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Constructability: A Model Framework for Knowledge Transfer Development, A Three Country Comparison

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Abstract. Constructability is an important approach that allows the building industry to achieve quality outputs making best use of resources – the linked goals of time, cost and quality. Information supply and knowledge transfer are central to this and are recognized as integral to an industry strategy to improve productivity. However, poor delivery of information to those at the construction site and lack of effective methods of transferring knowledge between parties involved in construction become major challenges. This paper reviews the building production practices and information networks adopted by three countries to achieve better constructability practices. The elements of ‘control’, ‘innovation’, ‘best practice’ and ‘audit’, identified as key to improving knowledge transfer, are modelled for the construction sectors of Singapore, Australia and Malaysia. A framework for knowledge transfer is proposed to promote better practices in the construction industry

Keywords: Building Quality, Constructability, Information, Knowledge Transfer

1. Introduction

The challenge to integrate and share knowledge in the construction industry has become an important agenda for many researchers worldwide. The issues relate to a lack of quality revealed through building defects, poor building performance and poor management of the construction project (Wong, 1996). As constructability is recognized as a process to integrate construction knowledge at every level of the construction process (Griffith and Sidwell, 1997; Nima et al., 2001), the factors that contribute to its success need to be identified. Poor practices relating to constructability, that include lack of interaction, miscommunication and inappropriate use of knowledge by industry personnel, suggest that this issue needs to be prioritized. Many construction projects do not receive feedback or constructability input due to the lack of a formal and explicit knowledge base, resulting in low quality outputs and poor building performance (Jergeas and Van der Put, 2001).

One of the factors closely related to this problem is caused by inadequate transfer of information in the building production process. Information is a key component for updating and optimizing knowledge. This information must be managed to bring in value. Previous research by Zaidi and Davies (2009, 2010) has proposed a model of information supply that includes the elements of ‘control’, ‘innovation’, ‘best practices’ and ‘audit’ as being relevant areas to explore to improve knowledge transfer. Singapore, Australia and Malaysia have been selected for review of the strategies adopted for developing information and information sharing in their construction industries. Developing from this work, this paper attempt to explore how the model of information supply (‘control’, ‘innovation’, ‘best practices’ and ‘audit’) contributes to constructability by identifying any areas for improvement in knowledge transfer.

2. Constructability Challenges- Information Transfer barrier

Constructability is described as a system to achieve optimum integration of construction knowledge in the building process for achieving maximization of project goals and building performance (Griffith and...
Sidwell 1997). It refers to the best use of construction knowledge and experience in planning, engineering, procurement and field of operations to achieve overall objectives (Arditi et al. 2002). However the production and flow of information between industry practitioners in the construction industry is identified as a critical element of the building construction process (Nima et al. 2001). Several studies have recognized that the problems relating to a lack of information and poor knowledge sharing in constructability constitute a major issue requiring urgent improvement (Jergeas and Van der Put 2001; Arditi et al. 2002). These authors highlight relationship issues such as lack of trust, lack of commitment and poor communication as major challenges. Arditi et al. (2002), suggest that constructability has also been hindered by designers’ misunderstanding or lack of appreciation of construction requirements. Often, contractors are not invited to participate or take part in design activities, when they can provide invaluable construction inputs at early stages of the building production process (Alshawi and Underwood 1996). Knowledge and information transfer have been identified as areas in which the construction industry must achieve significant improvement (Zaidi and Davies 2009). However, information transfer is generally given little attention in many country’s construction activities including Singapore, Australia and Malaysia (Wong, 1996; de Silva et al. 2004). There is thus a lack of integration in construction inputs and inadequate transfer of information, often resulting from lack of appreciation of the potential contributions of all parties involved in a construction project, the contractual process itself with its conflicting objectives and the often adversarial nature of construction contracts, all of which result in a general lack of communication which in turn creates constructability problems.

3. Information Sources

Previous discourses on knowledge transfer such as Zaidi and Davies (2009, 2010) typically synthesis information sources into four different components. These components - ‘control’, ‘innovation’, ‘best practice’ and ‘audit’ are explained as follows:

Control Element- In the construction process, ‘control’ refers to any information received from any public agency including any law, regulation, guideline or policy produced by local, national or international bodies. This also refers to the enforcement of building regulations made by government in order to ensure that any construction project complies with standards. Contractors are expected to comply with building codes, standards and good building practices; therefore information from the control element needs to be effectively communicated to ensure contractors are up-to-date with current requirements.

Innovation Element- Under the innovation element, optimization of construction knowledge could be achieved through an effective integration of information produced by research and development (R&D) agencies. Effective use of R&D information could be one of the strategies to increase construction project performance. Latest findings such as new construction materials, construction techniques or any novel approach could achieve better construction project quality and increase productivity and constructability. Given the ever increasing amount of information being generated, gaining attention for important new discoveries is a continuing challenge for R&D agencies.

Best Practice Element- Best practice is an initiative by governments and research agencies to motivate key players in the industry to apply proper building practice. This could be achieved through training programs offered by any public or private organization in the construction industry. Information related to any new technique such as supply chain management, value engineering, partnering, total quality management (TQM) etc is invaluable for construction personnel to improve their skills and practices.

Audit Element- Integration of construction knowledge is not solely dependent on the effective delivery of information from outside agencies from the control, innovation and best practice elements. The requirement to receive feedback on project performance should become one of the essential strategies for constructability to succeed. Therefore this paper suggests the audit element as an additional way to integrate construction knowledge in the construction process. Audit can include developing databases of projects to be used for benchmarking and setting Key Performance Indicators (KPI’s).

4. A three country review: issues and current practices for achieving constructability
4.1. Current practice in Singapore

Information as inputs to the construction process is received from a range of agencies in Singapore. The Building and Construction Authority (BCA) is the government agency responsible for regulation of the building and construction industry. The BCA takes the primary role in developing the construction industry through various systems that have been instigated, such as the introduction of performance-based codes, construction quality assessment system (CONQUAS) and legislation on buildable design, as a condition for building plan approval. The establishment of the Singapore Institute of Standards and Industrial Research (SISIR) is recognized as an important multidisciplinary technology resource centre. This agency has become a central resource for the industry to access information. In promoting the use of information technology (IT) to improve productivity in the industry, the Singapore government has developed national IT standards for construction. The Construction and Real Estate Network (CORONET) aims to re-engineer the business processes of the construction industry to improve quality, productivity and turnaround time. Innovative systems such as the e-Submission system, Integrated Building Plan Checking System and the Integrated Building Services Checking System have been operating since 2003.

4.2. Current practice in Australia

In Australia, the government controls building quality through effective enforcement of the building legislation system. Legislation such as the Building Code of Australia (BCA) and the Building Act 1993, imposes requirements relating to inspections, occupancy permits and enforcement of regulations. Building regulation is administered through various government instruments and agencies such as the Australian Building Codes Board (ABCB), Standards Australia (SA), and local government and planning authorities, etc. The introduction of a performance-based code in the Building Code of Australia (BCA) in 1996 allows the use of alternative solutions, thereby supporting the considered use of new and innovative building products, systems and design. This performance code allows designers flexibility in the use of any materials, forms of construction or designs provided that the intent of the BCA is met. Another strategy to achieve constructability is through R&D. The mission of the Australian Research Council (ARC) is to deliver policy and programs that advance Australian research and innovation globally and benefit the community (www.arc.gov.au) and it funds research into areas of national interest, including the building industry. The establishment of the several research agencies such as the Australian Commonwealth Scientific and Industrial Research Organization (CSIRO), Australian Housing & Urban Research Institute (AHURI) and Construction Industry Development Agency (CIDA) are complementary to this mission.

4.3. Current practice in Malaysia

In Malaysia, the construction sector aims to realize maximum value for all clients, end users and stakeholders and exceed their expectations through the consistent delivery of world class products and services. In achieving this objective, the Malaysian government has initiated the Construction Industry Master Plan (CIMP) 2006-2015 as the blueprint to transform the industry into a professional, productive, knowledge-based and progressive contributor to the country’s Gross Domestic Product (GDP) (Construction Industry Development Board, 2010). In the Malaysian construction industry, construction control and legislation enforcement are seen as essential. The establishment of agencies such as the Ministry of Works, the Construction Industry Development Board (CIDB) and research agencies including SIRIM and CREAM could drive the industry to achieve improvements in construction quality. The Malaysian government has also established innovative techniques such as the performance scorecard on Quality Assessment System in Construction (QLASSIC), enhancing the Partnering Program (P2P) strategy and raising knowledge levels in the construction community. Singapore, Australia and Malaysia thus all have a framework of legislation and R&D activities with the goal of improving building quality. The information that is provided by these sources provides invaluable input to the process of constructability.

5. Proposed Model for Knowledge Transfer Framework

In an attempt to improve the constructability approach in the construction industry, various mechanisms have been adopted and discarded by industry-based organisations and government organisations. This paper suggests that what is required are better linkages between the four factors considered to influence
constructability - The elements of ‘Control’, ‘Innovation’, ‘Best Practice Guidance’ and ‘Audit’, illustrated for Malaysia, Singapore and Australia (Figures 1, 2 and 3). The first strategy of this model proposes that good multi-way communication channels should be encouraged between construction ‘actors’ and the information providers, such as local authority agencies, research bodies and other institutions. This could be achieved through more effective interaction and socialization by the construction community. One of the reasons why constructability issues recur is due to poor decision making and communication breakdown. Brackertz and Kenley (2001) identify that there were no suitable communication channels and processes between authorities and other agencies. This justifies the proposed need for good multi-way communication.

The second strategy that could be adopted to integrate construction knowledge is through the effective distribution of information from research agencies. Research bodies such as the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia and the Standards and Industrial Research Institute of Malaysia (SIRIM) in Malaysia provide a wide range of research information. However, effective dissemination relies on information reaching the developer or builder on site. In an attempt to improve constructability, it is important to review current policy and to encourage contractors’ involvement. Short briefing notes or training days could facilitate more effective transference of knowledge.

In the best practice element, integration of construction knowledge is proposed through conducting workshops, seminars and best practice notes. Attendance at seminars and workshops could be a mandatory condition to renew builders’ licences and could be a significant way of updating skills and knowledge.
Fig. 2: Knowledge Transfer (KT) Approach proposed for the Singapore construction industry.

Notes:
MND : Ministry of National Development
BCA: Building & Construction Authority
CRS : Contractor Registration System
SIISR: Singapore Institute of Standard and Industrial Research
CONQUAS: Construction Quality Assessment System
CORONET: Construction & Real Estate Network
STB : Strata Title Board
HDB : Housing Development Board

Fig. 3: Knowledge Transfer (KT) Approach proposed for the Australian construction industry.

Notes:
ANZECC : Australia New Zealand Environment Conservation Council
ABCB : Australian Building Code Board
APCC : Australian Procurement and Construction Council
FMAA : Facilities Management Association of Australia
RICS : Royal Institution of Chartered Surveyors
CIOB : Chartered Institute of Building
CSIRO : Australian Commonwealth Scientific and Industrial Research Organization
AHURI : Australia Housing and Urban Research Institute
The concept of Continuous Professional Development (CPD) could also be extended to construction actors and not be limited to professionals such as architects, surveyors and engineers. These approaches could increase builder’s awareness of useful information from research organisations. Finally, constructability could be improved through an effective knowledge transfer through auditing. Benchmarking and setting Key Performance Indicators (KPI’s) can monitor the performance of organisations and the construction projects.

6. Conclusions

Producing quality buildings requires an effective application of constructability. Knowledge can be integrated and optimized through successful transfer of information. Based on the current issues of constructability in the construction industry, an analysis of current literature and a review of the organisations providing regulatory control, research, benchmarking, and best practice, in Singapore, Malaysia and Australia, this paper suggests the following:

i. The need to improve communication and interaction between information providers and parties involved in the construction process should be the first priority to be considered for the success of constructability.

ii. Construction companies and information providers must engage to ensure information transfer systems are set up that are effective thus achieving the goals of improved building quality.

In conclusion, the implementation of better knowledge transfer mechanisms through an effective information distribution strategy is likely to improve constructability. Finally, creating a knowledge chain among the four elements (control, innovation, appraisal, audit) of the proposed model could initiate continuous improvement in the construction industry.

7. References


