade contractors in the UK. The authors have focused on an area of engineering design/design management largely overlooked by researchers to date, despite its importance to the materialization of buildings. By concentrating on the role of trade contractors, the authors propose a generic sequence of design activities for construction elements, which recognizes project specific requirements and interactions with other components. The design of a precast concrete cladding panel provides a worked example. In addition to exploring the complexity of the detailed design phase, the authors conclude by arguing for a knowledge base for all technologies to guide the user to the most appropriate solution. Presumably such an approach would also help to make the management of this phase in the life of a design project more effective, thus helping to reduce uncertainty and associated waste during the realization phase.

Continuing the theme of information production and documentation, Tombesi et al report on the digital outsourcing of architectural services from an Australian perspective. This paper clearly identifies the challenges for researchers and practitioners in presenting a balanced view of the opportunities and perils inherent in digital outsourcing and the creation of distant alliances. This paper is interesting in that it does not concentrate solely on information communication technologies; more importantly, it addresses the socio-technical characteristics and cultural routines of the firms involved in such relationships. The complex socio-technical characteristics of architectural practices and the need for clear criteria and protocols when outsourcing work are emphasized. The experience of the research project to date has shown that distant collaboration changes significantly with the documentation requirements of the firms involved. Thus, it is crucial that the purpose of the work is clearly defined and the structure of the professional collaboration designed with the same care as that given to the building.

A common feature of the papers is the issue of knowledge and information transfer. In the final paper, Heylighen et al tackle knowledge capital in architectural education. This work draws heavily on the experience of the authors at the University of California – Berkeley, and posits a good argument for storytelling as a precursor to good design and its management. In addition to providing useful reflection on their educational programme, the authors aim to create a discussion forum for dialogue about how knowledge is generated and disseminated in architecture. Largely implicit in this paper is the relationship between storytelling and effective design management, especially through the ability to develop relationships in collaborative arrangements. Hopefully, this is an area for further research.

Explicit and implicit in the papers is the issue of how actors work, or at least attempt to work, together. Collectively, the papers help to emphasize the softer side of design management and the inter-relationships between people, technologies and management. Continuing the design management theme, two books are reviewed that deal with related factors. The first deals with partnering and integrated teamworking, the second with the integration of value and risk management.
ECONOMIC SCENARIO AND CONSTRUCTION INDUSTRY IN BRAZIL

With a population close to 186 million people, a gross domestic product (GDP) around US$1.492 trillion and a GDP per capita of US$8100 (CIA, 2005), Brazil has the largest domestic market in Latin America. Located in the south east of the country, São Paulo is Brazil’s most important city, and is the third largest in the world in terms of population, behind Tokyo and Mexico City. With regard to the Brazilian construction industry, São Paulo is also the most significant state for development, with about 30,000 residential units built annually just in the metropolitan area of São Paulo city (Conjuntura da Construção, 2005).

In the 1970s, foreign investment brought about significant growth rates in Brazil, which led to the implementation of large infrastructure projects and the development of a competitive heavy construction industry. However, public expenditure and growth rates were severely constrained after a shortage of foreign investment in the 1980s. Monthly inflation rates of up to 80% discouraged measures to improve efficiency owing to the attractiveness of financial operations. Low productivity, lack of quality and high material wastage contributed to create
a negative image of the construction industry, according to public opinion.

In the past decade, globalization, market openness, privatization of state-owned enterprises, monetary stability, fiscal constraint and shortages in public expenditure, changes in the procurement law, decline in profit margins and increasing customer consciousness have all contributed towards reshaping the profile of the construction industry. Some sectors responded promptly and established extensive measures to address the inefficiencies that traditionally plagued the industry.

Government-driven policies, such as the Brazilian Quality and Productivity Program (PBQP-Habitat), inspired in the Housing Quality Program of São Paulo State (QUALIHAB), enforced the gradual implementation of quality management systems as a requirement for construction and design firms to take part in public bids. According to the Brazilian Technical Standard Association, about 280 construction firms and 160 design and project management offices were compliant with ISO quality management system standards and about 1550 contractors were compliant with PBQP-Habitat’s requirements in the four levels of exigency (D, C, B and A) up to February 2003 (ABNT, 2003). These figures clearly illustrate the increased use of quality systems in the Brazilian construction industry. However, despite improvements achieved in some segments, advances across sectors and different regions of the country remain heterogeneous.

Foreign companies are present in various segments of the Brazilian construction industry. The decline in construction demand in developed countries tends to enhance the search for opportunities on an international basis and the entry of foreign competitors into developing markets. In Brazil, the entry of foreign organizations has exposed the technical and commercial weaknesses of local firms. In addition, the lack of mutual agreements to regulate the trade of building design services between countries has enhanced these limitations. Musa (1996) listed some relative weaknesses of local architectural offices in comparison with foreign firms, such as lack of responsiveness and flexibility, difficult relationships with technical designers and reduced involvement of clients in the decision-making process. Musa suggested some measures to reduce the impact of globalization and stressed the importance of initiatives aimed at reducing barriers to entry for Brazilian design practices in other countries, such as diploma validation requirements, excessive taxation and the need to set up a branch with a local company in order to gain access to these markets.

Despite recent improvements, the construction industry is still considered as backward compared with other industries. Frequently, construction methods are poorly chosen, workers are not properly trained and on-site supervision and project management are lax. Extensive waste, informality and project time and cost overruns are recurrent. The Brazilian construction industry also lacks consistent industrial policies, since its activity level is often erratic and driven by political motivations, such as absorbing non-skilled workers. In its annual report on the construction industry, for example, the Brazilian Institute of Geography and Statistics highlights that the informal sector was responsible for 63% of the value added by the construction sector in 2003 (IBGE, 2003; Zaidan, 2005).

The Brazilian industry is dependent on government programmes such as low-income housing, infrastructure and other civil works. The high cost of capital, credit scarcity, public expenditure shortages, political turbulence and economic shocks have recently affected the performance of the sector, despite a national housing shortfall in excess of 7.2 million units (Fundação João Pinheiro, 2005; Garcia et al., 2005). The construction industry experienced outstanding progress in the 1990s. However, the inconsistent economic growth in recent years may affect long-term initiatives working towards the improvement of the performance of the Brazilian construction industry.

**POTENTIAL BARRIERS FOR BUILDING DESIGN MANAGEMENT**

In no other important industry is the design responsibility so detached from the production responsibility as it is in construction (Banwell, 1964). Harvey (1971) criticized the separation between designers and contractors in England. Contractors are often excluded from the design process, while designers are expected to undertake responsibility for elements of the construction that they do not fully
understand. The construction industry presents a complex responsibility chain and nobody seems prepared to satisfy the client (Egan, 1998). Some commentators argue that designers could benefit from the early involvement of contractors, who, under traditional procurement systems, are not usually involved before the bidding process (Pocock et al., 1997).

Frequently, designers and contractors are working together for the first time on a project. Even if their parent companies have collaborated in the past, actual team members assigned to a new project will probably be unknown to each other (Groák, 1992). The fact that project team members do not know each other in personal and organizational terms is relevant (Brown, 2001).

Stakeholders commonly approach projects with particular expectations. Although these expectations vary according to the project type, clients usually seek time and cost certainty, and quality. Designers focus on aesthetics, functionality and a minimal use of resources. Conversely, contractors expect feasible methods, viable schedules and a profit margin commensurate with the level of risk transfer. The underlying divergence of objectives can hinder team building and encourage an adversarial approach. Selected by their reputation, designers will focus on quality; whereas contractors, hired by competitive tendering, tend to concentrate on efficiency and economy (Bobroff, 1991; Nam and Tatum, 1992; Barlow et al., 1997).

Architects have been accused of abandoning their responsibilities within the project team (Weingardt, 1996) and studies point out that they have been increasingly replaced by contractors and project managers in the design management role (RIBA, 1992; Gray and Hughes, 2001), mainly as a result of poor communication with clients and deficient cost and time management. The Tavistock Institute (1999) recommends the appointment of architects for the purpose of design integration and of other professionals for project management, since the latter involves duties that are unattractive to architects and which could thus be neglected if they were to undertake a project management role.

An adequate level of client involvement can demonstrably enhance overall satisfaction with the investment and the likelihood of meeting established goals (Davenport and Smith, 1995). If the client adopts practices that promote a collaborative environment, the stakeholders will be encouraged to increase the quality and efficiency of their services in all stages of the process (Jawahar-Nessan and Price, 1997).

Procurement systems can also influence the project performance and the integration between design and construction teams. The selection of procurement routes should consider aspects such as project type, building complexity, design and construction schedule and budget, and client organization and experience (Chan and Chan, 2000). Love et al. (1998) suggest a range of criteria to establish client requirements and inform procurement choices, namely, speed during design and construction, variability, flexibility to design changes, quality, protection against risks, complexity, responsibilities, total price and arbitration.

**POTENTIAL DIFFICULTIES FOR INTERNATIONAL BUILDING DESIGN TEAMS**

Despite recent technological developments, communication between organizations (or even within a single organization) has been identified as a main driver of failures in construction projects. Research carried out by British insurance companies pointed to poor communication and lack of coordination as primary drivers of client dissatisfaction, claims, frustration with unattended items, lack of positive relationships and incomplete information (Brown, 2001).

Communication and functional issues, which involve not only the organizations but also the individuals, cannot be ignored. Without an analysis of individual skills, cultures and interests, there will be little understanding of roles or respect for leadership structures, which can enhance rivalry and reluctance to cooperate. Issues such as roles, cultures and communication must be addressed if personal skills are to be optimized on behalf of the team (Brown, 2001).

In recent years, information and communication technologies have evolved rapidly. Providers have developed collaborative systems and started to offer services that enable project team members to cooperate in a virtual project environment. Collaborative
systems can bring about potential benefits, including reduction of communication failures, savings with posting and photocopying, speed, safety, privacy in data transfer, automatic issue of reports and elimination of document control and distribution procedures (Chinowski and Rojas, 2003).

However, team members tend to operate in isolation, which inhibits the establishment of trust and the awareness of individual roles. Therefore, project managers need to reinforce individual roles and conciliate team members’ expectations throughout the project. They should also set parameters for information exchange to reduce the likelihood of exponential increases in data flow and information overloads. Consequently, remote project teams require leaders who are able to communicate and establish relationships (Chinowski and Rojas, 2003).

In theory, international design teams can adversely influence team members’ willingness to collaborate because of factors such as remoteness, impersonal relationships, preconceptions, lack of adequate technologies to support communication and data transfer, different languages and particular individual and organizational cultures. On the other hand, foreign offices can bring a lot of advantages, notably technology transfer, innovative design concepts and awareness of aesthetic issues. Nevertheless, these benefits can be outweighed by the potential disadvantages, which should be properly managed to minimize the likelihood and impact of their occurrence.

Wang (2000) describes some difficulties in the assignment of foreign designers in Chinese projects: selection by a ‘competition of ideas’ does not consider the size, reputation and capacity of the design practice; lack of familiarity with local standards may necessitate late design changes or adjustments to plans and specifications by local ‘design institutes’; the need for large numbers of imported components in service engineering; deficient communication techniques; different languages; and long distances.

Moreover, Wang (2000) highlights the relevance of the functional arrangement for the performance of the design team. The appointment of foreign offices to coordinate the design ensures a broader fidelity with the original concept, but tends to create difficulties for local contractors. Alternatively, clients can assign Chinese design institutes for the preparation of detail plans and specifications so as to favour buildability in terms of local practice. Wang suggests a hybrid arrangement: the appointment of local designers at the outset of the project in order to adapt the design to local standards and to minimize the involvement of foreign designers in the detail work. It is assumed that this strategy could prove equally beneficial in projects that involve foreign design firms in Brazil.

CASE STUDY RESEARCH METHODOLOGY
The technical scope of a case study can be defined as ‘an empirical investigation that observes a contemporary phenomenon in a realistic context, especially when the boundaries between the phenomenon and the context are not clearly evident’ (Yin, 1994). Investigations that focus on the linkages between complex organizations – such as those involved in a construction project – may require the adoption of multiple sources of evidence (interviews, documentary analysis) and the consultation of multiple units of analysis (designers, contractors and project managers) to produce more reliable outcomes. Based on a broad literature review, a research instrument was prepared and tested in an exploratory case study. The questionnaire comprised open and closed questions related to the variables:

- **integration**: quality of interaction between project team members
- **procurement system**: method for the selection and organization of the project teams for the obtainment of a building by a client
- **project performance**: time and cost certainty, compliance with client’s objectives, and absence of claims.

Semi-structured interviews were conducted with seven primary players involved in the project consisting of representatives of the construction firm, the designers and the project managers. The following criteria informed the selection of the project for the case study – the participation of Brazilian leading construction and design firms, and the size, complexity and uniqueness of the project.
COORDINATION PROBLEMS WITH FOREIGN DESIGN CONSULTANTS ON A COMPLEX BUILDING PROJECT

With a net floor area of 82,000 m², the case study project creates a distinctive landmark in São Paulo’s landscape. Some innovative characteristics of the project include: appointment of foreign design consultants; extensive specification of imported components and equipment such as master control panels, chillers and lifts; modular panelized curtain walls; variable air volume systems for air conditioning; duplicated wiring; and an independent power generation system. For the facade, low-emissivity glazing controls solar heat gain and visible light transmission. An aerogel deposited within the glazing avoids condensation occurring when internal and external temperatures differ. Some specifications of the project were criticized by the project team, such as the reinforcement cover of up to 7 cm and the 20 different mix designs for the concrete structure, with concrete strengths ranging from 30–60 MPa. The excessive reinforcement cover required the use of water-vapour fans and ice in the mixing water to reduce surface concrete cracking. In addition, the curtain wall was designed to resist typhoons, despite no previous occurrence of typhoons in the local region.

The project adopted the traditional procurement system (separated design, bid and construct processes) with a guaranteed maximum price (GMP) contract divided into four stages, in which construction prices would be gradually reduced. The contractor was selected through a closed bid followed by a negotiation stage. The selection criteria took into account technical, economical and financial criteria. The successful construction company has operated in the local market for almost 40 years and has executed more than 4 million m² of buildings in varying market segments. Certification of the company’s quality management system, according to ISO 9001, was obtained in 1999. The construction team was composed of production, technical and administrative teams, and totalled 18 professionals.

The design concept was developed by US offices in Chicago and New York, and then adapted by local architecture and engineering firms. The foreign architectural office has accumulated experience in different project types in more than 50 countries. The service engineering design was developed by a US company with branches in different continents. A project management company from Chicago opened a branch in São Paulo especially to advise the client, whose team encompassed a facilities manager, two architects and a project management team with five professionals.

The structural design, developed in the US, was adapted by an Argentine design practice that had worked for the Brazilian client on another project in South America. The local design office participated in the development and coordination of architectural and urban planning designs. With a markedly commercial character, it focuses on the leverage of business opportunities within government bodies, public entities and developers. The organizational structures for the project and the design team are shown in Figure 1.

The case demonstrates that the appointment of foreign design offices fosters innovation and technological transfer, particularly in architectural and engineering design solutions, but can adversely impact on design management, since a number of technical, managerial, cultural and economic factors, such as the development of the local supply chain, should be realized at an early stage in the briefing process. In this context, it is argued that international design teams require careful management of the work scope for each designer, extensive configuration management, clear authority lines, mutual understanding of roles and responsibilities, management of interfaces and adequate selection of local partners. The design management may also be influenced by the organization of the design team or the roles and responsibilities assigned to each designer. Some of the difficulties faced by the project team as a result of deficiencies in the design management for the case study project are summarized in Table 1 and discussed later.

DEFICIENCIES IN THE SELECTION OF LOCAL AND FOREIGN DESIGN OFFICES

The design concept was commended as outstanding and innovative, but team members admitted with hindsight that design development should have been assigned to Brazilian offices from the outset of the
project, because of their greater familiarity with local construction methods and faster decision-making capacity. On the other hand, the local design offices were considered unsuitable for the project because of its technical and managerial complexity. According to the contract manager: ‘It’s inconceivable that one of the largest design offices in São Paulo doesn’t know [about] dry wall. This reflects a wrong selection of the partners.’ The design coordination, assigned to a local architectural office, was criticized: ‘When you bring designers together, they do not talk to each other. The coordination is not done or if it is done, it is not done well.’ According to a project manager: ‘Architects are considered efficient when they are able to produce compatible drawings, but they are not always good at coordinating the design process.’

The structural design was also questioned. According to one architect: ‘An engineer could find solutions in this project that have been used all over the world. There is no standardization. They possibly used all the solutions available in the concrete books.’ The design of the concrete structure was considered conservative due to the implicit lack of familiarity of US designers with this technology and to the lack of trust in the reliability of local contractors. A consultant hired by the construction firm to review the structural design found material errors and omissions such as beams with only 50% of the required reinforcement, which could have endangered the rigidity of the building.

DIFFICULTIES IN THE USE OF THE FOREIGN DESIGNS

The assignment of foreign designers to the design development assured the incorporation of the original design intent but raised further difficulties for the design management. In general, US suppliers undertake an essential role in the design detailing. Despite their international experience, the foreign design consultants assumed that local suppliers would be capable of detailing the shop drawings. However, Brazilian contractors and project managers noticed that the design documents were insufficient to inform local suppliers and subcontractors. This omission led to delays while the problem was rectified and hampered the mutual understanding of design team members’ roles and responsibilities.

A Brazilian architect who worked in the US architectural practice was initially assigned to coordinate the design. Despite the good intention, this proved unfeasible due to the attitude of foreign designers, who never made decisions during meetings and were considered technically defensive by other project team members. According to the contract manager, ‘as the project was falling behind schedule, it wasn’t working. Foreign designers don’t...
The specification of imported components posed difficulties for the construction firm as a result of non-standard dimensions, connections and methods of execution. Moreover, the design concept followed no modularization precepts. The contract manager pointed out that ‘modularization of the concrete structure differs from the standards of Brazilian curtain wall systems. There are different modularizations.’

The project also exposed some weaknesses in the local supply chain. An architect highlighted that ‘a US company delivered a curtain wall faster than a local factory’.

**THE POOR QUALITY OF THE BRIEFING PROCESS**

The architect stressed the importance of an intense involvement of the client’s organization throughout the briefing process so as to mitigate the risk of late design changes:

*If I could start it all over again, I would start from the briefing. Defining a brief is one of the most important milestones of a project, but nobody*

### TABLE 1 Deficiencies in the project design process and subsequent impacts on project management

<table>
<thead>
<tr>
<th>Deficiencies in the design process</th>
<th>Impact on project management</th>
</tr>
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<tbody>
<tr>
<td>Lack of standardization or excessive customization</td>
<td>Complex procurement, budgeting, contract management, change management and document control</td>
</tr>
<tr>
<td>Conflicting information in different documents</td>
<td>Work overload for the project team, complex procurement and budgeting, construction errors, rework and material wastage</td>
</tr>
<tr>
<td>Lack of information</td>
<td>Work overload for the project team, delays in the procurement of construction subcontracts, complex contract management, cost and time overruns, insufficient information for procurement purposes</td>
</tr>
<tr>
<td>Problems in the information flow and communication structure</td>
<td>Different level of information between team members, late incorporation of design changes in the plans, incompatibility between information received by team members, heterogeneous information</td>
</tr>
<tr>
<td>Delay in the incorporation of design changes in plans and specifications</td>
<td>Construction errors, complex document control, reviews with out-of-date information, varying levels of information between team members, complex contract management with subcontractors, stress, rework, execution prior to the incorporation of information in the design</td>
</tr>
<tr>
<td>Excessive non-reviewed items in plans and specifications</td>
<td>Complex document control on the site, risk of errors in the execution, demand of excessive follow-up meetings</td>
</tr>
<tr>
<td>Excessive design reviews</td>
<td>Cost and time overruns, construction errors, work overload for project team, stress, escalation in printing and photocopying costs, delays in the distribution of drawings to the site</td>
</tr>
<tr>
<td>Multiple stakeholders in the client team</td>
<td>Complex decision-making and approval process, excessive design changes, varying level of information between project team members</td>
</tr>
<tr>
<td>Excessive design changes in a late stage of the project</td>
<td>Complex contract management with subcontractors, difficult design review, rework, time and cost overruns, work overload for construction and coordination teams, negotiations with the client, rescheduling, changes in the budget, stress</td>
</tr>
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seems to care about it. The client should have participated more actively. So they came out later on with solutions used elsewhere, but which could not be adopted in this building.

The design management was largely affected by failures in the scope definition and design change management. The Brazilian architectural designer stressed the deficiencies in the briefing process:

*The brief should be finished by a given date. Then this date approached and there were a lot of changes. Nobody is to blame. We were unable to determine [from the brief] exactly what the client wanted. This is a point that should be stressed.*

DEFICIENCIES IN COMMUNICATION AND INFORMATION FLOWS

Ideally, the design management should define what type of information is relevant for each team member and establish communication lines, information flows, timetables and formats to transfer, record and distribute the information. The lack of communication procedures can lead to managerial problems, such as varying levels of information between project teams or even within a single team. According to an engineer:

*I received information initially and then a drawing with different information. Then I found that the designer did not receive the required information either. Consequently, he issued drawings that differed from what was agreed upon earlier. There are three or four client representatives directly involved in the process. So different people deal with the information and sometimes it does not reach all the recipients. I received information from the project manager that differed from that sent by the client. There are too many people involved, and not in an organized way.*

The complexity of the project and the unusual number of participants affected the communication process, which could have been facilitated by collaborative systems and the adoption of agreed upon coordination procedures.

LACK OF INFORMATION AND DESIGN INCOMPATIBILITIES

The lack of information affected the management of contracts with suppliers and necessitated the appointment of additional professionals to the construction team. Initially, a reduced team was assigned to manage the lump sum contracts, which were soon afterwards replaced by unitary cost
agreements because of the lack of information. According to the contract manager: ‘I shouldn’t care about it, but I spend 20–30% of my time trying to sort out the consequences of a poor design. The design is calamitous in this project.’ The construction team reported design errors and omissions and stressed the lack of quality control procedures. Design errors overburdened the construction team and hampered cost estimates. An engineer pointed out that ‘all technical, procurement and construction problems in this project are related to the lack of information’. A delay in the choice of stainless steel for the curtain wall postponed the schedule by four months. The contract manager complained: ‘We are once more building without a design. The owner wants to launch the project, but had he decided to complete the design earlier, he could have saved time and money.’

DEMAND FOR MUTUAL UNDERSTANDING OF ROLES AND RESPONSIBILITIES

The architect criticized the lack of clear authority lines in the design management. Conversely, members of the construction and project management teams argued that the coordination role was definitely assigned to the architect. However, typical roles of the design manager – such as control, registration, distribution and issuance of design documents, as well as quality control and change management – were undertaken by the construction team, who prepared a spreadsheet to guide the architect. According to an engineer: ‘I take a look at the drawings to identify missing or conflicting data and inform them through meetings, e-mails or letters. I identify the missing data and require its inclusion in the design.’

These difficulties were partially caused by a poor understanding of design team members’ roles and responsibilities and a lack of recognized leadership. The dissatisfaction seemed to emerge from unrealistic expectations, preconceptions and conflicting requirements. The team members clearly presented different understandings of their roles and responsibilities, as suggested by the architect interviewed:

Someone has already said that deadlines were not set to be met. I haven’t seen a single deadline met in this project. Now they set an unlikely schedule. They are going nuts to meet it. But we will succeed and it is going to end up with a big party.

DIVERGENT INTERESTS AND EXPECTATIONS BETWEEN PROJECT TEAM MEMBERS

Poor coordination procedures led to difficulties, such as different information levels, between the project teams. An engineer pointed out that three people from the client team worked directly in the process. Consequently, she received data both from the project manager and the client, leaving room for extensive doubts. Coordination procedures, implemented and supervised by each team leader, should have substantially minimized the emergence of different information levels between project teams.

The architect emphasized the conflicting interests between designers and contractors: ‘This is absolutely normal. We’re acting on the client’s behalf. We are protecting the client’s interest in this project; the contractor is protecting his interests.’ The architect also criticized the architects’ detachment from the construction and complained about recent changes in professional roles, which illustrate the underlying rivalry between architects and engineers, and the reluctance to change:

Architects are unconsciously relinquishing their traditional leadership role, which gives engineers the opportunity to enter the market. Engineers are not the same anymore. I used to learn with them. Now they become bureaucrats who manage the contract to meet the schedule, even if they have to destroy their partners. It really is a battle in this respect.

DESIGNERS’ DETACHMENT FROM TIME AND COST MANAGEMENT

The contract manager criticized the designers’ detachment from cost and time management: ‘It is clear to me. There is a historical detachment of designers from cost management that leads to construction problems. There is a deadline and I don’t know what I am supposed to do on some floors. I am not inventing this whole story.’ Excessive design
changes and late decision-making affected the progress of the project and the relationship between team members. According to an engineer, frequent design changes required an active contract management approach by the construction team:

Frequently, the work is already done when a design change appears. There is rework and a demand for new cost estimates. We try to identify the cost as the design is issued and negotiate it with the client. Then we have to procure it once again. This demands hands-on contract management.

CONTRACT COULD NOT BE IMPLEMENTED AS EXPECTED
The Maximum Guaranteed Price contract was considered comprehensive and conducive to achieving high performance by all parties. According to the project manager: ‘The contract has a US structure, but is organized and precise, and provides solutions for any dispute.’ Despite its strengths, the contract was not fully adopted, according to the contract manager, because of the lack of definitions in the design: ‘The cost should be reduced as the design was developed. We were unable to do it, however, as the design was incomplete. We had to raise the price. Thus, we offered no benefits to the client.’ According to the project manager, the inexperience of the local supply chain affected the contract enforcement: ‘A guaranteed maximum price (GMP) contract is clear for a North-American contractor. The second price is lower than the first one. If the design does not change, then the price is reduced. In contrast, a local contractor makes a lot of decisions based on assumptions.’ The contractor disagreed: ‘The first cost estimate was R$130 million, because there was only a schematic design. The first GMP was R$128 million and the last R$146 million. Something happened, right?’ He also questioned the so-called ‘concurrent engineering’:

Engineering has been re-invented in Brazil. I’ve been working for 23 years. Today, it is much worse than in the past. There isn’t concurrent engineering if this concurrence occurs during the construction. I cannot procure a curtain wall if I don’t know the type of glass or aluminium. This is not engineering to me, it is something else.

CONCLUSIONS
The assignment of foreign offices to work on construction projects in developing countries can bring about benefits, such as technology transfer and innovative design concepts. On the other hand, it poses difficulties for the design management as it may intensify coordination and communication problems, and there may be conflicting interests and a lack of mutual understanding of roles and responsibilities among project team members. Therefore, it can increase project risks to the client, induce cost and time overruns, cause excessive design changes and claims, and have an adverse impact on quality.

The involvement of foreign offices in the design development stage can warrant fidelity to original concepts and compliance with specified solutions. Nevertheless, differences in the level of information of construction documents, lack of familiarity of local contractors and subcontractors with foreign plans and specifications, and complexity in estimating, procuring and installing imported items and equipment may arguably affect the design and construction management. US construction documents present a lower level of information in comparison with Brazilian ones, since subcontractors and suppliers play an essential role in the development of the design in the US.

Furthermore, communication problems were intensified due to the employment of foreign designers. The Brazilian design team had to learn English and the foreign team had to learn Portuguese. According to the contract manager, nobody in the local design team was fluent in English. Certainly, this
aspect delayed the analysis of plans and specifications, affected the clarification of doubts and induced failures in the interpretation of the design documents.

Teleconferences were used by design managers but without great success. Drawings were also made available for download from an intranet at the outset of the project. However, the system was abandoned as the majority of the subcontractors had never used it before. Moreover, design documents distributed through the intranet bypassed the quality management system of the construction firm. Therefore, the availability of promising technologies does not guarantee immediate adoption and acceptance by project team members, since their implementation commonly requires investment, training, managerial changes and overcoming cultural barriers.

The study identified serious deficiencies in design quality management, such as failures in design briefing and scope management, incompatibilities, interferences, lack of procedures for the issue of design reviews, poor standardization and modularization, and an excessive number of late design changes. According to the interviewees, these problems emerged mainly as a result of: the unusual complexity of the project; deficient selection of local design offices; lack of precepts, tools and techniques for the design quality management; deficiencies in the scope management; and inappropriate choice of the procurement route.

Although the volume of information exceeded overall expectations, it is assumed that careful design planning and the adoption of simple precepts, such as the single statement of information, could have reduced the problems faced by the project team. The spreadsheet developed by the contractors for document management purposes denotes a proactive approach that should have been encouraged. The design coordination could have agreed upon an information demand schedule with client and construction teams. Presumably, this initiative was not taken due to conflicting interests and a lack of trust and genuine leadership within the project team.

The case study has highlighted some potential impacts of the trend for globalization in the construction industry, such as the purchase of goods and services on an international basis and the establishment of international design teams. Remote design teams promote innovative personal and professional relationships, but may conversely raise technological, managerial and organizational barriers to the integration of design and construction. Therefore, an informed choice of the procurement method and innovations in management, technology and human resources are required to establish trust and strengthen cooperation in international design teams.

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INTRODUCTION
Architectural design is a complex activity which poses difficult managerial problems. Complexities lie within the technical knowledge, information availability, the uniqueness of design and interactions between different stakeholders (Sebastian, 2005). Design involves a number of decisions with numerous interdependencies (Cornick, 1991; Ballard and Koskela, 1998). There are often conflicting requirements, demanding an effort to recognize, understand and manage trade-offs, and decisions must usually be made quickly and sometimes without complete information (Reinertsen, 1997; Sanban et al., 2000; Koskela, 2004). A large number of stakeholders are involved, such as architects, project managers, structural engineers, building services engineers and marketing consultants. Moreover, feedback from production and operation takes a long time to be obtained and tends to be ineffective (Formoso et al., 2002).

Design management, as a body of knowledge, has emerged with the aim of reaching a better understanding of these issues and how they should be tackled. In recent years, the rising complexity of projects and growing market competition has significantly increased the pressures to improve design performance i.e. to develop high-quality design solutions through shorter timescales. Such complexities affect both designers and contractors.

In the UK context, procurement routes such as design and build (D&B) and Public Private Partnerships (PPP) are currently being widely adopted. These enable clients and/or owners to benefit from having a single organization taking responsibility for delivering the required building and associated services according to predefined standards (Bennett et al., 1996). Akintoye (1994) further elucidates that the majority of D&B contractors employ external
consultant architects and engineers to develop the design. Within this environment, contractors need to appropriately manage the design process to maintain competitiveness in the marketplace and to reduce wastage both in design and in downstream construction activities (Broadbent and Laughlin, 2003).

However, to date, design management research has not sufficiently emphasized how contractors could manage design, what their role is in this process and what barriers they face. The concept of design management and the necessary skills to manage design from a contractor’s perspective appear to be unclear. Such a gap may be a partial consequence of the fact that design management has typically been approached mainly from the perspective of the different professionals involved in design (Press and Cooper, 2002). Therefore, a broader perspective on design management is needed.

This paper aims to partially address this issue by analysing data from two case studies in which contractors were responsible for managing the design process. The paper discusses the role of contractors in design management, examining the skills needs for design managers from a contractor’s perspective. Questions for further research are also posed.

DESIGN MANAGEMENT

Design management endeavours to establish managerial practices focused on improving the design process, thus creating opportunities for the development of high-quality innovative products through effective processes. Even though excellence in management is not considered a substitute for high-quality creativity and innovation, it can represent the difference between success and failure in multidimensional and complex project environments (Cooper and Press, 1995).

Emmitt (1999) poses that in architecture, the work of Brunton et al (1964) represents an early attempt to introduce managerial concepts in design. The search for an understanding of how people perform complex cognitive activities has been the underlying principle of design research for the past four decades (Kalay, 1999). During this period, there has been a slow but steady growth in understanding design ability. Similarly, the need to provide research and measures to encourage firms to make use of design for competitive advantage came to light (Press and Cooper, 2002). It was hoped that understanding ‘how designers think’ would lead to the development of methods and tools to help the reliable achievement of high-quality results in design (Kalay, 1999; Lawson, 2006).

In general, past research has focused on two different design management dimensions i.e. office or practice management and individual job management (the management of the design/project in hand) (Sebastian, 2004). However, such distinction may be potentially misleading since the two interconnect i.e. the management of people and social characteristics of staff employed will create the unique culture of the firm, which will in turn affect the way individual projects are managed (Emmitt, 1999).

From a project management or individual job perspective, the design process has been studied from two different viewpoints. The first aims to increase understanding of the nature of the design activity (e.g. Lawson et al, 2003). The second proposes ways in which design should be developed at its different stages, considering both ‘hard’ activities and ‘soft’ social design interactions (e.g. Kagioglou et al, 1998). Along these lines, design management has been closely related to a concern with systematic design methods, focusing on the outcome of design decisions (i.e. the product of design) and the activity of designing (i.e. the design process) (Cross, 1999; Press and Cooper, 2002; Lawson et al, 2003).

As a result, the need to consider the whole life cycle of projects became apparent. Architectural management evolved from approaching design as an isolated activity at the front-end of projects, to cover the project from inception through to demolition, recycle and reuse. Figure 1 describes the context in which design management happens, and demonstrates the importance of communication and collaboration with different stakeholders. These are essential design and design management skills.

Figure 1 demonstrates some of the different issues that need to be considered by design managers. Nevertheless, for design management to be effective, a more detailed understanding of skills needs is essential. A brief description of such skills,
as discussed in the literature, is presented in the next section.

**DESIGN SKILLS**

Design skills are essential for the activity of designing. Bloom *et al* (2004) state that, put simply, skills are what an individual possesses, and these can be learnt both informally (on the job) and formally (through training). It is important to recognize that there is a natural way in which humans develop the ability to design e.g. by categorizing different things or through activities such as changing the furniture layout in our houses. However, the development of design skills could be compared to the acquisition of a language, in that it is a continuous process beginning in childhood (Lawson, 2006).

It is accepted that in order to locate design skills and competences (i.e. knowledge and behaviours) and to consider their value, one must analyse the breadth of the profession of design. Differing design professions have evolved by educational push and by corporate and consumer pull, which means that there are various perspectives from which to assess the design and the design management profession and its future (Press and Cooper, 2002). It is well known that design activity includes high cognitive abilities, including creativity, synthesis and problem solving. Cross (2004) reviews the field of expertise in design, linking it to design behaviour and the design process. The author states that expert designers appear to be 'ill-behaved' problem solvers as they do not spend much time defining the design problem. Expert designers are, therefore, solution-focused, not problem-focused. Generating a wide range of alternative solutions is a recommended strategy in the literature (e.g. Reinertsen, 1997). However, Cross (2004) points out that this may not be necessarily good, as most expert designers tend to
define a single solution and then develop it further. The study of the way in which expert designers behave may provide clues as to how design management should be approached; however, the links between these two areas appear to be unclear in the literature.

Design managers’ skills have been briefly described in the literature. It has been stated that design managers need to have the skills to understand a comprehensive set of requirements and to support their capture from the client/users and construction teams (Barrett and Stanley, 1999). They also require communication skills, both verbal and visual, to coordinate the exchanges of information throughout design development, and to explain the concepts to the stakeholders whenever necessary (Press and Cooper, 2002). Therefore, design managers need to have technical skills, looking at design as a sequence of activities based on a rationalized approach to a technical problem; cognitive skills, approaching the skills and limitations of the individual designer; and social skills, looking at how designers interact with other stakeholders and how this influences teamwork and value generation (Cross and Clayburn, 1995).

Even though such descriptions are important, it is believed that more information is needed to support a better understanding of design management and of the skills that effective design managers should possess. The currently poor understanding of the role of design managers within different contexts (e.g. design office, contractors, developers, etc.) may be related to deficiencies in current definitions of design managers’ skills.

RESEARCH METHOD

The epistemological option for this study is based on the interpretative school of thought. The research uses qualitative approaches to inductively and holistically understand human experience in context-specific settings. As pointed out by Silverman (1998: 3), a ‘particular strength of qualitative research ... is its ability to focus on actual practice in situ, looking at how organizations are routinely enacted’. Thus, design management developed by contractors was analysed with an emphasis on meanings, facts and words to reach an understanding of the phenomena in practice.

Within this context, a case study approach with exploratory characteristics was used to understand the overall role of contractors in managing design, and examine the skills that design managers need to perform such activity. The two companies involved in the case study are major construction contractors within the UK, and both are heavily involved with design management due to the type of procurement adopted i.e. in both cases more than 60% of the work undertaken involves managing the design and construction processes. The companies were also selected because they considered design management to be of strategic importance.

Data were collected through (a) seven semi-structured interviews with design managers – four at company A and three at company B; (b) participation of one of the researchers in meetings in which design management issues were discussed (six at company A and four at company B); and (c) documentary evidence including company information over the Internet and descriptions of design managers’ capabilities and skills. Specific documents for company A included a design management map; a map linking the design and bid processes; training programme; mistakes made and lessons learnt; designer performance review form; management system procedure; D&B guidance notes; hospital bidding documentation. Documentary evidence for company B incorporated procurement information (e.g. http://www.dh.gov.uk/ProcurementAndProposals/PublicPrivatePartnership/NHSLIFT/fs/en); bidding documents; training needs for design managers; and description of the design managers’ role. All interviews were tape recorded and verbatim transcribed, generating a detailed report on design management issues faced by the companies.

Data analysis was developed with the aid of content analysis. According to Krippendorff (1980: 21), ‘content analysis is a research technique for making replicable and valid inferences from data to their context’ and its purpose is to provide knowledge and new insights through a representation of facts. The analysis focused on identifying the perceived role of contractors and its design managers in managing design and the problems faced, as well as the perceived skills that design managers should have from the contractor’s perspective.
FINDINGS
Case study findings are presented for companies A and B. The background of each company is discussed, followed by a description of its role in managing design. Interview quotes are provided to enrich the discussion. Finally, the role of design managers is discussed. The discussion section presents the cross-case analysis and draws major conclusions.

CASE STUDY 1: CONSTRUCTION COMPANY A
Company A is a major civil engineering and construction contractor. The company’s turnover is around £450 million a year, with a staff of about 1200 in the UK. The company works in different business streams and 70–80% of the contracts are procured through D&B or PPP. The company has main offices in 18 different regions in the UK.

Background
Company A was involved in an improvement programme called Implementing Best Practice. As part of the programme, a design management process model was developed. The model describes the design process focusing on the activities to be performed by the contractor’s design manager. The model aims to improve design management skills and therefore bring all company design managers up to a minimum standard.

The model is a prescriptive ‘to be’ generic model (see Winch and Carr, 2001 for a definition) developed at the firm level, presenting six project phases as described in Figure 2:

- get opportunity
- work up to bid: involves all design stages
- win and start up: includes the award of the contract, mobilization and production information
- do work: construction
- handover and close
- review.

Figure 2 also shows the hierarchical structure of the model, which presents three different levels of detail i.e. project stages, activities and tasks.

The model defines project deliverables as well as information needs in terms of activities, technology and people. The discussion presented here focuses on the role of design managers within the firm, as well as the problems faced by the company in managing design, which triggered the process model development.

Design management problems: the role of design management
In company A, design management is perceived as a significant risk due to the fact that badly managed design can cause increased construction costs, rework, changes and time delays. More importantly, poor design can cause failure in bidding, affecting competitiveness. Even though its importance is clearly acknowledged, design is the most inconsistently managed process across the company. Inappropriate planning, poor reviews, poor resource availability and poor quality were issues identified. As stated by a senior design manager interviewed:

This is where the problem is, processes are inconsistent at the moment, and design is the most inconsistent, and that’s the best way of describing it.

Design work is always sub-let to external consultancies. Progress is usually monitored against high-level milestones. However, milestones do not focus on the information that should be produced but rather on major activities such as getting planning approval. Furthermore, there is a belief that the detail design phase should be pulled from construction planning (as, in most cases, design and construction are developed concurrently), but this does not happen because of poor information transfers with external designers. As a consequence, many design decisions are taken on site.

Design review meetings occur less often than would be appropriate. Design fixity (see Kagioglou et al, 1998 for a definition) should be sought through these reviews, but the concept of fixity seems to be poorly understood, and there is no clarity on how it could be achieved. Moreover, defining and controlling the brief is considered a challenge, as designers have their own agendas that often conflict with the contractor’s interests, as clearly stated in the following interview extract:
FIGURE 2 Design management process model – hierarchical structure

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Designers want to reduce their own costs ... and are not so much [concerned] with reducing construction costs.

Further difficulties occur when design is novated to the company. This is generally problematic as the proposed design does not consider the company’s building standards, and there is poor financial flexibility to obtain design changes or details. In addition, it has been stated that sometimes designers are inflexible in terms of not being able to respond to the company’s requests because many design consultancies are small and lack ‘slack’ resources.1

The company has a total of 12 design managers which, in general, get involved in large D&B construction projects. Of those, three are designers and nine come from different backgrounds e.g. planners, programmers or quantity surveyors. Therefore, it appears that most design managers do not have appropriate knowledge, and possibly do not have the necessary skills, to manage design. This is evidenced by the following interview extract:

We have people doing design management but they don’t actually know how to do it, they are not qualified to do it ... because they don’t really understand the design process ... so the only thing that they can check it for is if it is buildable, and relatively simple plans, quality plans. So most of them ... tend to operate as information coordinators, it’s just pushing drawings out of the people, without really analysing quality or the process.

Finally, the company design managers suffer difficulties with external architectural consultancies as, in many cases, the latter believe the contractor to be taking over their responsibilities. This demonstrates tensions with regard to who should manage design – designers as service providers, or contractors as the internal client.

Skills required

Company A has difficulties in defining the role of design managers and consequently the skills required to perform the activity. Company offices in different regions work independently and this generates problems in implementing a unified approach. Furthermore, some of the company managers believe that as design work is subcontracted, design management should be too. Others believe that design is of strategic importance and, therefore, its management should be taken over by the company for its own benefit, as well as for the benefit of its clients.

Even though there was not an agreement with respect to subcontracting or developing design management internally, work was conducted as part of the process model design to establish basic design management skills. Seven key skills for design managers were established:

- design procurement
- commercial interface
- project standards
- design coordination
- design verification
- programme and performance measurement
- project systems (IT focused).

Those skills were further detailed through a list of 35 items summarizing the design manager’s role. These are described as follows.

First, the design manager should map the specific project process, based on the generic model. The project process should form the basis for planning and controlling design development, including the delivery of work by external consultants and subcontractors. Weekly meetings should be held to ensure work is developed to schedule, and the design manager should have authority to coordinate the participants and activities of each phase. Second, the design manager should appoint appropriately skilled design consultants. Third, s/he should be the communications link between the clients, designers and subcontractors, and therefore be responsible for controlling the briefing process and requirements management. In this sense, s/he should be capable of making fast and effective decisions on design matters. Fourth, issues of design aesthetics, buildability, costs, quality and programme constraints should be appropriately balanced. Drawings should be checked and approved for compliance with the contractor’s regulations. Finally, soft human skills are mentioned in terms of providing leadership and establishing teamwork.
However, it seems that the development of an overarching standard approach to design management within the firm remains a major challenge. This is partially a consequence of the divergent perspectives on design management within the company, which has been evidenced through discussions observed by the researcher about the implementation of the design process model. These focused much more on ‘what is a design manager?’ than on the implementation process itself. This demonstrates the importance and lack of clarity about the design management approach at company A.

CASE STUDY 2: CONSTRUCTION COMPANY B

Company B is an international construction group with capability in the design, procurement and delivery of major projects. Its turnover is around £1.6 billion, with about 9000 staff in the UK. The company has a major track record in working through initiatives such as private finance initiative (PFI) and design build finance and operate (DBFO) schemes with the public sector.

Background

Company B is involved with the LIFT initiative (Local Improvement Finance Trust). LIFTs are public/private partnerships set up to allow NHS Primary Care Trusts and their local partner organizations to develop primary healthcare facilities. Through LIFT, a number of schemes are clustered and delivered by a single private sector partner. Company B is the private sector partner in two major LIFTs in the UK, being responsible for designing, building, financing the facilities and providing facilities management and support services over a 25-year period.

Company B was responsible for procuring designers and managing the design process in the development of LIFT schemes. The design of such schemes is challenging, as buildings are innovative and complex. Complexities lie within the need to provide therapeutic environments supportive of the healing process and the need for a patient-centred service model (Gesler et al., 2004). The functional level of the buildings and the operating conditions are complex, as different services need to be delivered jointly, and the service mix and ways of operation are varied and unknown at the outset.

Design management problems: the role of design management

Company B considers effective design management essential in controlling the front-end of the majority of its projects. Furthermore, design quality is considered paramount to maintain and increase competitive advantage. However, the company faces design management difficulties. Poor clarity with regard to who should capture and manage requirements, poor control of design changes, difficulties in managing exchanges of information between clients, designers and contractors, and poor alignment between design solutions and clients’ requirements were issues identified. The occurrence of these issues is illustrated through the description of problems that have occurred on a specific primary healthcare project.

There was no appropriate ownership and control over clients’ requirements at the project environment. These were partially managed by the clients, partially by company B’s design managers, and partially by the architects. Requirements were not ranked neither was the ability to deliver analysed. As a consequence, there were difficulties in trade-offs between users’ wants and a prioritization of project needs. In addition, the design managers/designers were not present at all requirements capture meetings; therefore, the expected support to the client was not provided, and communications between clients and designers were inappropriate.

Furthermore, there was no audit trail for design changes in place. Requirements changes had been dealt with directly by the architects, and requests from users were generally included in the design without considering affordability or the effects that the changes had in terms of time delays. The number of changes in the project is clear from the following interview transcript:

_I do remember some late change requests, and I kept saying, do you [client/user] realize what this is going to cost you? And when they did, then they managed to refine their requirements. And there had been design solutions that had cost a fortune that had to be removed as inappropriate design solutions. So it was an unstructured, ill-disciplined process._
As in company A, design managers in company B come from a variety of professional backgrounds i.e. engineers, architects, building services and planners. Most importantly, many design managers did not have all the capabilities necessary to appropriately perform their role. The design managers interviewed did not have previous training or experience in design, as one had a degree in construction management and worked as a production coordinator, and the second had a building degree and had worked with construction planning. It is believed that this may have influenced some of the problems that occurred at the project level.

Interview data also made clear that design managers in company B tend to approach their work from personal, and sometimes contrasting, perspectives. For instance, one design manager believed that as he was representing the contractor, he should not be involved in requirements capture and management. However, it was on the remit of the contractor’s work to provide support to the clients in managing requirements. On the other hand, a second design manager believed that he should manage requirements and provide an appropriate link between clients, contractors and designers. Unfortunately, he faced problems in performing such activities because of his skills level and his poor bargaining power with both the client organization and the designers. Such different managerial approaches make explicit the lack of clarity in design management roles and responsibilities at the company level.

Skills required
Company B has stated the design management skills it requires in terms of different issues. Design managers are expected to have appropriate professional qualifications (e.g. RIBA, MICE, MIoB, etc.) and to be able to demonstrate competence in the role. There is a belief that good design managers must understand the project’s needs, budgets and aspirations, making decisions and communicating these appropriately. Furthermore, s/he must be capable of understanding processes within both the design and construction environments. Also, the design manager is considered to be key in creating a seamless link from design, through procurement into construction, commissioning and handover.

In this sense, design managers are expected to play an active part within the wider project team, liaising and coordinating the design team, the client, trade designers, statutory authorities and other interested parties e.g. fire officers, police, disability advisers, etc. Therefore, it is believed that design managers need listening, communicating and asserting skills, in addition to a thorough practical and technical knowledge.

Finally, design managers must be able to control the costs of the emerging design solutions and be capable of ensuring that the delivered design meets contractual and construction requirements.

In summary, it is possible to state that there is an emphasis on planning and controlling the design process in a project management ‘command and control’ style (Tzortzopoulos, 2004) i.e. defining the work that needs to be done and pushing it to the design team, and controlling design development solely through the production of deliverables. However, such a ‘command and control’ management style does not appear to be delivering the expected results.

DISCUSSION
Design managers need to have the appropriate skills and capability to lead design development (Mozota, 2003). Therefore, clarity of roles and responsibilities, the availability of appropriately skilled design managers and a clear vision of what the company is trying to achieve through design management are main issues. However, research results demonstrate poor clarity on all these issues at both case study companies.

There were divergent and sometimes conflicting perspectives on design management by the top management, regional managers and design managers throughout company A. Furthermore, there was a lack of agreement on the potential benefits of managing design from the contractor’s perspective. The lack of a clear and agreed company-wide design management strategy, coupled with the lack of clarity on the design manager’s role created difficulties at the company.

Similarly, at company B, each design manager appeared to be taking a personal view on how design should be managed. This is evidenced by the fact that design managers took conflicting approaches to
the management of requirements. Poor control of
design changes and difficulties in managing
communications and delays were also identified.

Therefore, difficulties in managing design can be
a consequence of the poor definition of the
companies’ role (and that of their design managers)
in the process. Generally speaking, the design
managers from both case study contractors
appeared to have inappropriate understanding, skills
and knowledge about design. These issues raise
questions that need to be answered through further
research.

First, should the management of the design
process be the responsibility of developers, contr-
tactors, designers or clients? Market trends indicate
that major contractors in the UK are involved with
design management, so research needs to be
developed to clarify the most appropriate role for
contractors throughout design development. Clarity
regarding the design manager’s skills and
competence needs, to allow them to effectively act
during design, should be sought in alignment with the
contractor’s role in the process.

Second, how should tensions be balanced
between designers wanting to manage design, and
the contractor’s design managers? Finding means to
appropriately empower design managers working for
contractors and also engage designers by demon-
strating benefits would be essential to ease such
tensions.

Third, can stakeholders from varied non-design
backgrounds achieve the necessary capabilities to
manage design without appropriate training? And
would the establishment of a unified conceptual
approach to design management reduce the occur-
rence of problems in practice?

Finally, the appropriate managerial strategies to
be adopted by contractors need to be established. Is
it appropriate for design to be managed solely
through a system of personal beliefs? In effect, an
appropriate level of process control should be
sought, allowing efficiency and reliability of stable
process activities to be achieved throughout the
different company projects (Barrett and Stanley,
1999). However, at the same time, design managers
should retain the capability to identify situations
that require change, ensuring effectiveness and
responsiveness throughout the process. This would
support improvement and innovation, allowing for
managerial autonomy in each project. It also allows
the ‘design’ of the best possible way of managing the
process by considering good practices and also the
structure of physical, political and cultural settings of
design action in each project context.

CONCLUSIONS
The importance of appropriately managing the
design process has been long acknowledged. In the
current context of contractors taking managerial
responsibility over the design process, this issue
becomes even more important as a new design
management direction emerges.

This paper emphasized a research gap in which
poor attention has been given to the management
of design from a contractor’s perspective. Case
study data evidenced shortcomings in practice
in terms of establishing the role of contractors
in managing design, as well as poor clarity
regarding the skills and competences necessary
for design managers working for contractors. Based
on these issues, questions for further research were
proposed.

The lack of a clear theoretical foundation for
design management influences the problems faced
in practice. To date, research has failed to provide
an overarching framework that could support
improvements in practice. This is related to the fact
that the main research focus has been on managing
design from a designer’s perspective only. Also, due
to the great diversity of design practice, poor
consideration has been given to the importance of
context, organizational and project issues in design
management. Poor clarity with regard to any of these
would lead to problems in design management
practice.

Therefore, we put forward the need for a more
critical reflection on design management’s purpose
and direction within the construction industry. More
specifically, clarity is needed as to how different
stakeholders should approach design management
so that the best value and most effective processes
can be achieved.
NOTE

1 Slack resources are surplus resources necessary to address unexpected work, threats or opportunities – see, for instance, Daniel et al (2004).

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INTRODUCTION

THE CHALLENGES OF CONTEMPORARY DESIGN PRACTICE

Present challenges such as increasing globalization of the marketplace and computer-based communication and information technology seem to create a growing need for simplicity, control and reliability. At the same time, contemporary consumer culture calls for customized and personalized goods. This evolution also leads to a demand for precise definitions of the values and qualities that can be used as managing tools in common building practice and it puts the traditional architectural design process under pressure. This paper outlines an approach to architectural quality as dealt with in the design process in an industrialized context. It also presents a way to analyse how and to what degree design processes are formed strategically according to specific architectural intentions (values). Through detailed interviews with professional architects, the way in which they manage the design process and how the architectural potentials are realized when dealing with modern industrial processes are examined. To analyse and structure the empirical data, a model was developed consisting of four approaches for action. The approaches are categorized along different dichotomies in order to point out different ways in which the offices can direct their design process (strategies) and reach particular end-results (goals). Two examples from the analysis are discussed according to the dichotomies and subsequently developed into a general classification focusing on strategy. A description is given of how the model was tested in the architectural education at the Royal Danish Academy of Fine Arts – School of Architecture. The overall research project has two aims – to help offices identify the characteristics and specific methods of working with architectural quality in an industrialized context, and to generate a common debate about quality in industrialized architecture. It is hoped that by presenting a way to talk about strategy and architectural value, it will inspire further elaboration of the field of strategic design management.

Keywords – Architectural quality and value; design strategy; industrialization; professional culture; role of the architect

Abstract

Complexity arising from increasing globalization of the marketplace and computer-based communication and information technology seems to create a growing need for simplicity, control and reliability. At the same time, contemporary consumer culture calls for customized and personalized goods. This evolution also leads to a demand for precise definitions of the values and qualities that can be used as managing tools in common building practice and it puts the traditional architectural design process under pressure. This paper outlines an approach to architectural quality as dealt with in the design process in an industrialized context. It also presents a way to analyse how and to what degree design processes are formed strategically according to specific architectural intentions (values). Through detailed interviews with professional architects, the way in which they manage the design process and how the architectural potentials are realized when dealing with modern industrial processes are examined. To analyse and structure the empirical data, a model was developed consisting of four approaches for action. The approaches are categorized along different dichotomies in order to point out different ways in which the offices can direct their design process (strategies) and reach particular end-results (goals). Two examples from the analysis are discussed according to the dichotomies and subsequently developed into a general classification focusing on strategy. A description is given of how the model was tested in the architectural education at the Royal Danish Academy of Fine Arts – School of Architecture. The overall research project has two aims – to help offices identify the characteristics and specific methods of working with architectural quality in an industrialized context, and to generate a common debate about quality in industrialized architecture. It is hoped that by presenting a way to talk about strategy and architectural value, it will inspire further elaboration of the field of strategic design management.
governing tools in common building practice. How to define and manage architectural quality seems to be determined by a series of conditions (product demands, value-chain definitions, technologies and requirements of the end-users) that are detached from the specific architectural context. Consequently, architecture and the design process are ruled by a mixture of quality standards and managing tools that do not relate to the architectural project as a holistic entity or, it could be argued, to architecture at all.

As a result of this evolution, the traditional architectural design process is being put under pressure as it is an ‘open process’ comprising artistic and innovative activities. Each step is difficult to fully plan and predict and when it comes to the end-result, it is impossible to control. At the same time, various research has shown that during the early stages of a project design (conception and programming), 90% of the final costs and qualities are defined (ATV, 1999). In our opinion, these two points highlight the need for a more conscious approach among practising architects as to how and to what degree strategic design management should be a part of the architectural design process. This is in order to better translate visions into built (real) form and realize as many of the embedded values as possible in a building project when confronted with the conditions of an industrialized reality.

The research project discussed in this article is an empirical investigation into how professional architects define and manage architectural qualities and values in the design process. It focuses especially on the architectural potential (freedom and constraints), which lies in the use of contemporary industrial manufacturing processes. Questions touched upon are: How is architectural quality defined in specific architectural solutions? Which strategies and methodologies are being used in order to reach specific goals (architectural qualities) in the production of architecture today?

DEFINING ARCHITECTURAL QUALITY IN AN INDUSTRIALIZED CONTEXT

In architecture, quality can be defined as a relative matter that relates to specific architectural questions and solutions. Architectural quality includes a number of dimensions that are not easily recognizable within a traditional industrial context. The industrial concept of quality primarily concerns functional and technical matters whereas architecture and its qualities reach much further as a culturally dependent product (Frampton, 1983). Besides functional and technical issues, architectural quality also embraces aesthetic and ethical aspects e.g. forming answers to questions such as ‘How shall one live to live in a right way?’ (Lundequist, 1992). As such, the concept of architectural quality concerns human existence, our needs and aspirations, and its core values can be said to have existed unchanged as long as the history of mankind. In summary, the industrial concept of quality has developed into a narrow rational/technical concept, whereas the concept of architectural quality can be characterized as an overall human premise (Beim, 2004).

Furthermore, architectural quality depends on how ‘the creator’ (here, the architect), as well as ‘the spectator’ (the user), perceive and interpret the ideas behind an architectural project as well as what sort of meaning (or lack of meaning) they transfer into the physical solutions. It then becomes a matter of perception and association i.e. I give meaning to what I see (perception), based on my previous knowledge and experience. According to Pallasmaa, it is important to be aware of the observed qualities and the generative concepts in relation to architectural perception as two different, but intertwining, levels of perception. They are described as, ‘analogous to the tension between the empirical and the rational, where the logic of pre-existing concepts meets the contingency and particularity of experience’ (Pallasmaa, 1994). In our opinion, this means that architectural quality can never be expressed as a single formula and neither is it possible to make direct comparisons between different levels of quality and different architectural solutions. This means that not only the architectural design process (as described above) but also the very concept of architectural quality seems to be challenged by the processes linked to industrialized manufacturing and computer technology which both require strict planning and a predictable output.

A THEORETICAL MODEL DEFINING FOUR APPROACHES FOR ACTION

Through detailed interviews with practising architects, the investigation tries to reveal how they
work in order to reach their final results. These results are not necessarily single building constructions, but also building concepts and building systems, as well as (industrial) design principles which we define as ‘industrialized architecture’. The architects that have been interviewed all work in the field of industrialized architecture and present interesting attitudes.

As part of the project, we have formulated a model consisting of four approaches for action (ideal types) which helps to categorize and structure the different ways in which the architectural offices try to manage the design process and the end-results. The approaches are not exact representations of any empirical reality, but try to collect a series of related motives for action, arranged as clear-cut strategies. The model was conceived through a brainstorm exercise based on general (intuitive) experience and specific impressions from the interviews, but has subsequently and continually been corrected and refined during the analysis of the interviews, while used as a way to structure the analysis. In this way, the model works more as a dynamic tool than as a rigid theoretical framework. Furthermore, it has been the intention to make the model useful outside this specific research project i.e. to generate consciousness and debate among practitioners and students about how they work. This approach – partly borrowed from the social sciences – seems appropriate in the present setting, as it does not try to ‘classify or bring order into a chaotic reality but rather aims at caricaturing essential characteristics in this reality’ (Andersen, 1990 – author’s translation). According to Andersen’s interpretation, ideal types work as ‘entrance keys’ to a deeper understanding of the inner nature of empirical phenomena.4

The four approaches contained in the model are:
- the pragmatic approach
- the academic approach
- the management approach
- the conceptual approach.

Each represents different strategies along four sets of dichotomies. These are:
- project vs process orientation
- architecture as an autonomous vs conditional discipline
- innovative vs evolutionary working method
- intuitive vs explicit accumulation of knowledge.

The dichotomies – as well as the approaches – have been adjusted and refined throughout the work with the empirical results.

THE PRAGMATIC APPROACH

This approach starts from the belief that ‘good architecture’ is ordinary buildings that work satisfactorily and are made for ordinary people. The brief, the given conditions and the context sets up a basic framework as a starting point. The role of the architect is not to revolutionize the world or architecture, but to present qualified proposals and improve the general standards. Knowledge is accumulated through a kind of apprenticeship based on routines and tradition and it is matured through working on specific projects. Knowledge is primarily produced and held by the involved employees in each project and there is no systematic cross-project evaluation and transmission. Architects deal with what is possible within the given situation. Objectives concerning architectural quality are defined by the

![Diagram of the relation between reality and theory](image-url)

**FIGURE 1** The relation between reality and theory (Andersen, 1990)
programme and during the specific sketching process. A personification of this approach could be the craftsman. In summary, the pragmatic approach defines architecture as a discipline depending on other disciplines. The approach is primarily project-oriented, based on tradition (evolution) with an intuitive non-explicit use of knowledge.

THE ACADEMIC APPROACH
Behind this approach, there is an understanding of architecture stressing a holistic perspective. Only the architect is capable of fully understanding this complexity, which nevertheless is created through interaction between various individuals/firms, each one contributing with specific knowledge. The role of the architect is to interpret and synthesize the many different inputs. Knowledge is systematically gained and critically held up against present knowledge. This means that knowledge is accumulated directly within the company. The working methods are fixed and transparent, and well-known solutions (typologies) are repeated while continually adjusted and refined. Every task is specified so that responsibility can be distributed easily. Objectives concerning architectural quality transcend the project level, for example sustainability, low-cost building or exploitation of the potential of daylight. Through a fixed method, architects try to reach some defined goals of quality. The personification would be the scientist. Summing up – the academic approach claims architecture to be an autonomous discipline. It is primarily process-oriented, based on tradition (evolution) and has a high level of explicit knowledge accumulation.

THE MANAGEMENT APPROACH
This approach is based on the belief that architecture is created by the interaction between different agents both inside and outside the building industry, and the architect has no unique status in this context. Efficient coaching/management, rational thinking and good business are musts to attain good results. Knowledge is based on theoretical models and experience collected for internal use. The business administration is in charge of the total amount of knowledge as a platform for decision-making. Keywords are professional business administration, specialization and management of each employee’s qualifications. This assures an optimal use of all the know-how and skills held within the company by its employees. In this way, room is made for new ideas to emerge by possessing sufficient economical resources in each project, as well as in the company as a whole. A personification could be the manager. Summing up – the management approach claims architecture’s dependency on other disciplines. It is primarily process-oriented, innovative and has a high degree of explicit knowledge accumulation.

THE CONCEPTUAL APPROACH
Architecture is conceived as an art in this approach. Every building must – regardless of technological limitations and restrictions – form a unique statement, which means being more than just a ‘physical shelter’ for human activity. To work as an architect is a vocation. Every work (of art) has its own significant premises, which means that you cannot transfer the same knowledge from one project to another. Reusing former ideas or solutions can even restrain the work. Every project must start as a tabula rasa where a particular concept sets up the framework for possible action. This concept may originate or be inspired by part of reality, but generates its own logic. The quality is embedded in the value of the concept, the degree of innovation or the special characteristics and the clarity of the final result. However, this quality definition does not exclude technical and functional dimensions, but they are not regarded as main parameters. The approach can be personified as the artist. Summing up – the conceptual approach claims architecture to be an autonomous discipline. It is primarily project-oriented and innovative and has an intuitive non-explicit use of knowledge.

The four approaches are to be understood as impartial and we have tried to not favour one approach over another. We have assumed that all approaches can result in high levels of architectural quality and great value for the end-users and society. The approaches are an expression of a cultivation and grouping of related characteristics. In reality, architectural practice will always be more ambivalent and often point towards different approaches simultaneously. As such, general architectural practice most likely forms a complex combination of different strategies.
AXES OF DICHOTOMIES
To further illustrate the model, Figure 2 sets up the four different concept axes or dichotomies used in the summary of each approach. The figure and dichotomies should help to distinguish the approaches from each other and facilitate their comparison.

PROCESS/PROJECT
The first dichotomy is a process/project axis that describes the focus of the architects when working in the office. A process focus starts from the assumption that structuring and managing the process is the best way to control the result. The way we do things has a great influence on the final outcome. This means that the working methods often have a general character directed towards ‘how to do’ and this is not necessarily linked to any special characteristics in the actual project. The project focus starts the other way around with the aim of ‘what to do’. This makes the process more arbitrary or improvised in the way that ‘anything goes’ in order to reach the goals set up in a specific project. A unique result can be an outcome of many different processes. The working method is thus postponed in relation to the product/project.

EXPLICIT KNOWLEDGE ACCUMULATION/INTUITIVE NON-EXPLICIT USE OF KNOWLEDGE
The second dichotomy deals with the nature of the knowledge used or could also be illustrated as the ‘media and code’ used for information storage and exchange. Explicit knowledge accumulation mainly uses external media and universal codes\(^5\) e.g. paper/pen (media) and letters/English (code). This type of knowledge accumulation facilitates communication and exchange by making it more independent of the actors involved. Intuitive non-explicit use of knowledge is stored in the actors themselves and codes are personal, or at least limited by personal access.\(^6\) This knowledge can be conscious but is more likely to be part of the subconscious. The actual knowledge accumulation will always be a combination of the two extremes. This has to do with the interpretative act, which will always be involved in the translation of any form of information independent of media and code into usable real-time knowledge. ‘Who’ is reading the text or looking at the drawing is just as important.

INNOVATION/EVOLUTION
The third dichotomy spanning from innovation to evolution is related to the ‘use’ of knowledge when generating new ideas and projects. Innovation has to do with the ability or the intention to throw away what you already know and take in completely new information without prejudice. This knowledge can be both reliable knowledge generated in external environments\(^7\) and more ad-hoc knowledge generated by a particular combination of conditions that are present in the specific case or situation. Evolution means that the main part of the knowledge or information employed in a project is already possessed by the actor (the architect) before the beginning of the project. Compared to nature itself, evolution is based on mutation where minor corrections and refinements make an organism (object or process) more apt in a certain environment, context or situation. Yet again, reality will always be somewhere in between. It is not possible to start completely from scratch even if you wanted to. There will always be reuse of some basic knowledge e.g. how to use a pen or the dimensions of the human body (in architecture). At the opposite end of the spectrum, total reuse will not generate new ideas and cannot even be defined as evolution.

FIGURE 2 The different approaches placed within the four dichotomies
The fourth dichotomy describes architecture’s autonomy or dependency. An autonomous architecture is an architecture that is exclusively defined within itself and the architect dominates when it comes to deciding what is relevant to include in this definition. This has to do with a conception of architecture as a true profession rather than an occupation (demarcation/action). On the other hand, architecture as dependant discipline, places the architect as one actor among many others in the production of architecture. This is not necessarily constraining for the development of architecture; the vague borders can be seen as possibilities and inspiration rather than limitations.

The dichotomies represent a simplified way to classify the different theoretical approaches. This should help to make the model a useful tool for analysis and discussion of specific empirical reality in architectural offices. In this research project, it has been tested on a collection of interviews with professionals from different Danish and foreign architectural offices. An interesting analysis would not try to make an exact match between reality and theory, but rather discuss the clashes between the rigid classifications and the ever-complex reality.

**CASES FROM THE ANALYSIS**

Using the model as a language or a matrix enables us to locate and discuss the specific statements concerning architectural quality (goals) and the way to attain it (strategies). The overall scope of the analysis and the research project is to ‘locate and discuss’ – rather than to interpret – the different strategies and specific goals (in the process of architectural design) as reflected among a selection of practitioners (cases).

Design strategies seem to work on several levels and some of them are only indirectly related to the actual design process. A strategy can be directed strictly towards the formal design – the process of giving physical shape to a project, but it can also have broader technical scope introducing industrial building techniques or deal with more legislative themes such as building standards and codes. The strategy can also focus on external factors such as environmental issues or politics, which may be considered to have decisive impacts on the actual design. As a general guideline, one can look at the ‘level’ and the ‘nature’ of the strategy employed (Figure 3). ‘Level’ refers to the level of consciousness – high or low strategic consciousness – and ‘nature’ points to a distinction between the concrete (exact) and abstract nature of the specific goals implied in the strategy. Here, we will briefly present two examples from the analysis that both present high strategic consciousness but comprise very different natures spanning from the concrete (exact) to the abstract.

**EXACT (CONCRETE) STRATEGY**

One of the case studies is the work of the architectural office Lundgaard & Tranberg (LTA), a medium-sized Danish company with 35 employees founded in 1974. In the mid-1990s, the office developed a building concept or system called Comfort House, which is based on a business consortium that joins contractor NCC and engineers Carl Bro with LTA as the architects. The concept or system is partly an organizational framework and partly a constructive system for housing complexes of varying size. The managing director at the time was interviewed. (The office is now owned by a partnership of leading employees.)

Most of the statements from the interviews place LTA closest to the pragmatic approach, although many features are also related to the conceptual approach. The management and academic approaches share no significant resemblances with the way LTA seems to work. In very general terms, the approach can be characterized as clearly project-oriented mainly using intuitive non-explicit knowledge. Furthermore, LTA does not state architecture as an autonomous discipline while both innovative and evolutionary features can be found.

Comfort House is a standardized building system, although the starting point in LTA is the actual project rather than a general strategy. There is no fixed procedure or a complete *tabula rasa*. The organized framework and the building system give some common directions for the different actors involved in the process but leave a great deal of openness for the architect in some specific parts e.g. designing the facade and organizing the plan. A common set of rules make it possible for the involved actors to work...
more simultaneously e.g. the engineer does not have
to wait for the final solution from the architect before
calculating the structure.

LTA's design strategies run in two directions: on
the one hand, they accept the building system and
focus on the inherent possibilities and, on the other
hand, they always try to challenge the lure of
repetition, which also characterizes the system.

The project-oriented focus characterized by the
pragmatic approach, and which also can be found in
the LTA interview, leads to quite specific strategic
statements e.g. improvement of building
components and detailing, and how these are related
to the whole. Examples could be LTA's work with a
greater deal of flexibility where the foundation meets
the ground, various placements of the plane of the
façade or the use of alternative materials. The
analysis points to a moderate to high level of strategic
consciousness directed towards exact (concrete)
goals (Figure 3).

**ABSTRACT STRATEGY**
The second case is an interview with the managing
director of Arkitema (AT). AT is the largest
architectural office in Denmark and was founded in
1970. The firm shows an explicit interest in
industrialized processes and, among other reasons,
was selected because of its biannually published
*Videnregnskab* – a written and illustrated summary of
its business and where it wants to focus in the future.

The interview places AT close to the management
approach. AT's approach can, in general terms, be
described as mainly process oriented. Explicit
knowledge accumulation is the aim and to some
degree a fact. AT does not state architecture as an
autonomous discipline but claims extreme
dependency on related fields while many innovative
features are present with the aim to empower the
architect.

The process orientation is found in the focus on
organization within the company and the organization
of the building process as a whole. However, it must be stated that the interviewee works at the organizational level, which is not necessarily representative of all employees. One of the initiatives is a pronounced specialization of the staff, which are grouped into expert departments with different profiles. A particular task force is specialized in research and accumulation of knowledge. This part of the company does not deal with external customers, but rather generates value indirectly by supporting and inspiring the other departments. The role of the architect is not to decide what is wrong or right in terms of architecture, but instead to enable the involved actors to make the best decisions. The architect thus becomes a process manager more than a decision maker. By opening up and giving other actors influence in traditional working fields of the architect, the possibility of gaining access to other decisive areas seems to be maximized. This turns the way the architect works upside down and points to distinct innovative features.

Most of the strategic choices presented in the interview point towards a more general level (non-project specific) with focus on the process instead of the final product. Strategies are less directed against internal factors e.g. specific formal design, and more against external factors e.g. coordination with other parties involved and questions about the organizational setup of the construction process. One of the major problems in the building industry, according to the interviewee, is precisely the improvised character of this organizational setup. The analysis points to a high level of strategic consciousness directed towards abstract goals (Figure 3).

NO STRATEGY

Both examples analysed present a high degree of strategic consciousness, but of a very different nature. To complete the schema, the other interviewed offices reveal considerably lower strategic consciousness mainly of an exact nature, which in many ways corresponds to the pragmatic approach. A low strategic consciousness of a more abstract nature would correspond to an extreme version of the conceptual approach although Figure 3 cannot be understood just by locating each of the four approaches in a quadrant. All the cases present interesting attitudes towards industrialized architecture and are consequently located in the ‘upper conscious end’. An allegation could be that many traditional offices would be located in the ‘lower conscious end’ showing low or no strategic consciousness at all. The aim of this project is not to confirm this, but instead to contribute to make these companies more responsive to the way they work.

IMPLEMENTATION AND FURTHER PROJECTS

The model of action has been presented in various contexts thus trying to initiate a more conscious strategic approach among architects.

Preliminary attempts to test the model were made in March and November 2005 with two different groups of architectural students. In March, the students attended a half-day workshop on project design and group processes. They were presented with the model of action and a couple of examples from the analysis, and were given time to think about and write down their personal approach using the model and the four theoretical approaches as a point of departure. Each student was then asked to present their approach. The idea was to discuss how the personal approaches related to the theoretical ones and, on a more specific level, to see if the results could point towards different roles among the students in their current group project.

The presentations and the subsequent discussion showed that the students placed themselves in similar ways. Most identified themselves mainly with the conceptual approach with some resemblances to the pragmatic approach. This implied that even though they as students were in a process of learning, they did not claim to use any systematic or explicit form of knowledge accumulation, but rather improvised (intuition) or did ‘as they used to do’ when they had to start up a project. However, many of the students also claimed that more systematic knowledge accumulation – as characterized by both the management and the academic approach – would be desirable, but that they had no tools to reach such an end.

The second workshop was planned to run for a week. This time, groups of four or five students worked with the model, designing a building system...
for a facade. As an introduction to the whole scheme the students first had to define their own approach on the basis of the model. Each group was then given a specific approach that they had to follow strictly. The assignment consisted of two parts – a planning phase and an executing/building phase. The students found it difficult not to fall back on their traditional working methods, but after a while they began to find it easier when they dropped their individual need to influence the project and instead worked as a group. When executing their schemes, they fully carried out their roles and the various project results of the groups turned out very differently – very much in accordance with the different approaches.

In general, the students seemed enthusiastic about trying these new working methods and some of them said they were surprised how effectively they had worked with the project. The approaches had provided a neutral ground for their cooperation. As for the results, it was quite astonishing how much they differed and hence provided interesting material for academic discussion. The model appeared to work; however, as part of an architectural education exercise it was more important in helping students to understand the core elements of the profession, rather than providing students with operational tools.

Through publication in architectural magazines (Arkitekten 06/05, Nordic Journal of Architectural Research, etc.), by means of workshops and future courses arranged at the School of Architecture in Copenhagen and through presentations at relevant design conferences (CIB W096, Joining Forces, EAAE, etc.), we are trying to make the project more than a final report to be placed on the bookshelves of other researchers. It is our hope that the model can and will be used by architectural offices to study the actual ‘processes’ taking place when architects work on a specific project. We have learned that what people ‘talk’ about doing and what they actually ‘do’ when they work, are two different things. The thesis is that the correspondence between these two levels can vary considerably and it thus becomes interesting to analyse both sides – especially with a focus on the strategic consciousness described in the previous section.

The second project focuses on the ‘product’ that comes out of the building process. When dealing with design, it is a fact that you can never claim that a specific process will lead to specific previously defined qualities. It is therefore equally relevant to analyse the actual ‘works’ or results. The aim is to develop the terminology and concept formation on architectural quality in an industrialized context claiming that this will, to some extent, differ from its more traditional equivalent. We need new or supplementary concepts to be able to talk about and hence better understand the (industrialized) architecture we find today. The result from the two projects will be used to describe characteristics of the relationship between process and product. The division in two main concepts is thus meant as purely analytical; it helps to clarify certain aspects about a reality that will always be a complex web of ‘interaction’ between the two.

CONCLUSION

One could ask if industrialized architecture really needs its own terminology and specific strategic design management in order to direct the architectural value. There is no doubt that there is a difference between not being conscious and ‘choosing’ not to be so. Our argument is that given the new and industrialized context as described above there is definitely a need for this conscious choice. This is not only seen as a means to empower the architect as a professional person and the profession, but rather to emphasize what is more important – the ‘architectural quality’. The traditional design process is under pressure and in this context it is our opinion that new measures must be taken to ensure that design is not reduced merely to cost control, industrial just-in-time production or building codes. These are important issues, but they should be submitted and measured against a more general approach including all the other important aspects of a ‘holistic’ architectural design process.
We believe the proposed model, including the dichotomies, represents a way to form a language by which we can work more consciously with the complexity of architecture in an industrialized context. By using the model on our empirical data as well as in an educational context, we have been able to point out and discuss different strategies and how they are used in order to aim at specific goals. It is our hope that it will inspire further use and elaboration of the field of strategic design management.

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Modelling Trade Contractor Information Production

Colin Gray and Salam Al-Bizri

Abstract
Design management research usually deals with the processes within the professional design team and yet, in the UK, the volume of the total project information produced by the specialist trade contractors equals or exceeds that produced by the design team. There is a need to understand the scale of this production task and to plan and manage it accordingly. The model of the process on which the plan is to be based, while generic, must be sufficiently robust to cover the majority of instances. An approach using design elements, in sufficient depth to possibly develop tools for a predictive model of the process, is described. The starting point is that each construction element and its components have a generic sequence of design activities. Specific requirements tailor the element’s application to the building. Then there are the constraints produced due to the interaction with other elements. Therefore, the selection of a component within the element may impose a set of constraints that will affect the choice of other design elements. Thus, a design decision can be seen as an interrelated element–constraint–element (ECE) sub-net. To illustrate this approach, an example of the process within precast concrete cladding has been used.

Keywords – Design; information transfer; management

INTRODUCTION
Emmitt (1999) recognizes the complexity of the design process and the need to model it for planning and organization purposes. Coles and Barritt (2000) provide a conventional planning approach, but this has its limits and does not deal with the issue of detail design in sufficient depth given the scale of design outside of the design team. Austin et al (2001) recognize the need to model the interaction between numerous information sources and inputs to the design. They also recognize the supply chain inherent in component design and the need to model using a process map approach. However, they do not develop the models necessary to provide the detailed description of design needed to plan it in detail. Also, the majority of the studies of design information production concentrate on that produced by the consultant team in the early stages of the design process as defined by the RIBA plan of work. However, this framework was criticized by Gray and Hughes (2001) in that detail design, production information and shop drawings, for component-based construction, are a continuum more properly called ‘engineering design’. The bulk of the information that is produced for engineering design involves the integration of the specialist trades’ design into the whole. The scale of specialist contractors’ involvement in the whole of the project information production process is extensive. Freeman (1981) in a review of comparative studies of UK and US practice, noted that Eden and Green in a study of US hospitals had found that for a 300-bed hospital, the design team produced 204 drawings and the specialist more than 3000. In a study of seven UK projects, reported by Gray (1999), the percentage of the total drawings produced by the specialist trade...
contractors on a typical UK building project was 42%, with a range of 10–75%. The Senator House case study (Steel Construction Institute, 1993) reported that the design and fabrication drawings for a steel frame comprising 2930 pieces of steel, required 1200 structural consultant drawings and more than 2000 fabrication (shop) drawings. However, this scale of involvement is largely unrecognized and yet has to be managed in order to deliver the supply of components to the site (Gray and Hughes, 2001). The failure to design the project as an assembly of interacting pieces may prove to be detrimental to performance during installation (Tsao et al., 2000).

This paper explores the nature of the specialists’ information production process with a view to developing an understanding of the process of design within this area of design and information production in order that the scope and scale can be planned as an integral part of the whole design process.

DEVELOPING AND MODIFYING GENERIC MODELS OF DESIGN

The proposition is that each construction element or component has associated with it an established sequence of design processes that can be modelled. At the right level of detail, this would enable the production of a common or generic model. The model should hold the common elements for a particular technology. When using the component in a specific situation, the model should be able to be adapted. One issue, therefore, is to define an appropriate level of detail that permits the generic patterns of the processes to be found. This is not to be confused with the notion of the iterative nature of the design process. Each step in the process may well contain considerable iterations as the process is defined in a broad sense. Much iteration occurs because the designer is unaware of or has yet to receive input information to the process. If the necessary inputs can be defined then iterations may be reduced, so improving the execution of the process. With an established model of the design process for each technology and component set within it, the designer can understand the scope and scale of the process. This was the thrust of the work of Farell (1968) but, because of the nature of the planning and computing technology at that time, he had to work within a known framework which was to concentrate on the exchanges between technologies to enable the design of the interfaces. However, the underlying model is: inherent process, sequence of processes, constraints from information providers, interface/fixing design and, finally, timing resulting from the interaction between interrelated, technologically driven processes.

The design management task is to then ensure that the sequence is understood and that the designers in every process understand their role and task so that information flows between them. This is the main reason the current work focuses on information requirements and flows at component level.

The constraints that control the selection from, and the modification of, the fundamental sequence in a design process can be classified into two dimensions. First, the constraints that tailor this design element to the specific building. Second, the constraints produced as a result of the interaction between the elements of another technology. In other words, the choice of elements that satisfy a design problem and the interfaces between the technologies produce a network, and a complex design decision can be seen as an interrelated element–constraint–element (ECE) sub-net.

In practice, it is difficult to identify the network as it is complex i.e. the number of different patterns of relations between elements increases when the number of different elements increases. Thus, a proper approach to solve the complexity could be:

- select one design element or component at a time and predict the implicit constraints
- identify the constraints produced when linking to other design components
- develop the resulting model of the design process.

A decision has to be made as to the level of detail for modelling. It would probably be impossible to model every component because of their variety. As Farell (1968) found, it is best to let the designers determine the scale of work in each process, while managerially it is more important to determine the information flows and inputs (Gray and Hughes, 2001). The choice
here is the general level of component e.g. cladding panel.

**METHODOLOGY**

The issue of design management that this work addresses is the supply of detailed production or fabrication information to either the site or for the component manufacturing stage. In order to determine the scope and scale of information production for a trade, it is necessary to determine the range of components that are being used and the degree of customization. A generic model will specify the available range and the number of constraints (variations on a theme) will enable the variation to be determined. At the information production stage, and particularly the shop drawing stage, there will be at least one drawing for every unique combination of item and modification. The approach used to determine both the range and possible customization was to examine the information generation process of a specialist trade package with the objective of identifying the best practice set of activities. Best practice has been defined as the element’s sequence and information flows that would produce the most effective technical solution in the most efficient manner.

Precast concrete cladding and its connection to a structural frame was chosen to develop the approach. This was a suitably complex component that has a clearly articulated interface with a structure.

The process of understanding the information requirements was as follows:

- first, study the available literature to create an initial understanding of the technology of precast cladding from which an initial model of the design process was developed
- second, conduct an input/output analysis of the data and information transfer points between the precast cladding design and the structural design to understand the flow at the interface (typically caused by the fixing details) between the technologies
- third, evaluation by a panel of experts of the resulting model using an iterative Delphi approach to achieve the final model. The experts used worked examples of details to confirm the correctness of the map or to modify it until there was final agreement, and
- finally, model the process in a suitable form that would allow the output to reflect and adjust in response to the selection and choices that had been made.

These steps, when combined, enabled the creation of a generic model that could be modified for each of the panel-to-structure combinations.

**DEVELOPING ECE NETS AS GENERIC MODELS**

The model representation chosen was knowledge-based engineering (KBE) as it has the most flexibility in adjusting generic models to the specific situation. IDEF0 process maps could have been used (Karhu *et al.*, 1997), but are subject to manual rewriting for each application whereas KBE can adjust automatically. Experience of knowledge-based development has shown the context must first be described before the abstracted elements can be described in a suitable way for a knowledge-based approach (Gray and Little, 1985).

**DESIGN CONTEXT FOR KNOWLEDGE-BASED DEVELOPMENT**

Precast architectural cladding panels are usually non-loadbearing, but loadbearing panels are used when they provide the most economic structural solution. Designing non-loadbearing precast concrete cladding panels and their connection to the structural frame is a complex process, which involves designers from different design teams and organizations. The architect, structural engineer and cladding specialists are usually involved. The specialist has to determine every requirement for each panel and instance. So the following is repeated for every panel type where there is a change so that the manufacturing process can make the right panel.

The design of non-loadbearing precast concrete cladding is highly interdependent with the structural frame. The units and their fixings are designed to withstand panel self-weight, wind loads and the lifting and handling stresses during manufacture and erection. The process of designing non-loadbearing precast concrete panels and their relationship to the structure...
involves the architect, structural engineer and the trade contractor. The main factors, which the designer has to consider in determining the final panel size, shape and fixings, are discussed below.

**DIMENSIONS OF THE PANEL**
The precise dimensions of the panel are determined by the architectural and structural requirements, the practicality of manufacture, the transportation and weight of unit for lifting. From the input information of elevation and detail drawings, the cladding designer determines the panel’s width and length. The precise structure of the panels is a function of many considerations. However, the self-weight of the unit and the fixing methodology are the most important for the structural engineer. For each fixing location to the structure, the structural engineers should check the loads on the structure as it may affect the column dimensions and spacing. Also the structural engineer should consider the effect of the weight of the cladding panels on the edge detail of the structural slabs. This is the first iterative loop between the specialist and the design team.

**SHAPE OF THE PANEL**
Panels can be of either uniform thickness or thin panels with reinforcing ribs. The profile of the panel is defined by the panel’s web thickness, plus the thickness of the horizontal ribs and the vertical strengthening ribs (Figure 1).

Uniform thickness panels are preferred, but coffered edge (ribbed back) panels reduce the self-weight of the panels, as well as providing a substantial joining profile for the panel. Information about the edge of the structural slabs and the column dimensions is exchanged between the structural engineer and the cladding designer so that when sizing the horizontal ribs and vertical ribs the reinforcement can be avoided.

**TYPE OF PANEL**
There are two main types of panel – mullion and spandrel units. A mullion panel extends from floor to floor while a spandrel panel spans between columns or from window to window. The architectural drawings provide the cladding designer with information about the height of the panels, but the design of the structural slabs affects the decision on the height of the panels as their depth can affect the height of the spandrel panels and the floor-to-floor height; therefore, this will affect the height of the mullion.

**PANEL SUPPORTS AND FIXINGS**
Panels can be either supported at the base or hung from the top. Generally, bottom-supported panels are preferred as the panel will be in compression and the risk of cracking is minimized. The nibs on the panels transfer the loads to the structure. In the case of the uniform thickness panels, the fixing would be
designed to transfer the total load. Fixings can be either loadbearing or restraint. The fixing method to the structure can be either by angle cleats or dowels.

**Angle cleats**

Angle cleats are used to restrain the panel at the top, and may be used to fix the panel at the base. The size of the angle cleat is calculated according to the loads. Angle cleats should be designed to give dimensional adjustment in three planes – vertical adjustment, horizontal adjustment between the cleat and the panel to the face of the building, and linear adjustment parallel to the edge of the slab (Figure 2). Vertical adjustment is provided by slotted holes in the angle cleat and packing pieces allow horizontal adjustment. Cast-in channels provide adjustment parallel to the edge of the slab. Cast-in sockets, drilled-in sockets and expanding sleeves can also be used to provide the fixing at the edge of the slab.

**Dowels**

Dowels can be used to restrain the panel through the bottom support ribs into the slab. The dowel system is normally slotted so that it does not restrict thermal movement. Dowels are cheaper than cleats and easier to assemble however cleats are more flexible in accommodating dimensional inaccuracies in the structure. A hole is formed in the panel and a pocket is cast into the in-situ floor to receive the dowel.

Inaccuracies can occur during construction. To overcome these inaccuracies, tolerance must be allowed in the method of fixing to accommodate the variable clearance between the panels and the structure. The tolerance specification is another point of iteration – to obtain an agreement that satisfies all parties.

Specialist cladding contractors prefer bottom-supported panels as the panel will be in compression. The specialist’s first choice of fixing would be cleats, but the choice of base-supported panels gives the cheaper option of dowels. When the cladding panel is fixed to an in-situ concrete slab, there may be greater structural inaccuracy and cleats allow a greater accommodation of wider tolerances.

The cladding designer should provide the structural engineer with information about the fixings that will be used, as the choice of cleats, dowels or other type of fixing affects the design of the fixing points at the edge of the structural slabs. When the cladding designer chooses cleats, the structural engineer can choose between cast-in channels, cast-in sockets, drilled-in sockets or bolts with expanding sleeves depending on reinforcement density. Channels are the preferred method. If the cladding designer chooses dowels, the structural engineer has to consider how to provide the pockets at the edge of the slab, with the resulting demand on casting accuracy.

**ELEMENT–CONSTRAINT–ELEMENT SUB-NETS**

To achieve the flexibility necessary for future modelling, the different configurations of the element–constraint–element network are presented in the KBE format (Al-Bizri, 1995). This is preferred to an IDEF0 approach, as used in design process modelling (Karhu et al, 1997), because of the need to express choice and the need to adapt to changing situations. Using the precast concrete cladding design in relation to a concrete structure as an exemplar, it has been found that there are four generic types of relationship between the two elements (Figure 3). These can be expressed in the following logical statements:

**Case 1:** [e1] consequence [e2]

Example: Column dimensions have a direct consequence on the width of the vertical strengthening ribs of the coffered-edge precast...
concrete cladding. This relationship between the column and the ribs of the precast concrete cladding can be expressed by:

\[ e_1 \text{ consequence } e_2 \]

where:

- \( e_1 \) is the column and its dimensions in the frame technology
- \( e_2 \) is the width of the vertical ribs of the coffered-edge precast concrete cladding technology.

Case 2: \( e_1 \) constraint \( c \) consequence \( e_2 \)

Example: The depth of the structural slab affects the floor-to-floor height and the floor-to-floor height will be a constraint that will affect the height of the mullion of the precast concrete cladding. This relationship between the depth of structural slab and the height of the mullion of the precast concrete cladding can be expressed by:

\[ e_1 \text{ constraint } c \text{ consequence } e_2 \]

where:

- \( e_1 \) is the depth of the structure slab in the frame technology
- \( c \) is the floor-to-floor height in the frame technology
- \( e_2 \) is the height of the mullion of the precast concrete cladding technology.

In certain situations more than one solution is possible and although these are preferences, other choices may be made. However, any model must make provision for such a situation and the following two cases illustrate how the proposed model can advocate a preference by weighting one choice more than another.

Case 3: \( e_1 \) preference \( e_4 \)

Example: The choice of base-supported precast concrete cladding gives a preference to the choice of dowel as a fixing for the precast concrete cladding. This relationship can be expressed as:

\[ e_1 \text{ preference } e_4 \]

where:

- \( e_1 \) is the base-supported precast concrete cladding in the panel technology
- \( e_4 \) is the dowel fixing preference for the precast concrete cladding affecting hole location in the frame technology.

Case 4: \( e_1 \) constraint \( c_2 \) preference \( e_5 \)

Example: The choice of in-situ structure slab causes specific tolerance issues and gives greater preference to the choice of cleat as a fixing for the...
precast concrete cladding. This relationship can be expressed as:

\[ e_1 \text{ constraint } c_2 \text{ preference } e_5 \]

where:

- \[ e_1 \] is the in-situ structural slab
- \[ c_2 \] is the tolerance profile
- \[ e_5 \] the cleat fixing of the precast concrete cladding is the preferred option.

A complex ECE sub-net results when combining the four generic cases of ECE relationships.

ELEMENT DEFINITION USING AN ECE SUB-NET

The definition of an element could be seen as a component within a technology; first, where there is a choice e.g. the precast concrete cladding panel’s shape can be uniform or coffered edge and, second, the features e.g. the panel element has three dimensions, ribs, webs and fixings. Some of the features will be preferred such as cast-in channel fixings, but all may be interrelated.
The following are examples of the sub-nets of the decision-making process generated using the ECE net approach. The examples are for the two key decisions for precast concrete panel design in relation to a concrete structural frame – the fixing types and locations, and the size and shape of the panel. Once the basic decision of fixing type has been made, the panel designer requires the total information for each panel in order to complete the manufacturing (shop drawing) for each panel.
SUB-NET 1: FIXING DECISIONS (FIGURE 4)
Cleats are usually preferred, however, the choice of a base-supported panel gives greater preference to the choice of dowels. With base-supported panels, any type of fixing is possible, whereas dowels are not used with top-hung panels. The choice of in-situ structure slab causes specific tolerance issues and gives greater preference to the choice of cleat as a fixing for the precast concrete cladding. The choice of cleats permits the choice between channels, cast-in sockets, drilled-in sockets or expanding sleeves as a method of fixing at the edge of the structural slab. Cast-in channels are usually the preferred fixing method at the edge of the slab, however, by choosing dowels, the fixing method at the edge of the slab should be pockets, which is the less preferred option.

SUB-NET 2: PANEL DIMENSIONS (FIGURE 5)
Uniform thickness panels are usually preferred more than the coffered-edge panels. However, the self-weight of the panel may influence this choice towards a coffered-edge panel, as this would reduce the self-weight of the panel. A coffered-edge panel also provides a better joining profile. When a panel has a coffered edge, the loads the panel is exposed to affect the depth of the horizontal ribs and the vertical ribs. The design of the edge of the structural slab affects the depth of the horizontal ribs and vertical ribs, as they have to be large enough for the panel to be safely fixed to the structure. The column dimensions affect the breadth of the vertical strengthening ribs in the places where the panels attach to or pass the columns. The size of the panel i.e. web thickness, span and height, affect the self-weight of the panel. Consequently, the self-weight affects the design of the edge of the structural slab so that it can carry the load over the length of the edge, as well as the loads at the fixing positions. The loads affect the column size and spacing.

CONCLUSION
The elements of a generic model of the design process at the detailed level has been developed. An approach based on the identification of the deliverables of the design process enables a bottom-up model to be built for any technology. Constraints when certain technological choices are made, allow the model to adjust to the specific situation. Additionally, preferences for particular solutions can be provided to guide the user as to the best-practice solution.

If this approach were to be developed further into a knowledge base for all technologies, it would require the definition of the design elements of the domains and the constraints that link these design elements to each other. The knowledge base could be structured into the following modules:

- The element definition modules. Each module in this section defines the design elements of a specific technology, such as a concrete structure elements definition module.
- The specific domain nets modules. Each module defines the ECE sub-nets generated by the interrelationships of the specific domain elements.
- The global nets module, which defines the ECE sub-nets generated by the interrelationships of design elements across domains.
- The design context module, where the user can consult detailed information about the design considerations relevant to an ECE sub-net supported by graphics.

A knowledge base built in this way can offer proactive advice as to preferred design options when certain choices either have been made or are about to be made. Once the inputs, outputs and constraints are known, it is then a question of scaling the model up to cover all of the unique instances for each component set.

The potential of this approach is that it is grounded at the lowest level – the detail of the technology – to drive the model. In the end, buildings are built from sets of components which have to be produced to order which, in turn, demands perfect information. A KBE model allows considerable flexibility to self adjust, to proffer alternatives based on a combination of factors, so incorporating experience. What this model does not achieve is a plan. It is only able to produce the best-process content and a model of the interactions to achieve the sequence of design. It would have to be used as input to techniques such as ADePT (Austin et al., 2002) which can then be used to prioritize the sequence of information production.
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ARTICLE

Rules of Engagement: Testing the Attributes of Distant Outsourcing Marriages

Paolo Tombesi, Bharat Dave, Blair Gardiner and Peter Scriver

Abstract

In the space of a few years, the provision of architectural services that rely on the digital outsourcing of documentation responsibilities to other firms – often located offshore in areas of the world with lower labour costs – has come to the forefront of the restructuring debate of the architectural sector. Today, the discussion about digital outsourcing cannot be reduced to the simple exploitation of rent differentials between distinct socio-economic and professional worlds. It must also reflect and examine the objective extension of the transactional market of architectural practices, where firms can reorganize their production strategically across a vast territory to remain sustainable or competitive. Even though the distant collaborations that underlie this arrangement are drawing more public attention than in the past, it is still difficult for non-anecdotal evaluations to take place, since the parameters currently employed in the analysis of this phenomenon have not yet been sufficiently developed theoretically. As a result, it is arduous for industrial scholars, or for those firms that have not directly taken part in such ventures, to assess the perils and possibilities of this emerging mode of service delivery in a balanced way. Building on work carried out for a research programme sponsored by the Australian Research Council, this article establishes a set of criteria and protocols to gauge, more systematically, the potential and viability of distant alliances. By adopting such criteria, it becomes clear that the evaluation of digital collaborations cannot be done in the abstract or solely through the use of office spreadsheets. It requires a thorough consideration of the socio-technical characteristics of the firms involved, and an in-depth analysis of their cultural routines.

Keywords – Architectural practice; design management; IT; outsourcing

INTRODUCTION: OUT OF THE CLOSET

You can teach a man to draw a straight line ... and to copy any number of given lines or forms with admirable speed and perfect precision ... but if you ask him to think about any of those forms ... he stops; his execution becomes hesitating ...; he makes a mistake in the first touch he gives to his work as a thinking being. But you have made a man of him for all that. He was only a machine before, an animated tool...

And observe, you are put to stern choice in this matter. You must either make a tool of the creature, or a man of him. You cannot make both. Men were not intended to work with the accuracy of tools, to be precise and perfect in all their actions. If you will have that precision out of them, and make their fingers measure degrees like cog-wheels, and their arms strike curves like compasses, you must unhumanize them... (Ruskin, 1853).

A spider conducts operations that resemble those of a weaver and a bee puts to shame many an architect in the construction of her cells. But what distinguishes the worst architect from the best of
bees is this, that the architect raises his structure in imagination before he erects it in reality. At the end of every labour process we get a result that existed in the imagination of the labourer at its commencement. He not only effects a change of form in the material on which he works, but he also realizes a purpose... (Marx, 1887).

In the space of 20 years, information and communication technologies have virtually uprooted traditional modes of professional exchange and interaction by disconnecting the production and distribution of information from the physical world. With paper no longer an essential support to the transfer of design decisions, the Prometheus of architectural practice has been unchained from the tyranny of place and physical ('hard-copy') document delivery. Today, drawings are assembled and moved around for the most part electronically (Baker, 1999; Dalal, 2000; PMA, 2001; ZweigWhite, 2001).1

Until recently, though, this Prometheus seemed reluctant to show off its newfound agility. While there appeared to be no problem in celebrating the power of digital technology to compress time and space, virtually connecting distant locations and clustering distant people together, there was palpable resistance in laying down explicitly the multiple office unit configurations resulting out of this opportunity, or addressing openly the social implications or possible repercussions of the passage from physical (and therefore local) workplaces to digital (and therefore potentially global) workspace (Tombesi, 2001a).

As Solomon and Linn (2005) suggest, such reluctance can be caused by the stigma associated with such arrangements, and the fact that they encroach upon employment, money and profit – traditionally sensitive territories of professional practice. In addition, the ‘north–south’ connotation inevitably characterizing many of these collaborations can still conjure up images of socio-technical colonialism, where economic powers tap into a global pool of lower-cost resources that are either underutilized or in excess (Tombesi, 2001b; Tombesi et al, 2003; Wilkins and Tombesi, 2005).

Today, the design industry may have reached a point where cultural cargos are ready to give way to balanced and critical discussion. Digital practice has certainly attained new levels of exposure. The evidence of professional or business relationships involving the alliance of firms from higher-wage and lower-wage regions is mounting rapidly (Housley Carr and Krizan, 1988; Korman, 1995; Baker, 1999; Klein, 2003; Lyall, 2004; Rubin et al, 2004). A search of OffshoreXperts – a website of distant outsourcing – will produce armies of potential drawing services subcontractors, divided by world region or type of specialty. They may not all qualify for advanced consulting, but their cyber-spatial presence illustrates a degree of organizational infrastructuring unthinkable only a few years ago.

More significant, however, is the fact that distant services have come out of the proverbial professional closet to situate themselves at the forefront of the architectural sector restructuring debate. Both professional and management journals now give digital outsourcing a modicum of coverage, and the many professional firms that have used such services are more prepared to talk about it, at least compared with the past.2 This may be partly connected to the evolution of building design markets in advanced economies such as Australia’s, where the specialization of firms in construction documentation or project administration – i.e. services valued by sophisticated clients particularly on complex projects – is now considered a sound professional strategy to hedge knowledge-acquisition or specialist training costs and reduce offices’ financial exposure. Be that as it may, the chief executive officers of some of the most successful offshore design service subcontractors have entered the professional scene from the front door of American Institute of Architects (AIA), Royal Institute of British Architects (RIBA) and Commonwealth Association of Architects’ (CAA) meetings, with addresses or workshop presentations aimed at debunking myths of makeshift competitiveness through the display of professional wares and office workforce preparation.

As a matter of fact, many of these structures have come to resemble (or literally to replace) commercial design or executive architectural offices in the US or the UK. They use the same language, publicly subscribe to an ideology of scrupulous productivity and value for money, and in some cases have graduates of prestigious universities or former associates of renowned firms at their helm.
Meanwhile, the advantage of their location becomes the object of institutional support, with government agencies and professional bodies from developing economies addressing, specifically, the possibility of cross-border activities, the lowering of barriers to digital trade in architecture, and the facilitation of commercial establishments through tax cuts (see, for example, Young-Pugh (2005)). In some cases, this results in the concentration of IT infrastructure around specific, and essentially urban, locales. This is a strategy that gives such territorial enclaves a technologically competitive edge, favourable to the export processing of IT-related activities as well as the attraction of foreign investment (Tombesi et al., 2003).

FROM COMPETITIVE TO COMPARATIVE ADVANTAGE

Acknowledging the evolving position of digital outsourcing in architectural practice does not just provide a chance for historical or sociological reflection. The recognition that distant service collaborations are gaining acceptance as a legitimate professional tactic also serves to understand that the environment within which these take place is likely to change, and that the average expected quality of the services performed is likely to increase.

In a widening market characterized by firms’ long-term strategic decisions and higher levels of public information, where there is ample opportunity to preview skills and undergo preliminary pilot collaboration tests, the appropriate use of drafting routines, detail libraries and quality assurance guidelines is the necessary condition to operate at a minimum competitive level. However, once competition compels labour cost-cutting measures to be adopted, as a rule, by all players in the field, the problem with distant collaborations is unlikely to be simply that of finding a documentation contractor who can draft correctly and more cheaply than in-house resources. Rather, it will concern the ability of competing players (firms) to join forces with truly complementary establishments that can enhance their service delivery ability.

In widely published professional texts such as Styles and Bichard’s Working Drawings Handbook (2004), or in the material produced and disseminated through industry-wide working groups such as the UK-based Construction Project Information Committee, construction documentation conventions and logics tend to be presented as generally applicable norms and standards of good practice presumably derived through a neutral, context-free translation of generic principles. However, as Coxe et al. (1987) have shown, individual architectural firms tend to develop distinctive subcultural practices of their own. These practices conform to and employ specific systems of design procurement, decision-making, element costing and technical linkages that have major consequences over the formatting/layout of contractual information and associated graphics. This generates markedly specific collaborative needs, which can easily become the basis for ad-hoc alliances and the arrangement of selective services in a fee-shrinking environment. Several drafting outsourcing firms have understood the potential of these collaborations to help them differentiate their work from that of their competitors, and are now eager to prove their ability to participate more fully in the design or project development process.

Recent developments notwithstanding, neither industrial nor academic research have yet produced a reflective theoretical framework, or investigated the underlying attributes of successful alliances between collaborating entities. Most of the (few) examples available in the existing literature to illustrate the ‘dos and don’ts’ of outsourcing practice are too crude and elementary to form a serious benchmark for a professional sector, and practical workshops tend to focus on business issues or management tips rather than technical details. From this point of view, digital outsourcing is still being dealt with superficially, as a generic form of service offloading that requires only limited disciplinary scrutiny. Yet, without proper categories of analysis it is difficult to advance the discussion beyond the anecdotal. In the absence of evaluative criteria that are comparable across the board, the experiences of different firms remain isolated in their own particularity. What is needed, by contrast, is an inclusive conceptual scaffold that allows the successful parameters of digitally supported distant collaborations to be characterized, and their likely impact on forms of architectural practice in the contemporary climate to be weighed.
up vis-à-vis particular kinds of project requirements and development paths.

**SETTING UP THE SCAFFOLD**

The definition of such a scaffold was one of the objectives of an Australian Research Council-sponsored research project, concerned with the evaluation of the industrial potential of distant collaborations between architectural providers, and the assessment of the likelihood that such practice will develop into a fully-fledged mode of service delivery.4

In order to achieve these two objectives, the research programme was set up as an industrial laboratory that reproduced and helped solve the difficulties that firms face in establishing a collaborative link and evaluating its viability. Within this laboratory, a series of controlled documentation projects involving collaborations between different distant design service providers and a selected group of architectural firms based in Melbourne (the hometown of the research team) were to be carried out digitally, with specific indicators to measure the levels of cultural understanding as well as technical proficiency required, and the results obtained.

In concrete terms, the plan of this ongoing research is to connect a group of seven Melbourne-based architectural offices that reflect different professional markets, building types and office sizes, with four other specific, similarly sized groups of theoretically competitive drawing service providers. Based on previous research, a decision was made to compare the performance of four types of firms that cover the sociological spectrum of service subcontractors in architecture:

- Australian firms that specialize in contract documentation, thus reflecting market niching decisions rather than socio-economic differences
- Indian professional firms, which epitomize entities active in a professional reality with similar historical roots but different socio-economic and environmental conditions
- Web-based firms, specifically set up to work remotely, without any programmatic connection to their physical place of operation – which are the direct result of technological opportunities, and
- South-East Asian firms employing staff with direct experience in Australian education and professional practice, and possibly run by former Melbourne University students.

The involvement of each group with digital subcontracting is informed by different rationales and embodies distinct professional cultures – task-based, non-Australian place-based, technology-based, and place-informed. The particulars of the work and the progression of tasks can be found in Tombesi et al (2005).

The theory behind the methodology selected (and outlined in Figures 1 and 2) was that, by organizing a system of technical tests and design tasks that did justice to the complexity of the design process and the variety of skills required to carry it out properly, qualitative differences in the performance of distant actors could be examined, and the relationship between these differences and certain environmental
characteristics be determined. Once the conditions that should be satisfied for Australian architectural establishments to outsource their work had been articulated explicitly, the tests developed could help determine whether or not the different types of firms currently involved in the market of digital collaborations have the technical capacity to meet the requirements identified.

Within the context outlined, the most important element became the design of a documentation template that could be employed for the various pilot tests. The template was envisioned as a strategic compilation of single project-specific information previously produced by each one of the architectural firms contracting out the service, which would be used in two ways:

- to reflect upon and articulate, in-house, the characteristics of the work needed or expected from future partners, and
- to evaluate submissions from potential external collaborators.

In other words, the template was a device conceived both to help define the scope of work of a collaborative test, and to form the benchmark upon which the technical and economic performance of the firms subcontracted for the pilot would be measured (Figure 2).

These two functions were part of the same collaborative loop. At one end of the loop, each architectural firm would select technical drawings from a previously developed project documentation set that reflected the characteristics of the work carried out inside the firm, the constraints and the production environment (A.0 in Figure 2). Such drawings would form the basis for a cartoon set specifying the scope of the submission e.g. the documentation required from the subcontractor (A.1). This cartoon set would be supplemented by two items:

- (A.2) a copy of the material used by the original architectural firm to produce the content of the template (e.g. brief requirements, sketches and drawings, office detail libraries, particular system specifications, office CAD layering conventions, photographs of buildings or building solutions references), and
- (A.3) a copy of a complete set of drawings from another project, which implicitly described the
firm’s approach to project documentation and selection of details, as well as the parts of the work that are technologically or architecturally important to the same firm.

Together with a schedule of the drawings eventually required – effectively the same schedule of drawings produced by the firm for the original project (A.4) – this information would constitute the package sent to potential drafting subcontractors to understand the scope of the work, determine the price of the service outsourced, and establish the production timeframe. This would result in a preliminary indication of the cost differences between in-house and outsourced work, and a quantification of the savings theoretically achievable by subcontracting work to categories of collaborating firms differently organized or differently located.

At the other end of the loop, the template would be used by the architectural firm to compare the documentation submitted by the drafting service provider with the documentation originally produced in-house. The performance of the subcontractor would be determined on the basis of categories explicitly established and employed at the outset, and translated into qualitative levels related to how closely the work received approximates to the standards set by the firm itself. Levels would vary from ‘unacceptable’ (0) to ‘superior’ (5), and would be organized either in bar chart or diamond diagram formats to allow immediate visual comparisons between firm types (Figure 4).

DEFINING LAYERS OF IDENTITY
This agenda defined the template as a technically complex documentation micro-project, which had to reflect multiple representational dimensions. It had to be agile enough to be used by the parties preliminarily, before entering a formal contractual relationship, and yet thorough enough to include well-structured drafting tasks. In turn, these had to be engineered so as to entail (and allow one to observe) various kinds of technical knowledge and professional skills, including use of explicit and implicit conventions in building design and construction.

Eventually, a decision was made to limit the template to less than six documentation sheets and up to approximately 40 hours in production time requirements. Such dimensions were considered appropriate to guarantee both an inclusive drafting scope and a pilot that could be developed quickly and at a relatively small cost for the architectural firm.

As implied in Figure 2 and described in Figure 3, the set of documents required within this framework

![Figure 3: Conceptual and graphic structure of the template](attachment:Figure_3.png)
had to contain descriptions of the project at different scales, reflect location-, assembly- and component-drawing challenges, and imbue specific documentation strategies. The drawings also had to encode the firm’s way of communicating its own trademark language decisions (i.e. prescriptive technology), responding to code requirements (i.e. normative technology) and acknowledging local practice conventions (i.e. conventional technology). Technical graphics, in other words, were expected to include a range of representations from ‘generic’ to ‘specific’. More broadly, the structure of the template was designed to induce future partners to display three layers of skills encompassing increasingly more complex and yet tacit arenas of practice – vocational, professional and socio-cultural.

Vocational skills related to the subcontractor’s ability to act simply as a drafting agent, by translating the pre-construction document information received into a proper construction drawing notational format. Professional skills implied the subcontractor’s ability to respond to less literal demands from the documentation provided. These include understanding and supporting the design intent of the documents, integrating scales of representation, tracking down possible inconsistencies, and adding or correcting incomplete information. Socio-cultural skills referred to the subcontractor’s ability to interpret the constraints generated by the institutional environment of which the contracting firm is a part. These comprise building and planning codes that must be considered in the preparation of the drafting pilot but are not part of the documentation package received; technical traditions that affect the selection of details, the organization of project procurement and the structure of documents; and cultural preferences that inform the specific development of particular solutions.

While it is comparatively easy to establish abstract requirements, it is more difficult to embed them neatly in actual documents. For this reason, ad-hoc arrangements had to be adopted in order to associate evaluative categories to the graphics needed by the contracting firm and produced by the subcontractor. Accordingly, it was decided that vocational skills were those displayed in the proper rendering of the various individual representations required by the test – floor plans and sections as well as horizontal and vertical details. The analysis of professional skills, instead, hinged on the relationship (established or understood) between the various representations contained in the template. Socio-cultural skills were to be found in the integrated incorporation – in the technical development of the drawings – of the prescriptions generated by the architectural language of the contracting firm, by normative requirements and by local customs.5

By considering these three categories simultaneously, one could determine how closely the documentation pilot approximated the ‘culture’ of the architectural firm administering the test (Figure 4).

**REVEALING TECHNICAL DIFFERENCES**

The conceptual definition of the template has been important in the development of the research project as it helped to highlight a critical element in the preparation of the background material for the collaborations. It was observed that as one combines technical documentation categories, precise evaluative parameters and individual firms’ ambitions, the selection of drawings for the template takes on a very specific and idiosyncratic character that informs the structure of the template itself. Considering construction documentation comparatively – in the light of different firms’ methods, office routines and design objectives – turns neutral representations into culturally charged information strategies.

The preparation of the templates in collaboration with the Melbourne-based offices selected for the project supports this assertion. In spite of the fact that each template was supposed to generate answers to the same questions and be equivalent in scope, the architectural agenda of each firm, their employment structure and the methods consequently adopted to illustrate their design decisions and technological choices, varied so widely as to require different sets of technical descriptions and different weights for the parameters adopted. An example can be given by using three of the firms contributing to the research.

**FIRM A**

The trademark of firm A, a high modernist design unit, is the employment of quasi-industrial materials and construction systems (e.g. concrete and commercial
aluminium window sections) in the high-end domestic market. This requires a thorough resolution of project detailing, possibly early in the documentation programme, so as to control the architectural design intent tightly and not to allow the domestic-scale contractor to tackle the work as a generic assemblage of given industrial components. Firm A normally produces a higher-than-average amount of highly resolved construction documents. Many of the technical drawings are relational in nature, and place emphasis not only on the independent description of the various building systems but also on their reciprocal position and interaction.

In the single-family project selected for the template (Figure 5), the choice of concrete as the structural and aesthetic generator of the architecture had determined an inflexible system where the integration of services, finishes and built-in joinery required early and close coordination with subconsultants to minimize the possibility for positional errors. Within this context, the documentation approach adopted by firm A subdivided location drawings into layers, effectively trade-sequencing structure, services and finishes. Consideration of the resolution and communication of detail issues was also necessary in order to facilitate the early production of fabrication shop-drawings, rendered necessary by the close spatial integration of independent systems or trades, and the fine tolerances of finish required by a building design consisting of deceptively simple lines. In addition, materials selection e.g. concrete and glass needed careful detailing because of the required thermal performance of the building within the context of residential regulations. Hence, much thought had to be given not only to insulating the concrete and glazing systems but also to the incorporation of concealed shading devices to reduce the thermal load.

From a collaborative standpoint, firm A was thus interested in testing its potential partners’ ability to take the firm’s preliminary architectural sketches, well developed technical detail specifications and
structural engineering decisions, and transform these, based on an analysis of the firm’s previous documented work, into proficient construction drawings comparable to those produced in-house. This, in fact, is the area where firm A invests most of its skilled-labour resources during the design documentation process.

For this reason, the template/cartoon set defined for the pilot (Figure 6) included three different technical layers of the same floor plan (a, b, c), two simple location sections featuring internal and external areas (d) and elaborate sets of vertical (e) and horizontal (f) component details. The challenge, here, was to understand and represent subtle variations in the configuration of each system vis-à-vis its position in space and within the building, while supporting both the semantic and the performance value of the solution designed by firm A.

FIRM B

Firm B, by contrast, is a high-profile, small-size office well known for its attempts to design buildings with highly figurative and textural effects through the use of mostly standard construction systems in a relatively conventional way. When the use of a selected palette of materials lies outside the bounds of ‘common practice’, specific solutions tend to be developed through the nomination of specialist contractors, a choice that results in the preparation of in-house documents that are considered essentially as scope drawings. However, with the firm’s strong emphasis on particular formal aspects of the design, much of the preliminary detailing work must still liaise with and incorporate input from manufacturers. This ensures that it will eventually be possible for this latter group to use their systems according to non-standard configurations while still achieving satisfactory performance (for instance with waterproofing).

The multi-family housing project upon which the collaboration template of firm B was organized was one such case in which an uncommon palette of materials was specified. The row of apartments defined a regular longitudinal volume with complex transversal cross-sections and an elaborate envelope system consisting of creased concrete facade panelling and curved stainless steel cladding. Within the volume, client-specific unit configurations generated a series of individual programme solutions, each with its own micro-design and documentation challenges. In fact, significant gymnastics were required to accommodate unit services, adapt their...
functional layout to the architectural ambitions of the project, and meet building code requirements for fire and acoustic performance as well as access issues. The successful response to these matters required close documentation collaboration with the structural engineer and quantity surveyor.

This type and method of work affects firm B’s document production patterns. The office seldom generates sets of documents that progress consistently through the various phases of the project. Because of the propositional nature of their design solutions, it is not unusual for the latter to change substantially in the passage from schematic design to design development, and from contract documentation to construction documentation. Yet, the effort involved in documenting each stage of the project is substantial given the close integration of formal and technical aspects.
FIGURE 7 Firm B’s original project as built

FIGURE 8 Collaboration template for firm B
throughout the entire design process. As a result, firm B was interested in finding out whether it could outsource the production of technical representations that were not only imbued with the initial intentions of the designers but also capable of articulating these further, while ensuring code compliance.

In this case, the template differed significantly from firm A’s on two grounds:

- preliminary drawings could not be used effectively because they tended to describe superseded solutions
- it was more important for the subcontracting firm to show an understanding of the design philosophy of firm B and the normative context in which it operates, rather than demonstrate ability in developing the full technical details of the systems represented.

These two circumstances were acknowledged in the template/cartoon set by reducing the number of drawing items required from the drafting service supplier but increasing the amount and range of the preliminary documentation provided in support. These included structural and mechanical engineering diagram representations, sketches of architectural and technical details, trade specialists’ shop drawings, individual client briefs, and quantity surveyor comments. Set-out drawings for floor plans and sections were also provided by stripping off the final contract documents issued by firm B on the original project. In the end, the template consisted of four items:

- two overall floor plans showing typological principles, structural bays and service areas
- two cross-sections, chosen to highlight specific architectural and code challenges
- the detailed description of such challenges (e.g. slanted wall window details, public passage headways and wall composition, and circulation requirements)
- an enlargement of the service area portions of the first floor plan, with the development of selected details.

FIRM C

Firm C, a market-leading specialist in healthcare design, offered a radically different collaboration scenario. Most of firm C’s work involves extension and adaptive reuse of major hospital facilities. Within an environment that sets rigid guidelines for building organization, typological structure and interface with existing volumes, the challenges encountered by the office are concerned not so much with architectural expression but rather with programme development and coordination, floor layout and ‘old-new’ building connections. Firm C needs to devise efficient functional responses to mostly given floorplates where several systems must be integrated, and also make sure that these responses incorporate and interpret the latest changes in planning and occupational health and safety regulations, building standards and fit-out systems.

In this case, the advantage in establishing collaborations hinges upon the office’s ability to find partners who can fulfil early planning responsibilities within the boundaries of the programme received, while documenting (and possibly finalizing the design of) robust construction systems that reflect the constraints imposed on the building by its existing structures. It is imperative that the design of these systems considers all possible aspects concerned with their manufacture and assembly in order to not create interferences during the procurement process.

Firm C can rely on a solid library of spatial and technical layout solutions, integrated by thorough design routines in the office manual, and a wide range of previously developed details. Yet, while the planning component can be developed on the basis of programme, norms and precedents, construction design must always refer to the specific conditions of the particular project. The one selected for the pilot test – a hospital renovation in Melbourne that includes the addition of a front wing (Figure 9) – highlights these aspects clearly by calling for two types of design response:

- the organization of levels and horizontal plates according to specific hospital functions, and
- the resolution of building connections to the street and to the old hospital.
Accordingly, the template defined for the test (Figure 10) consisted of:

- the overall floor plan of a ward with particular circulation characteristics and prescriptive adjacencies
- a detailed plan of an in-patient unit with all the right clearances
- a main elevation featuring fenestration strategies for the ward
- two side elevations showing their connection to the main new front and to the volume of the existing hospital at the rear
- a collection of horizontal corner assembly details featuring construction system differences between the various sides of the building, and
- conceptual vertical assembly details of the original brick and new curtain walls.

The three examples clarify both the importance and the relativity of the evaluation categories defined in Figure 4. As both expected and natural, the notational correctness of each item drawn under outsourcing arrangements (i.e. the ‘vocational’ skills of the chart) is a common requirement for all firms. For any language to be understood, its words must be spelled properly. The relevance of ‘professional’ parameters, however, changes according to the firm, except for the support of design intent.

Technical sophistication, cross-referencing and scale integration are very important to firm A. The ability to detect and correct inconsistencies is also critical to its collaborative horizons (although difficult to acquire straight away), because discrepancies may occur, with major negative repercussions, across different systems and layers of information.

The same discrepancies are more likely to appear in firm B’s work – easier but not as important to detect – because the scope-defining nature of the graphics implicitly acknowledges an additional layer of documentation for construction. In this case, the drawings set an agenda at each scale that will be actualized later on.

With firm C, this luxury disappears, since the nature of its work requires careful preliminary planning of overall and detailed solutions as these impinge directly on project scope viability, budget and construction procurement paths.

Also, locational vertical sections are particularly relevant to the documentation of firm B, whereas floor plans and assembly drawings remain central to the practice of firms A and C. Implicit normative requirements play an important role in each firm’s document production, although in different ways:

- with firm A, they inform the combination of technical systems and building components
with firm B they enter the spatial detailing of the sections
whereas with firm C they concern the feasibility of the entire proposal.

In spite of all the differences highlighted, the success of hypothetical drawing alliances would seem to reside in collaborators’ ability to understand and contribute to the ‘documentation’ design intent of each firm – a concept not further definable in theory but only discernible on the basis of its practice.

CONCLUSION: ESTABLISHING SPECIFIC COLLABORATION PROFILES

At the time of writing this article, the various templates are about to be sent out to the four groups of distant providers indicated earlier, to assess their
performance and see whether this changes according to different degrees of parity and familiarity with the specific professional cultures of the commissioning firms. The results of these experiments will be communicated in due course. Thus far, however, the experience of this research project has already provided us with one important lesson: the underpinnings of collaborative changes drastically according to the specific (albeit usually underplayed) documentation needs of firms. Consequently, given the broad professional variance in the market of potential subcontracting entities, the latter must be selected on the basis of a precise understanding of their technical role. This role can only be assessed by reflecting carefully on the contracting party’s work.

The dialogical nature of this relationship has certainly been described before. The passages from Marx and Ruskin quoted at the beginning of this article resonate powerfully with such insight. But in the interim between their critical observations of production in the first machine age and the technological hyperbole of our third (digital) machine age, it has too often been imagined that the cognitive and cultural complexities of human work have ultimately been reduced. Treating distant service providers as generic (and therefore allegedly efficient) automata may not pay off in the end because it is the work contracted out in the first place that cannot be generically developed. Successful distant alliances require the design and assessment of both partners’ contributions, based on the specific instance of the collaboration rather than respective industrial profiles.

‘Lest to be put to shame by bees,’ as Marx wrote, the purpose of the work must be clear. It is not only the structure of the building but also the structure of the professional collaboration that must be raised in imagination before being erected in reality.

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NOTES
1 The protocols and technology for transferring electronic files were developed in 1973, and adopted by the pioneering architectural offices to exchange information between their distributed offices (Kemper, 1985). With the expanding coverage and connectivity of global networks, especially after the popular reception of the World Wide Web in 1992, electronic exchange of information increasingly became the default (and preferred) option for professional communication. These very technologies also made possible the development of ‘virtual studios’ linking teams across different geographic locations and time zones. The technological vision and social implications of these developments were presaged (even before the technologies were developed) in As We May Think by Bush (1945).
2 A survey conducted for the Boston Society of Architects in 2004 revealed that 20% of architects surveyed used offshore services and half the respondents were considering use of these services (Hillman, 2005).
5 The distinction between vocational and professional skills resembles the categories introduced in 1991 by Robert Reich, then Harvard academic and future secretary of Labor under the first Clinton administration. In The Work of Nations, Reich divides mobile workers into ‘routine producers’ and ‘symbolic analysts’. Routine producers are those who process data by following instructions. They perform repetitive tasks and respond to explicit procedures, no matter how articulate these are. Symbolic analysts, by contrast, intervene on reality by reducing it to abstract images, manipulating these images, communicating them to other specialists, and coordinating their work. They are involved with independent problem-solving, problem-identifying and strategic-brokering activities, and make decisions based on critical judgement sharpened by experience. When applied to architectural practice, symbolic analysis suggests an obvious affinity with design responsibilities and professional skills, while routine production connotes documentation and vocational tasks.
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ARTICLE

Building Stories Revisited: Unlocking the Knowledge Capital of Architectural Practice

Ann Heylighen, W. Mike Martin and Humberto Cavallin

Abstract
Since architects deal with unique projects, their knowledge is largely experience-based, tacit and embedded within the design and construction process. Nevertheless, few consistent and systematic mechanisms exist that try to establish and maintain access to the profession’s knowledge. Effectively capitalizing on this knowledge thus seems as pressing a problem as producing more knowledge. Building Stories, an experimental course at University of California – Berkeley, started with a carte blanche opportunity and generous support from leading architecture firms in the San Francisco Bay Area, to try to unlock the knowledge capital of architectural practice through storytelling. This paper is about creating a discussion forum for dialogue about the nature of knowledge in architecture, how it can be captured and disseminated. More importantly, the paper illustrates how designers and other participants in the design and making of architecture can share their experiences through the method of storytelling. The paper looks back on the outcomes of Building Stories over the past five years, and on how it has evolved into an inventive methodology for catalyzing knowledge sharing between projects, between individual architects and architecture firms and, finally, between practice and academia. After briefly recalling the underlying ideas of Building Stories and their implementation as an operational methodology, the paper reports on its recent in-depth evaluation involving former participants from various contexts – young and seasoned professionals in practice, students and researchers in academia. Besides valuable feedback on Building Stories as such, this assessment provides more general insights regarding current ideas and practices of knowledge production and sharing in architecture.

Keywords – Architectural practice; collaborative culture; knowledge exchange

INTRODUCTION
More and more people acknowledge that the activity of designing involves some kind of knowledge production. This directly follows from the type of knowledge that designing relies on (Heylighen and Neuckermans, 2000), which is largely tacit (Polanyi, 1967) and embedded within the design process (Schön, 1983).

At the same time, the relatively recent trend towards academic research in architecture is producing a growing body of knowledge, which hardly filters down to practising architects (Neuckermans, 2004). A survey among practitioners and academics in architecture revealed an evident lack of networking between both communities (Watson and Grondzik, 1997). Doctoral dissertations, for instance, have become everyday food in most architecture schools, but their implications for professional practice, and ultimately for architecture as a built environment, have yet to be demonstrated.

Together, these observations suggest that the challenge architecture is facing today should be seen less as a need to generate more knowledge, than of
Making effective and equitable use of what is already available. In view of this, our research aims to develop a more profound understanding of the characteristics and roles of knowledge in architectural design, and to use this understanding as a basis for developing ideas about more efficient knowledge exchange between architectural practice and academia (Heylighen et al., 2005a).

**CAPITALIZING ON ARCHITECTURAL KNOWLEDGE**

Trying to improve knowledge exchange in architecture raises the question: what is knowledge in the first place? In the literature, knowledge appears as a concept with many facets and layered meanings. Rather than by formulating precise definitions, knowledge tends to be addressed by making all sorts of distinctions between different knowledge types, such as between declarative and procedural knowledge (Ryle, 1949) or between explicit and tacit knowledge (Polanyi, 1967).

Tacit knowledge represents knowledge based on the experience of individuals. It expresses itself in human actions in the form of evaluations, attitudes, points of view, commitments, motivation, etc. Usually, tacit knowledge is difficult to express directly in words and often the only ways of presenting it are through metaphors, drawings or other methods of expression not requiring a formal use of language. On the practical level, many experts are often unable to articulate all they know and are able to do, and how they make their decisions and come to conclusions. Polanyi (1967: 26) captures the essence of tacit knowledge in the phrase ‘We know more than we can tell’ and further clarifies the concept in commonplace examples like the ability to recognize faces, ride a bicycle or swim without even the slightest idea of how these things are done. Rosenberg’s (1982: 143) description of traditional technological knowledge, accumulated in crude empirical ways without reliance upon science, provides a good definition of tacit knowledge in technology companies: ‘The knowledge of techniques, methods and designs that work in certain ways and with certain consequences, even when one cannot explain exactly why.’

More generally, a distinction can be made between, on the one hand, traditional epistemology, which emphasizes the absolute, static and inhuman character of knowledge and, on the other hand, the more recent theory of knowledge creation, which considers knowledge as a dynamic human process in which personal convictions are justified in a search for the truth (Nonaka, 1994). In the latter view, knowledge differs from information in that it only exists in the heads of people, whereas information exists outside the human mind and can be embedded in any attribute involved in communication (e.g. text, speech or images) (Coenen, 2005). Sending information between people may cause a change in the receiver’s knowledge i.e. it may lead to knowledge transfer. Yet, this transfer never produces an exact replica of the sender’s knowledge in the receiver’s mind, since the latter’s memory is different when receiving the information and knowledge is precisely created by assimilating the information received in memory. Indeed, we understand when we try to integrate new things we encounter with what we already know (Schank, 1982).

In a professional context, a similar distinction is made between, on the one hand, the ‘knowledge base’ i.e. the formal and codified domain expertise claimed by a profession (Habraken, 1997) and, on the other hand, the practitioner’s ‘knowing-in-practice’, which – as Schön (1987) has taught us – is largely implicit and learned by doing. Medical doctors, for example, obviously must know about the human body, but if they are to diagnose an illness and cure the patient, this knowledge as such will not do. Similarly, lawyers must know more than the law if they want to apply it successfully in real cases.

Having more or less an idea of what types of knowledge exist, the second question to be addressed is: what, if anything, is specific about architectural knowledge? In other words, why do we think that architectural knowledge is special and thus needs special treatment? According to Lawson (2004), a first clue that may help us answer this question is that design education looks different to much else of what goes on in universities around the world. If you go into schools of design, you will see time and again a very similar pattern grounded in the traditional master–apprentice model: students working in the design studio on limited, yet realistic...
design projects tutored by more experienced designers. The studio setting offers students a transitory space (Winnicot, 1971) on their way to architectural practice, where they learn through the practice of designing without being aware of what is learnt (Schön, 1983, 1985).

In the case of architecture, the commonness of the studio format should not come as a surprise. As Habraken (1997: 267) points out: '[o]f all the professional fields, architecture is where the virtue of a knowing-by-doing is most readily accepted by its practitioners'. In fact, this exceptional cultivation of knowing-in-practice may point to a second clue: architecture’s failure to claim a common knowledge base. In Habraken’s view, the problem is not necessarily that architecture does not codify its knowledge base formally, as other professions such as law or medicine do: ‘Granted implicitness, however, there should be some evidence that knowledge is shared among architects at all, because it is only by sharing that a professional knowledge base can be claimed’ (Habraken, 1997: 268). And this is where the shoe seems to pinch: the architectural profession not only tends to be highly secretive, it also fails to incorporate knowledge management theories and methodologies that have gained widespread acceptance in other fields (Doctors, 2004). In fact, even the modest requirement of sharing a vocabulary is not met. As Habraken (1997) convincingly illustrates, architecture does not have a common language of general significance. Architects have an alarming tendency to coin a personal vocabulary and to give things new names every time.

A third and final clue may be found in the innovation literature (that is, outside the architectural literature), which relatively recently complemented the classical distinctions mentioned above by distinguishing between component and architectural knowledge (Henderson and Clark, 1990). The latter term is introduced to denote ‘knowledge about the way in which components are integrated and linked together into a coherent whole’. This reference to architecture seems to derive from the fact that the different issues architects must take into account necessitate the continuous importation and integration of ideas from other disciplines to help guide the design process. Because architecture lacks a clear epistemological basis, the specificity of architectural knowledge thus seems to lay not so much in a particular set of ideas, themes, information and theories, but rather in how these are worked through to produce architectural artefacts (Hoque, 2004). In this view, the notion of knowledge is redefined as an active process, as a performative rather than a static concept. Austin (1975) identifies certain statements in English that cannot be characterized as imperatives, because to utter them is:

\[\text{Not to describe the doing of what is to be said, but in so uttering to be doing ....} \]

The name performative is derived from ‘perform’, the usual verb with the noun ‘action’: it indicates that the issuing of the utterance is the performing of an action.

Unlike ordinary practical knowledge, performative is an intellectual operation where (like knowledge-in-action) knowing is in the doing.

**STORYTELLING: AN ENGAGEMENT OF EXPERIENTAL KNOWLEDGE**

Given this intimate relationship between knowing and designing in architecture, it is perhaps not so surprising that, apart from a few isolated pilot initiatives, there are hardly any consistent and systematic mechanisms to establish and maintain access to the profession’s knowledge base, let alone to extend its potential reach. (Two examples of such initiatives worth mentioning here are a recent attempt to capture the rationale behind decisions as they are taken during the design process (Cerulli et al, 2001) and the nationwide case study documentation programme set up by the American Institute of Architects (AIA) to help improve US practice education (AIA, 2004).) Indeed, capturing and sharing something as complex and dynamic as architectural knowledge seems extremely difficult at first glance. (Some knowledge is recorded by the resulting construction documents or the built form itself (Habraken, 1997: 284), yet neither the documents nor the built form can reveal the constantly changing conditions that actually structure the process of designing (Brown and Duguid, 1996).)
expectation, however, is not confirmed by everyday life. People manage to cope with and share phenomena of a very complex nature fairly well. The natural way in which they seem to do so is by telling each other stories.

In his book *The Springboard* (2001), Denning convincingly explains, and at the same time demonstrates through his own stories about the World Bank, how knowledge can be transferred effectively by storytelling, not so much through transferring large amounts of information, but as a means to catalyze understanding. Denning (2001: xiv) notes:

> Storytelling gets inside the minds of the individuals who collectively make up organizations and affects how they think, worry, wonder, agonize and dream about themselves and in the process create – recreate – their organization.

In addition to the benefits of using narrative, storytelling is non-adversarial and non-hierarchical. As such, it provides an opportunity to cut through the defence mechanisms so prevalent in the reality of creative work like architecture, where ideas and outcomes have major meaning and importance in terms of ownership and recognition. Storytelling is not a replacement for rigorous analytical thinking, but it complements our understanding of a phenomenon by bringing alternative perspectives and world views. The critical point, however, is that storytelling allows for several important issues to be addressed in terms of the complexity of architectural design and making. Stories are not only direct, easy to read and entertaining; they respect the intricate relatedness of things in a way that makes them easy to remember afterwards. As such, the story format provides a dense, compact way to deal with and communicate complexity in a short period of time. Their outcomes provide the reader of the story with ownership access by connecting the story being told to their own personal experience. The outcome is not about the facts, but about the ideas, processes, decisions and implications of the interactions embedded in the story. According to Denning (2001: xix-xx), stories that are successful have certain characteristics: these stories are told from the perspective of a protagonist with a predicament that is prototypical of an organization; the explicit story is familiar to the audience and has a degree of strangeness or incongruity for the listener; the story is told as simply and briefly as possible; it sparks new stories in the mind of the listener; and, finally, as in all stories, it must have a happy ending.

In order to demonstrate the applicability of stories to architecture and the building industry, the following sections focus on Building Stories, an attempt to unlock and explore the knowledge capital of architectural practice through storytelling. After briefly recalling the ideas underlying Building Stories and their implementation as an operational methodology, a recent in-depth evaluation involving former participants is reported. Besides valuable feedback on Building Stories as such, this assessment provides more general insights regarding current ideas and practices of knowledge production and sharing in architecture.

**BUILDING STORIES IN A NUTSHELL**

Building Stories is a programme developed at the University of California – Berkeley to capture and explore the tacit knowledge embedded in real-world building projects (Martin et al., 2003). Inspired by the power of storytelling as a vehicle for tacit-to-tacit knowledge transfer, temporary teams of students, interns and professionals build stories about projects that are in the process of being designed and/or built. So far, the Building Stories methodology has been applied in two different ways: the original, all-in version, which constitutes the focus of this paper, takes shape in an experimental course spanning an entire semester; the ‘light’ version consist of a one-week workshop, which essentially squeezes the activities of the original version into five intensive days.

**AN EXPERIMENTAL COURSE**

‘Building Stories: A Case Study Analysis of Practice’ is an experimental course offered in the Architecture programme at the University of California – Berkeley. It crystallizes the Building Stories methodology by engaging teams of architecture students, architectural interns and seasoned professionals in exploring the knowledge capital embodied by the best practices of significant architectural firms in the San Francisco Bay Area.
Each team is composed of two students, one intern and one project adviser provided by the firm designing the project. The student faction contains at least one Master of Architecture student and two recent graduates serving as interns in an architectural practice. The project adviser acts as a conduit for access to the materials for the project under study. In addition, the firm, at its discretion, may introduce team members to consultants and other professionals involved in the design, management and construction of the project. Professional students are given formal IDP (Intern Development Programme) credit toward their requirements for internship and licensure. The project adviser and other major participants of the firm receive AIA continuing education learning units for their involvement.

The course combines a guided set of activities in a case-based method of instruction. Students and interns enrolling in the course follow two parallel and complementary learning agendas. One provides a theoretical and methodological framework for undertaking a case study through storytelling. The second constitutes active engagement in building one or more stories about a selected project by analyzing primary source documents and interacting with practitioners responsible for it. Weekly lectures/discussions make students and interns familiar with the materials of the Building Stories approach and with critical questions to explore the richness embedded in real-world projects, while opening up a dialogue on the rigorous study of broader aspects of the profession. In addition, students and interns team up with their project adviser on a regular basis, to discuss key issues of the project that address general aspects of the profession, and to evaluate progress of their investigation and stories.

During the first seven weeks, each team investigates the – up to then – entire history of their project, using six categories as guidelines to organize and direct their investigations:

- project definition and clients’ aspirations
- marketing process, project team organization and work plan
- design process from schematic design to construction documents
- project construction management and administration
- commissioning, measuring of project success, post occupancy evaluation
- examples of practice innovations.

This first half of the course concludes with an interim report and presentation covering the specific detail characteristics noted above. In addition, each team identifies a series of issues or threads that provide an opportunity to build stories during the second part of the course. These represent themes such as unique clients’ circumstances, special financial conditions or particular organizational structures that give direction to unfolding a specific story.

The second half of the course concentrates on ‘putting flesh on the skeleton’ i.e. formally constructing the story details. The story is developed much in the same manner as one would write a novel. The plot or thread is positioned – a failed bond issue; the characters are illuminated – the introduction of a construction adviser as the client; and the settings of the actions established – a revised firm organization to value engineer the originally proposed scope, schedule and budget. Over the next six weeks, new chapters are added, giving meaning and understanding to the story. The final report includes the stories produced by the team, along with the information collected during the investigation.

OUTCOME

At the end of the semester, the final reports are posted on a public website, making the experience and insights they capture accessible worldwide. So far, the website features more than 22 stories about 12 different cases, ranging from the San Francisco Zoo (designed by Field Paoli Architects for the City of San Francisco) and the Mount Zion Outpatient Cancer Center (by SmithGroup for UC San Francisco), to the new De Young Museum (by Herzog and de Meuron in collaboration with Fong and Chan Architects for the Corporation Of the Fine Arts Museums). It serves both as a repository of stories about design practice and as a foundation for further research on the projects in future courses.

As such, Building Stories could potentially serve as a means for sharing insights and experiences from
practice with students, educators and researchers, but also with contemporary and future colleagues (Heylighen et al., 2004; Martin et al., 2005). The latter is more spectacular than first meets the eye given the notorious nature of the architectural profession sketched above.

However, the growing on-line story repository is but one mechanism of knowledge sharing in the Building Stories programme. An additional mechanism derives from the fact that Building Stories teams are inherently heterogeneous in terms of the skills and experience team members bring to it (Heylighen et al., 2005b). At the end of the programme, the temporary network of students, interns and professionals dissolves. Yet what they have learned from each other creates a competence that becomes highly valued in their respective environments, be it practice or academia. The expertise and hands-on experience of the professionals in the team enables students and interns to develop a critical understanding of the issues and tasks of design practice. In return, the participation of students assures a continued supply of competencies trained in the latest research skills and techniques. Moreover, the (academic) knowledge networks they have access to, and the time and energy they can invest, make them highly attractive to design practice. Judging from our observations during the past five years, this newly acquired competence—the skills, attitudes and perspectives that follow team members to other projects and contexts—seems at least as important and valued a form of sharing as the on-line story repository.

BUILDING STORIES REVISITED

In autumn 2004, a seminar named ‘Building Stories Revisited’ was organized to create a platform for studying the process and outcome of Building Stories in previous years in relation to the more general discussion on knowledge in architecture and how this knowledge could be unlocked. Through the seminar, we tried to substantiate our first observations and verify to what extent the programme manages to unlock the knowledge capital of architectural practice. The seminar largely took place around four roundtables—the first three with students, interns and professionals who participated in Building Stories in previous years and the other one with principals of major design firms in the San Francisco Bay Area. The aim was to get a more articulate understanding of what participants take home from Building Stories, and of its position in relation to the larger phenomena of knowledge production, management and exchange in architectural practice and the importance of storytelling to this process.

STUDENTS

For the undergraduate students, some of which were part-time interns in the firm sponsoring their case, working on a Building Story gave them a better picture of what really goes on in an architecture firm. They gained insight into a lot of technical issues, but also into how different players work together to form a team, and how the nature of the team and the mode of communication within it affect the resulting building. As one student put it:

The case study touched on parts that I would have never experienced with internship alone. I was able to better understand the complicated process of getting a design built to finish, which I can apply to what I learn in classrooms and result in even a greater comprehension of the architecture world. I feel I have become less of an ignorant student, who has no idea or even cares about how work is done in real life, and have grown more consideration and admiration for the work architects, as well as all the different players within a project team, do.

Another former undergraduate especially expressed admiration for the multitude of roles architects play beyond designing, roles he did not even think of when coming out of school.

In addition to this ‘reality check’—and for some even ‘shock’—one graduate student appreciated the opportunity to effectively conduct interviews before starting her master’s thesis. In her view, Building Stories should be marketed as a ‘flight simulator’ for practising research methods to any student planning to conduct qualitative research on architectural practice. Moreover, since her participation in the class, she regularly draws on the story repository as a mine of information for various purposes.
The young professionals, for their part, turned out at least as enthusiastic about Building Stories as the students, yet had more difficulty explaining why: ‘What you’re getting out of it is ephemeral, it’s not clear-cut knowledge.’ One of them originally intended to present his experience to his colleagues in the firm, but never did so because ‘they wouldn’t understand it; they almost have to go through the process themselves’. When asked again what made this process so interesting, he mentioned the opportunity to trace as an outsider all the influences that shape a building. What happened to this project could happen again in his career later, hence his interest in how they solved it. Another young professional wanted to participate in Building Stories because he had always admired the architect designing the building under study. Unlike what he had hoped for, however, his participation did not provide the magical insight into how his idol creates good design. What it did provide was a bit of grounding, and a more realistic picture of what a successful architect does: ‘It’s not because he [his idol] is an excellent designer that he got to dictate the whole project.’ Moreover, he no longer felt it was so important to work for this specific architect, because he saw how his work translated to everybody’s work.

Let us now consider the architects, the seasoned practitioners, themselves. Did participating in Building Stories have something to offer them and their firms? One of them appreciated above all the opportunity to draw on ‘that resource on campus’ and to get ‘a peak through a younger lens’. His colleague also enjoyed the opportunity to provide young people with a window on the collaborative effort of design practice, the part of the profession he loves most. An adviser from another firm especially valued the larger perspective provided by the case study, as opposed to the detailed, day-to-day view practitioners tend to have:

It’s beginning to start a process for myself to analyze what happened, how the project evolved ... I enjoyed going back through the documents and realize: ‘Oh my God, we really did this. I have to remember this for the next project!’

By way of summary, the principal of a firm who participated many times in the past five years placed Building Stories’ value on three different levels.

- First, it equips the firm as a whole to be self-critical in an entirely new and systematic way, and to reflect on and record its process of creation for further refinement. The Building Stories teams did not only bring up many issues that clarified how the firm works, they also came away with a good feeling that this way of working actually has some validity.
- Second, at the level of the individual employees, young professionals in the firm get an opportunity to see what other firms are doing ‘without having to put together their portfolio’.
- Finally, and perhaps most spectacularly, Building Stories makes collaboration and sharing a reality in a profession that is known to be highly secretive.

After the roundtables, the students who were enrolled in the seminar (all of whom were PhD researchers) were given several assignments to connect the topic of the seminar to their thesis subject. Throughout several papers they were asked to discuss the role of knowledge, as related to their thesis subject: in the projects reported on by the stories available on-line; in Building Stories, both as process (approach, methodology) and as product (the stories); and in architectural practice and education at large.

At first, the researchers were highly sceptical about the capacity of the stories as vehicles for knowledge transfer. Yet, eventually, the story collection turned out to be a surprisingly valuable resource for their PhD research.

One researcher investigates the variable signification of collaboration in the architectural profession (Doctors, 2004). Collaboration is a cultural practice of two or more individuals working together on a task or project, and intrinsically provides a framework for producing, sharing and contesting knowledge. Many disciplines commonly employ collaboration and have studied its efficacy from social, economic and cultural perspectives. In
architecture, however, the use of the term is often misleadingly interchanged with that of coordination, cooperation or communication. Moreover, it rarely evidences consideration for the wide variability spanning from the utopian Ruskinian interpretation of medieval-era trade guilds to its polemical challenge of the architect-hero paradigm.

Analysis of Building Stories revealed both the process and the product to be peppered with instances of collaboration (whether or not termed correctly). Key to the methodology is the participation of students, interns and professionals working collaboratively towards shared authorship of tacit knowledge derived from a story. In this collaborative process, the roles and rules for engagement are most likely to be more implicit than explicit, and the responsibilities are largely distributed according to each participant’s skill set, interests and availability. Yet, while working in this horizontal decision-making model, participants are learning about the various (other) shapes collaboration can take. The stories about the new De Young Museum project, for instance, provide unique insights into the tactical challenges of establishing a workable organizational structure and methodology to compensate for geographical and cultural differences among non-collocated team members.

Another researcher studies design ethics in practice. Although she described her interest in ethics as mainly theoretical, the process of looking at practice turned out to be very fruitful. While revisiting Building Stories, she identified various points in the stories where decisions have been made and other points where they could be made, if there were to be a level of explicitness and consciousness about opportunities for ethical consideration in the design process (Becker, 2004). A case in point is the Pottery Barn. From the start of the project, politically active community groups expressed concern about a national chain store and its impact on the future of the neighborhood, which drew a lot of media attention and triggered attempts to influence the approval process. In the Berkeley High School story, conflict arose between those wanting to generate income for their business and those having a deeper sense of historic preservation and life outside the margins of a project’s financial gain. The researcher came to realize that moments like these – where multiple interests conflate and conflict, or even where one begins to sense conflict, moments in which the progress of a project is threatened – are precisely the potentially deliberative moments, those in which ethics would logically be addressed. Clarifying the multiple points of conflict that became (or could have become) sites of reflection within the Building Stories may become a first step towards establishing a new model for ethics in practice.

The third researcher explores the nature of professional knowledge in architecture (Hoque, 2004). Extensive literature study inspired the hypothesis that architectural knowledge is performative (Austin, 1975): it does not consist of a particular set of ideas, themes and theories, but rather of how these ideas, themes and theories are worked through to produce architectural artefacts. Confronting this hypothesis with the Building Stories collection revealed the notion of performativity to be very apt in describing what occupies the architects involved in various projects, such as Berkeley High School, UCSF Medical Educational Research Center and the Golden Gate Parking Structure. The latter project, for instance, involved several different parties who are not architects or designers. The architects’ task was to take their various views and needs, to translate these into a common language and represent them in the context of architecture and construction, which perfectly illustrates the performative actions mentioned above. At first, the researcher found it very difficult to distinguish information from knowledge in Building Stories, but by addressing the stories in terms of performativity, she was able to identify much more clearly the instances of knowledge production. As such, the stories turned out to be valuable for her research because they provided her with real-world examples to work with.

**DISCUSSION**

According to Habraken (2003: 7), ‘a profession’s identity is defined in terms of knowledge and skills. It will be asked: What is it your profession knows that others do not? Do you have the skills and methods to apply that knowledge successfully?’ As pointed out above, the architectural profession seems to combine an alarmingly absent knowledge base with an
exceptional cultivation of ‘knowing-in-practice’ i.e. knowing how to integrate multiple elements from various sources and disciplines into one coherent whole. In view of this, Habraken (1997: 284–285) argues for a revaluation of the shared knowledge of space and built form, to the extent that it reflects the agreements honoured by those acting on it. He feels that the implicit way in which this knowledge used to present itself in systems, styles, patterns and types, no longer suffices and calls for deliberate study on how its application (or lack thereof) impacts the health and quality of the environment. In essence, Habraken’s proposal comes down to (re)establishing architecture’s knowledge base by studying the outcome of architects’ knowing-in-practice.

Building Stories adopts a similar, yet significantly different, approach in that it proposes to (re)establish the former by exploiting the process of the latter. Through storytelling, it tries to capture and share architects’ knowing-in-practice as it presents itself in designing and building projects and, as such, to do justice to the performative nature of architectural knowledge. As far as the capturing part of Building Stories is considered, further work is needed in order to improve and guard the quality of the resulting stories. Interestingly enough, however, this does not seem to hamper the sharing part. The outcome of the seminar reported on above strongly suggests that Building Stories is particularly successful in creating entirely new opportunities and interfaces for exchange. Judging from the roundtables and the PhD students’ research papers, the initiative seems to provide an inventive methodology for catalyzing knowledge sharing between projects, between individual architects and architecture firms (through the on-line story collection, but also through the participation of young professionals); and between practice and academia (equipping design firms to draw on ‘that resource on campus’ and vice versa). As such, Building Stories offers architectural education a useful pedagogical device, provides architectural practice with an effective vehicle for self-critique, and even may serve as a valuable resource for architectural research.

The latter may sound somewhat surprising at first. Indeed, advancing storytelling as a vehicle for studying architecture and architectural design looks suspiciously like dragging the Trojan horse into the walls of research. For inside these walls, storytelling is often viewed as, if not suspect, then at least disputable, and in any case of no more than secondary importance, at best useful for illustrative purposes. However, the outcome of our evaluation strongly suggests that initiatives such as Building Stories may have relevant and important complementary contributions to make to the understanding of architectural design and the nature of design activity. As Bucciarelli (2001) contends, a good story is a truthful story and, like a scientific theory, can be put to the test, making sense to the participants as well as to ‘outsiders’. It relies on the facts observed as well as metaphor and, as such, is open to different interpretations. This does not necessarily mean, however, that it is ‘unscientific’:

The claim here is that a good story which has depth ... in allowing for varied interpretations, avoids the over-simplification of a behaviorist’s model or cognitive scientist’s mapping and as such is in closer touch with reality – however that is construed. (Bucciarelli, 2001: 300)

In summary, this retrospective view of Building Stories revealed the content of the story repository to be a rich source of knowledge in its own right. It was, however, the process of constructing and telling the stories that was the most important outcome. Each of the participants i.e. undergraduates, graduates, interns, seasoned professionals and researchers acknowledge the power of storytelling as a methodological approach to uncovering specific knowledge through experience. It is safe to say that this effort of using storytelling is ‘closing the gap between knowing and doing’ in the design and making of architecture.

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CONSTRUCTION PARTNERING AND INTEGRATED TEAMWORKING
REVIEWED BY STEPHEN EMMITT

There is growing interest in relational forms of contracting and closer cooperation between construction project partners. Project partnering, strategic partnering and alliancing are growing in popularity and are being implemented with varying degrees of success. These approaches rely on the successful interaction of individuals within and between organizations, where effective communication, trust and the desire for continual improvement are paramount. Integrated teamwork – assuming that we are able to adequately define the concept – is, however, very difficult to achieve in project-based organizations. It is an area in which clear, well-informed advice is required.

Construction Partnering and Integrated Teamworking aims to provide guidance to practitioners interested in applying partnering and integrated teamwork methods. The argument is for a structured approach to value enhancement and the authors do a good job in promoting the drive towards a value-based culture in construction. The book comprises 38 short chapters that collectively deal with the need for a culture change, the development of an integrated team, advice on workshops and the implementation of best value. Inspiration for the book comes directly from the Latham and Egan reports. The style of writing is clear and positive, and the use of short, relatively concise chapters helps to make the book accessible. Throughout the text, there are a number of small case studies and practical tools to assist with team-building activities.

Construction partnering is dealt with in a logical and pragmatic manner and represents a useful primer for readers unfamiliar with the main concepts. The first 10 chapters explore the main issues and help to clarify the differences between facilitators and advisers. A distinction is made between partnering and partnerships, but clear definitions of project partnering, strategic partnering, integrated teams and value are missing. Chapters relating to workshops provide some practical advice for readers with limited experience of workshop methods. Similarly, the chapter on issue resolution (Chapter 17) provides sound advice. Unfortunately, some of the later chapters fail to add much value. Most notably the topics of lean thinking, sustainability, whole life costing and innovation deserve much better treatment than they are given. Short chapters may work well in a workshop environment but, read in isolation, many readers will be left wanting more explicit guidance.

The interaction of actors is a highly complex social phenomenon. Some of the underlying issues, such as communication and trust and risk management are rather superficial in their treatment. The chapter on trust briefly deals with the initiation of trust, the building of trust and maintaining trust. However, the authors fail to discuss equally important facets such as the boundaries of trust and the importance of personal contact. The importance of social interaction is mentioned, but is not explored in sufficient detail, and the book paints an overly simplistic picture of team development and improvement. Challenges and opportunities of integrated teamwork are not adequately explored. The authors note that there are opportunities for improvement in communications, a claim few would argue against, but then make some rather general
statements. Given that the concepts promoted in the book rely on interpersonal communication for their success or failure, this is a major weakness.

Project partnering and integrated teamworking have been given a lot of press coverage in professional journals and many readers may feel frustrated that this book makes no attempt to add anything new to our knowledge base. Perhaps the biggest disappointment is the rather scant attention to the challenges inherent in partnering-type arrangements. There is a brief description of some of the pitfalls of partnering, but this is not sufficient. Recognizing some of the problems would have helped to provide a more balanced view and would have added real value to the book. Similarly, the considerable challenges of creating and maintaining integrated project teams are not addressed. The way in which groups form and become effective, or conversely fail, are not explored, nor is the problem of groupthink – a well recognized ‘pitfall’ of collaborative arrangements and teamwork. It is disappointing that the authors have not included more examples of instances where partnering failed to meet the commonly shared objectives and the difficulties of making teams and groups work effectively. The reasons for poor performance are often very subtle, and some description of the problems and how to mitigate the negative effects would have been insightful. Practitioners know that real life is messy and success or failure usually comes down to the people charged with implementing initiatives.

**VALUE AND RISK MANAGEMENT: A GUIDE TO BEST PRACTICE**

**REVIEWED BY STEPHEN EMMITT**

Value or, more specifically, the management of value in construction is growing in popularity with a wide range of stakeholders. Although value and values remain difficult concepts to quantify and qualify, there is clear evidence of a shift towards a value-based approach to design and construction. Value management techniques are increasingly being used in practice across a wide range of project types and sizes. Parallel to this is the development of the theory behind a value-based approach to projects, which is starting to mature and provide some elegant approaches. Within these models, the important issue of risk can be addressed as part of the value agenda. Risk awareness and the management of risk have also developed rapidly over recent years, providing practitioners with a range of practical tools to identify and manage risks, both within projects and project-based organizations.

*Value and Risk Management: A Guide to Best Practice* takes an original approach to the subject and, at nearly 400 pages, provides a lot of information. Attempting to combine value and risk management in one book is an intriguing prospect and, on reflection, a rather obvious thing to do. Dallas makes a good argument for combining value management techniques with risk management and in doing so provides sound practical advice to the reader. The book comprises 12 chapters, which collectively provide an interesting journey from why successful projects need value and risk management (Chapter 1) through to a comprehensive ‘toolbox’ of checklists, forms and tables (Chapter 12). Value management and risk management are clearly and concisely described in separate chapters before dealing with the most fruitful part of the book, the need for an integrated approach to value and risk management (Chapter 4). The argument is simple, it is wasteful trying to maximize the value of a project without dealing with the risks that are likely to materialize and hence destroy the value. The emphasis is not on trying to avoid risks, but on the necessity to take risks to maximize value within a structured and managed framework. This approach is refreshing and takes the reader away from the misconception that risk management stifles creativity and innovation. The author should also be congratulated for recognizing the impact that people have on project success.

Chapter 5 explores the role of people within projects, dealing briefly with communication, selection criteria, styles of leadership and difficulties that may be encountered during value and risk management exercises. Look out for what Dallas calls the ‘spectator’ (reluctant contributor), the ‘windbag’ (likes the sound of their own voice), the ‘rambler’ (poor orator) and the ‘squatter’ (fixed
views, stifles innovation). Chapter 6 affords comprehensive coverage of concepts, standards and qualifications.

Of the 12 chapters, ‘Learning from Others’ (Chapter 7) is perhaps the most curious. I was expecting a chapter on knowledge transfer between projects and organizations and associated material; it appeared to be a logical development of what went before. Instead, the chapter includes short contributions from seven guest authors to help broaden the debate. These fascinating interjections do indeed raise a number of issues, although the majority of the contributions are rather short and may have the result of leaving the reader slightly frustrated. For example, the section on soft value management (by Professor Stuart Green) starts to take the reader to another (arguably higher) level, but stops prematurely, leaving the reader wanting more. Collectively, the contributions come over as little more than sound bites, which offers too little value. Some critical contributions would have been welcome at this juncture; the book is robust enough to accommodate a more balanced view.

Chapters 8 through to 12 deal with the practical issues of study types, techniques for value and risk, value management techniques and risk management techniques, concluding with the ‘toolbox’ chapter. All of this material is well presented, clearly explained and of considerable practical value to the reader. The illustrations, tables and checklists are clear and help to get the message across. Space does not allow for detailed description of these chapters, other than to say that the information contained within is comprehensive and more than sufficient for the needs of most readers.

Compared with Construction Partnering and Integrated Teamworking, the writing is not as lucid, but the book offers considerably more factual information and hence represents much better value for money. Value and Risk Management: A Guide to Best Practice is a worthy addition to any library. The book would also make a welcome desktop companion to practitioners and represents a useful source of information and inspiration for students studying the built environment.

Approaches such as partnering, integrated teamworking, value management and risk management can help to bring people together, but whether or not the actors subsequently act as an integral whole is another matter. Complex interactions within project teams and project groups within multi-project environments is an extremely complex field, as highlighted in the papers selected for this special edition. More attention to such issues in textbooks would be a welcome development.

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