

# THE DEVELOPMENT OF AN INTEGRATED KNOWLEDGE MANAGEMENT MODEL FOR CONSTRUCTION

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Knowledge management (KM) is now recognized for its potential to bring considerable gains to construction organizations, their projects and individual workers through social and technological interventions. There is however, a paucity of empirical research in this area, and furthermore a lack of integrated KM models in the literature. Continuing research into KM in the Irish construction industry is presented, where a range of methods have been utilized to address issues relating to KM within the leading Irish construction companies. Current approaches to managing knowledge within these companies and an assessment of the potential for a more formal approach to KM are considered. A number of these companies are engaged in Engineers Ireland's (EI) Continuing Professional Development (CPD) accreditation scheme and are finding it difficult to understand the concept of KM, which is a criterion for accreditation. It is now proposed to engage further with these companies, and through a grounded theory approach, develop an integrated theoretical model for KM which is both pragmatically useful and credible, bridging the gap between theory and practice. Based on the developed model, a key objective of the research will be to develop guidance and training which will be endorsed by EI and assist Irish construction firms in understanding KM, achieving CPD accreditation and improving performance. It is also anticipated that the research will foster closer links between industry, academia and professional bodies in addressing the poor levels of collaborative research and innovation within the Irish construction industry.

Keywords: continuing professional development, grounded theory, Irish construction, knowledge management.

## INTRODUCTION

The construction industry is recognized as being poor at learning on a consistent basis and improving performance and is notoriously slow in adapting to progressive change (KLICON 1999). The project-based, fragmented and unstable nature of the industry has led to chronic knowledge loss compared with other industries (Orange *et al.* 2003). Knowledge Management (KM) has been promoted as a means of harnessing and utilizing intellectual resources to address these challenges, improving innovation, business performance and client satisfaction, although there is uncertainty about how to devise and implement a viable and cost effective KM initiative (Kamara *et al.* 2002). KM as an academic discipline is relatively young, with interest stemming from a number of issues: a dramatic improvement in data processing capabilities and communications technologies, an increased recognition that businesses must continuously improve and acknowledgement of learning as a core strategic competency (KLICON, 1999). Salisbury (2003) ventures that it is still a rather vague

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topic, with as yet, no common understanding, apart from organizations becoming 'smarter over time'. Two of the main disciplines to have embraced the KM discourse are information systems and human resource management, an integration of these having the greatest potential for advances in the field. Jashapara (2004:12) defines KM as: "*the effective learning processes associated with exploration, exploitation and sharing of human knowledge (tacit and explicit) that use appropriate technology and cultural environments to enhance an organization's intellectual capital and performance.*" KM has received significant attention from the construction management academic community in recent years, evidenced in a number of recent publications and conferences. However, KM is considered to be in its infancy in the construction industry (Carrillo *et al.* 2004), and is seen as a recent and evolving practice for construction organizations (Robinson *et al.* 2005). The lack of a working definition of knowledge within some construction organizations and awareness of the importance and potential advantages of KM reflects a casual approach, and indicates the need for further exploration of knowledge and KM-related issues (Robinson *et al.* 2005, Hari *et al.* 2005). There is a dearth of empirical research and integrated KM models for construction, resulting in the continuing need for the development and testing of such models (Walker and Wilson 2004, Egbu 2004). Ongoing research into the development of an integrated model for KM is reported, with a particular focus on the leading firms in the Irish construction industry.

## **IRISH CONSTRUCTION**

The overall output of the Irish construction industry in 2006 was €36bn, accounting for 24% of the country's GNP, making it "*the most important part of Irish economic growth (Davis Langdon PKS 2006: 3).*" The industry is facing a number of challenges: the introduction of fixed price government contracts, an increase in the number of foreign-based firms entering the market, over-reliance on the housing market and a predicted slowdown in construction output in the coming years (DKM, 2005). In this context, Engineers Ireland (EI) and the Construction Information Technology Alliance (CITA) have cited the strategic importance of KM to the industry. EI, the country's largest professional body, have recently included KM in the criteria for their Continuing Professional Development (CPD) accreditation scheme. Based on initial desk research, the main CPD efforts within the leading Irish construction companies currently focus upon becoming accredited by EI. Twelve of the top twenty companies are engaged in the accreditation process, of which two are fully accredited.

## **AIM AND OBJECTIVES**

The overall aim of this research is to develop an integrated model of KM through the application of grounded theory. It is anticipated that this will aid the implementation of KM within Irish construction organizations, lead to CPD accreditation from EI and ultimately contribute to an improvement in business performance. In order to achieve the stated aim, the following objectives have been formulated:

1. To develop a critical understanding of the current body of KM literature, considering strategic, cultural and technological aspects in the context of construction organizations.

2. To identify and critique existing approaches to managing knowledge within the leading Irish construction companies and compare them to KM practices in other countries and/or industries.
3. To formulate a strategic framework for the promotion and development of KM within the Irish construction industry through a co-operative approach between industry, academia and professional bodies.
4. To devise CPD accredited education and guidance resources based on the developed model, to improve awareness, understanding, and implementation of KM within the construction context. The delivery of such resources will contribute towards the evaluation of the developed model in terms of its usefulness and credibility with industry.
5. To make recommendations for the further development of KM at both organization and industry levels within the Irish construction industry.

## KNOWLEDGE MANAGEMENT

It is recognized that construction organizations have been managing knowledge informally for years, but that the challenges facing the industry “*mean that most organizations now need a more structured, coherent approach to KM (Hari et al. 2004: 848).*” A distinction is made in the literature between two categories requiring KM in the construction industry: within projects, across temporary, multi-discipline project organizations; and within individual firms (Kamara et al. 2002), “*there may be much greater potential for use within individual companies (KLICON 1999:30).*” Traditionally labour-intensive organizations employing a full workforce of tradesmen and labourers, large main contractors have generally moved away from being a ‘building company’ towards directly employing a core professional and management team to lead teams of outsourced contractors (Raiden and Dainty 2006). In a study of Carillion, a leading UK construction company, Jewell and Walker (2005: 122) found the main business driver for KM to be the “*very nature of the modern construction industry – being highly competitive, high risk, with low margins. To succeed in this environment, a business has to be sharper, more efficient, and consistently using its knowledge assets to ‘get it right first time’ and avoid repeating mistakes.*”

### Starting a KM Initiative

Both Robinson et al. (2005) and Egbu (2004) have identified a number of issues to consider in beginning a formal KM initiative:

- Develop a KM strategy with management and financial support
- Identify the type and nature of knowledge that needs to be managed
- Understand the characteristics of knowledge
- Develop a knowledge-sharing culture
- Link KM to existing incentives and performance measures
- Provide support from both IT and non-IT tools
- Utilize a KM maturity scale in order to objectively benchmark KM implementation efforts

The main feature of a KM strategy is the promotion of a knowledge sharing culture, a suitable ICT infrastructure, and the identification of processes and activities where

value can be added through KM (Carrillo *et al.* 2004). Prior to developing a KM strategy, the effectiveness of current approaches to managing knowledge within the organization should be explored in terms of people, process and technology. In a study exploring KM in construction organizations, it was found that the majority of respondents did not have highly developed KM strategies, structures or an appropriate culture (Egbu 2004).

Kamara *et al.* (2002) identified processes for managing knowledge in construction as; reliance on accumulation of individual knowledge; long-standing agreements with suppliers; post project reviews to capture lessons learned; transfer of people in different activities; formal and informal feedback; informal networks and collaboration; reliance on departmental/divisional heads to disseminate knowledge and the use of IT tools to support information sharing and communication

In order to inculcate an environment for managing tacit knowledge, trust, respect and reciprocity are vital (Egbu 2004). *“Developing knowledge-oriented cultures, motivating individuals to share and use knowledge, and encouraging every person to view their jobs in terms of effective knowledge management. Managing knowledge is managing people; managing people is managing knowledge (Davenport and Volpel 2001: 218).”*

*“IT systems don’t manage knowledge; they manage data and information (Prusak, 2006).”* The role of IT in a KM system is as a facilitator as previous attempts to capture personal experiences proved unsuccessful (Carrillo *et al.* 2004). There is a need to incorporate technologies that augment existing work practices, with the development of an IT strategy being important in improving its effectiveness (Egbu and Botterill 2002). The suitability of a full-scale measurement framework for KM is brought into question by Robinson *et al.* (2005) who suggest that organizations at the lower end of KM implementation should rely on qualitative evaluation. There have been a number of significant studies into KM in construction, most notably KM for Sustainable Construction Competitiveness (KMfSCC, 2004). Other studies into KM practice within the construction industry have focused on both contracting and consultant organizations (Carrillo *et al.* 2004, Kamara *et al.* 2002, Hari *et al.* 2005). The characteristics of these types of firms are inherently different, and approaches to managing knowledge should be adopted to reflect this. The role of HRM and IT in KM in construction have been studied separately (Olomolaiye and Egbu, 2004, Egbu and Botterill, 2002). This discipline-specific approach has led to a lack of integrated models for KM in construction. One such integrated approach, the K-Adv model, was judged to be too difficult to implement by the organizations involved. A draft industry guidance document was produced and tested as part of the research, which was found to be conceptually too complex to understand, even by some KM specialists within the contributing organizations. Participants in the research indicated that a less complicated and shorter guidance document was preferable (Walker and Wilson 2004). Hari *et al.* (2005) believe that more education and training of construction personnel is required in the area of KM.

## **PROGRESS TO-DATE**

The following reports upon primary research conducted to-date, highlighting the key findings from various research activities.

### **Preliminary Study – Survey of 20 Leading Irish Construction Firms**

Following an initial literature review, it was decided to conduct a survey of the leading twenty Irish construction companies, based on their 2004 turnover. These leading firms were selected as they are perceived to exert the most influence on the approach to managing construction projects and the industry in general (Thomas 1999). Due to the complexity of the construction industry, particularly in terms of the types and sizes of organizations engaged in construction-related activities, it was decided from the outset to utilize non-probability sampling. Companies were selected from two sampling frames (Hayes 2005, CIF 2005), thus increasing the likelihood of the inclusion of all eligible organizations. An initial phone survey revealed that none of the twenty companies had a Knowledge Manager or a director with responsibility for ICT, it was therefore decided to conduct a detailed survey of both the Managing Director and ICT Manager. The required ICT infrastructure for a KM system appears to be in place within the respondent's head offices, although on site it is not so well developed. The communications infrastructure which facilitates data transfer between the offices and sites is underdeveloped. The use of software technologies to support KM is quite low, which may be due to the constraints imposed by the under development of the hardware infrastructure at an organization-wide level.

### **Field Research 1 – Interviews with Senior Managers**

Senior managers from ten of the leading twenty firms were interviewed. All identified participants operate either at board level or directly below the main board of directors, and all are heavily involved in the day to day operations of a number of construction projects within their respective organizations. These individuals were chosen to get an overview of the current approaches to managing knowledge from both strategic and operational perspectives. Conducted between December 2005 and January 2006, it was found that current approaches to managing knowledge were mainly informal, apart from the two CPD accredited companies who have made a conscious effort to address KM issues. There appears to be a strong relationship between the level of CPD activities and KM practices, with accreditation by EI having a positive impact on those organizations engaged in the accreditation scheme. The respondents were unanimous in their view that a more formal approach to managing knowledge could contribute to improving the overall performance of their organizations, although they were unsure of how to address KM.

### **Field Research 2 – Case Study of CPD Accredited Company**

The possibility of conducting some in-depth research emerged from an interview (in field research 1) with a director from a company who has achieved CPD accreditation from EI. This led to the design of a questionnaire, the purpose of which was to explore the effectiveness of identified KM initiatives such as the lessons learned database and seminars, CPD, and communications within the company's Dublin office. Follow-up interviews were then conducted with the full site team on a project based in Waterford between May and June 2006. The questionnaire and interviews found that attempting to manage knowledge with a lessons learned database, had proved unsuccessful. However, the alignment of individual's learning and CPD needs to the company's objectives appears to merit further investigation from a KM perspective.

### **Field Research 3 – Interview with EI CPD Accreditation Manager**

An unstructured interview was arranged and conducted with EI CPD Accreditation Manager in July 2006, to discuss KM in relation to construction organizations. It was

found that these firms are struggling with the theoretical concept of KM, believing that ICT systems are KM solutions. The prospect of developing guidance documentation and training resources aimed specifically at construction organizations was discussed as a possibility of raising awareness and understanding of KM, and ultimately improving its implementation. Such documentation and training would have to be “*very practical and not theoretical and include a lot of ideas and solutions.*” The CPD Accreditation Manager indicated that EI are very interested in the research and are willing to support its future endeavours.

## PROPOSED RESEARCH METHODOLOGY

To-date, the research has adopted both quantitative and qualitative strategies however as the work progresses it is anticipated that qualitative research will be the main focus. Due to the emerging nature of the research, it is proposed to adopt grounded theory as the over-riding strategy. As the research advances, it is expected that a number of case organizations will emerge allowing for the integration of the case study approach into the research. The research has unfolded from an exploratory study into one which has engaged some of the leading organizations and bodies in the Irish construction industry. Despite the uncertain nature of the grounded theory approach, there is a definite justification of this research in the backing it has received from both EI and CITA, and the participation of the leading construction companies, who have expressed an interest in further research and participation. The grounded theory approach first came to prominence in Glaser and Strauss (1967). It has been adapted by numerous researchers, with a number of different interpretations evident, with its very nature contested by its originators (Locke 2001, Gibbs 2002). Despite numerous variations, grounded theory is now recognized as one of the most popular approaches to qualitative data analysis (Gibbs 2002).

*“Grounded theory methods consist of systematic, yet flexible guidelines for collecting and analyzing qualitative data to construct theories 'grounded' in the data themselves (Charmaz, 2006: 2).”*

The main points which make the case for the use of grounded theory in this research have been highlighted by Denscombe (2003) as:

- Uses empirical field research as its starting point (the researcher starts the fieldwork research early in the investigation)
- Develops its analysis with constant reference to fieldwork data (an iterative process)
- Produces explanations that are recognisable to the subjects of the research
- Is geared to modest localized explanations based on the immediate evidence
- Adopts an emergent design (based on theoretical sampling)
- Generally is linked with qualitative research, exploratory investigations, small-scale studies and research focusing on human interaction in specific settings.
- In relation to management research, grounded theory can be particularly useful in examining a wide range of issues about people, their behaviour, relationships and communications (Locke 2001, Goulding 2002).

The following aspects require careful consideration in the adoption of grounded theory:

**Prior knowledge:** the requirement for the researcher to enter the field with no prior knowledge has been questioned (Goulding 2002). It is now generally accepted that some prior reading is required to identify initial ideas and concepts, with the extant literature being incorporated into the emerging theory as the research progresses (Denscombe 2003).

**Theoretical sampling:** as concepts emerge from the initial field research, further sites are selected based upon developing categories and emerging theories (Goulding 2002). The rationale being that the selected sites best support the development of the theoretical framework (Locke 2001). The selection of appropriate comparative cases can also help to improve the developing theory leading to enhanced analysis.

**Data collection:** grounded theory has been adapted and integrated with other data collection methods such as case studies to offer a more robust qualitative research method (Locke, 2001). Due to the lack of focus on data collection, interviews with selected participants will be one of the primary methods used. The researcher can also write memos as part of the data collection process, these provide a bank of ideas which can be revisited; to help map out emerging theory and are used to identify concepts and their properties (Goulding 2002).

**Data analysis:** the main difference to have evolved between Glaser and Strauss has been in analysing the data (Gibbs 2002). A three-stage approach to analysis developed by Strauss and Corbin (1990) shall be adopted:

- *Open coding:* the text is read reflectively to identify relevant categories;
- *Axial coding:* categories are refined, developed and related or interconnected;
- *Selective coding:* the ‘core category’ or central category that ties all other categories in the theory together is identified and related to other categories.

In order to facilitate analysis of the data, the qualitative data analysis software, NVivo shall be utilized as, “*the design of NVivo was strongly influenced by grounded theory and therefore the program gives good support for the method (Gibbs 2002: 165).*”

**Theoretical saturation:** occurs when additional analysis no longer contributes to discovering anything new about a category and is vital if a theory of substance is to be developed (Denscombe 2003, Locke 2001).

**Writing Grounded Theory:** it is recommended that the style of presentation should move back and forward between extensive theoretical presentations and illustrative live excerpts from the research setting (Locke 2001). The use of diagrams can also aid the illustration of points being made (Goulding 2002).

**Reviewing Grounded Theory:** the proposed theory should be considered in terms of whether it is pragmatically useful and credible. Credibility, “*is not only a property of the developed theoretical frame but also its interaction with its intended audience (Locke 2001: 61).*” To check the credibility of the developing theory, the researcher should return to the original informants and obtain their opinions (Goulding 2002).

The grounded theory approach is now proving popular within the construction management research domain, with a number of current research projects being undertaken in the area of KM (Hunter *et al.*, 2005).

## **FUTURE RESEARCH ACTIVITIES**

It is now proposed that the research moves forward building upon the progress to-date and adopting a framework which capitalizes on the expressed interests of the leading Irish construction companies, and both EI and CITA (with whom many of the leading companies are involved). A number of critical activities need to be undertaken in order to advance the research. The concepts and categories which emerge from the previous stages (Field Research 1-3) will to a large extent dictate the direction of further research sites (i.e. theoretical sampling). It is intended to conduct further qualitative research exploring the strategic, cultural and technological considerations of KM, through the use of interviews and/or focus groups.

## **CONCLUSIONS**

This paper has reported on continuing research into KM within the Irish construction industry. Based on the progress to-date, the following conclusions can be drawn:

1. KM is now recognized as being important to both the global and Irish construction industries, having the potential to improve performance within organizations.
2. As a relatively young academic discipline, there exists a lack of understanding of both knowledge and KM within construction organizations.
3. KM is not solely an ICT-based endeavour; rather it requires strategic consideration of the integration of cultural and technological issues.
4. Despite the development of research into KM in construction, there still appears to be a gap between theoretical models (academia) and practical understanding (industry).
5. Significant progress has been made in the present study and there now appears to be an agenda for further research. Through a grounded theory approach, with the leading Irish construction organizations and professional bodies, further research is planned to develop an integrated KM model.

It is anticipated that the development of a model of KM will improve the understanding of knowledge and KM in practice and contribute to the advancement of the KM research agenda in construction both in Ireland and further afield. Furthermore, the formulation of a strategic framework for the promotion and development of KM will go some way to addressing the low levels of research and innovation within the Irish construction industry. By demonstrating that a collaborative approach between industry, academia and professional bodies can lead to real improvements, a new agenda for research may emerge and further research opportunities may arise. It is also intended that the research outcomes will impact upon future policy development within EI and their CPD accreditation scheme.

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