

**THE DEVELOPMENT AND IMPLEMENTATION OF KNOWLEDGE MANAGEMENT
FOR IRISH CONSTRUCTION ORGANISATIONS THROUGH GROUNDED THEORY**

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The construction industry is recognised as being poor at learning on a consistent basis and improving performance and is notoriously slow in adapting to progressive change. Knowledge Management (KM) has been promoted as a means of harnessing and utilising intellectual resources to address these challenges, in addition to improving innovation, business performance and client satisfaction. Two categories requiring KM in the construction industry have been identified; within projects, across temporary, multi-discipline project organisations; and within individual firms. It is accepted that there may be much greater potential for KM within individual companies. Despite the recognised need to adopt KM, it is considered to be in its infancy in the construction industry and is seen as a recent and evolving practice for construction organisations.

The lack of a working definition of knowledge within construction organisations 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. There is a dearth of empirical research and KM models for construction, resulting in the continuing need for the development and testing of such models. One theoretical model which was developed for, and tested by the leading Australian construction organisations was found to be conceptually too complex to understand and implement, even by some KM specialists within the contributing organisations.

This paper reports upon ongoing research into KM within the leading Irish construction organisations, and presents a strategic framework for the development of a KM model through a grounded theory approach. To-date, the research has engaged many of the leading construction organisations and has gained the support of Engineers Ireland (the country's leading professional body), the Construction Information Technology Alliance (CITA). The research has confirmed the need for a more coherent approach to managing knowledge and has highlighted a lack of understanding of KM and knowledge within the organisations involved. Through a cooperative approach between industry, academia and a professional body, the strategic framework aims to develop and test a model of KM for construction. The adoption of grounded theory will aid the practicality of the developed model as it produces explanations that are recognisable to the subjects of the research.

A key objective of the research is to devise CPD accredited education and guidance resources based on the developed model, to improve awareness, understanding, and implementation of KM within construction organisations. The delivery of such resources will contribute towards the evaluation of the developed model in terms of its usefulness and credibility with industry. It is expected that the research will contribute to the current body of KM research while having a real impact on the development and implementation of KM in construction organisations. The value which academic research can deliver to organisations has been questioned by a number of the research participants. By demonstrating that a collaborative approach between industry, academia and professional bodies can lead to be mutually beneficial, a new agenda for research may emerge in what is a traditional, conservative industry.

INTRODUCTION

Considered to be one of the most dynamic and complex industrial environments the construction industry is a project-based industry within which individual projects are usually custom-built to client specifications (Raiden and Dainty, 2006). Projects are typically delivered by a temporary organisation comprising designers, consultants, contractors, supplier and others. The need for knowledge management (KM) is particularly relevant to the construction industry which now faces many challenges. These include economic swings, new markets emerging in the global economy, increasing competition, the impact of technology, new and increasing demands from clients, customers and society, and the requirement to maintain a highly skilled workforce at all levels (Egbu and Robinson 2005). Contracting firms are becoming increasingly involved in challenging and complex, knowledge-intensive procurement routes such as management contracting, design and build, joint ventures, public private partnerships as well as the traditional procurement route. According to Quintas (2005) there are two potentially conflicting objectives of KM, to build knowledge bases cumulatively and to learn from past experience; and to ensure learning beyond core areas, generating the capability to assimilate new knowledge in order to be able to respond to change. In a study of American contractors, Fisher et al. (1998) identified a number of reasons for implementing KM practices as: high staff turnover leading to loss of experience; large size of organisations make sharing knowledge difficult; and departmental silos and fragmentation within the organisation.

Construction organisations have garnered much attention in terms of the potential benefits of knowledge management, with little evidence of how to actually manage knowledge in practice. A lack of understanding of both knowledge and its subsequent management within the industry indicates the need for further empirical research in the field (Robinson et al. 2005). The types of

organisation which shall be given consideration in this paper are main contractors. Traditionally, these organisations were labour-intensive employing a full workforce of labourers and tradesmen to execute the construction phase of a project on a building site. Many of these companies have now moved from being a 'building company' towards directly employing a core professional and management team to lead teams of outsourced contractors. The nature of the industry requires them to establish temporary organisational structures at dispersed geographical locations, frequently at a distance from central management (Raiden and Dainty 2006).

Against the backdrop of an industry which is highly competitive and exhibits low levels of research, the purpose of this paper is to present ongoing research into knowledge management within the leading Irish construction organisations. Through grounded theory approach a KM model will be developed and evaluated by industry, thus reducing the gap between theory and practice. Commencing with a background to the Irish construction industry this paper shall also present a review of literature related to KM in construction, progress in the research to-date, the proposed research methodology and future research activities.

IRISH CONSTRUCTION

The overall output of the Irish construction industry in 2006 was €36bn, accounting for 24% of the country's GNP, with over 12% of the country's workforce directly employed, making it a key driver of Ireland's economic growth over the past decade (Davis Langdon PKS, 2006). Despite this success, 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. The Chairman of the Forum for the Construction Industry (FCI) recently

expressed deep concern over “*the conservatism, lack of innovation and low levels of R&D in what is arguably one of Ireland’s most important industries*” (Kelly, 2005). In this context, the Forum for the Construction Industry (FCI), Engineers Ireland (EI) and the Construction Information Technology Alliance (CITA) have all cited the strategic importance of KM to the industry.

Applied Construction Innovation Centre

In 2003, the FCI commissioned a report exploring the business case for an Applied Construction Innovation Centre (ACIC). The report identified a number of key subject areas as strategically important for the development of Irish construction, including new materials and technologies, new construction processes and technologies, ICT and KM, environment and sustainability issues. Knowledge creation and innovation were identified as being principally driven “*at firm level, within a stimulating macro framework (Fitzpatrick Associates, 2003: 40).*”

Engineers Ireland

With in excess of 22,000 members EI is the largest professional body in Ireland, its primary role to be the representative voice of the engineering profession in Ireland, representing all disciplines of engineering. EI have recently introduced a Continuing Professional Development (CPD) accreditation scheme to support lifelong learning in member organisations in a range of sectors including ICT, consultancy, pharmaceutical and medical, manufacturing, construction, and public bodies. The scheme is designed to support lifelong learning, by stimulating and recognising good organisational practice in the areas of professional development for engineers and technical staff (but can also be applied to all staff members in all areas of an organisation). The scheme requires organisations to meet the following criteria: a CPD policy, individual training needs analysis and performance management, an average of 5 days formal CPD per

annum, a mentoring programme, involvement with professional institutions, and a KM system to ensure systematic capture and dissemination of useful knowledge and experience. Suggestions offered for knowledge sharing and KM include: regular briefings by staff to share technical and business knowledge, a company library, a lessons learned database, an engineering forum and an annual company symposium.

Construction Information Technology Alliance

The Construction IT Alliance (CITA) was formed in 2001 with the vision of harnessing the potential of information and communication technologies in the Irish construction industry. Membership of CITA includes of over 110 stakeholders in the Irish construction industry including leading architectural, engineering, surveying, management, construction, supplier, ICT and academic organisations. CITA activities include the hosting of bi-annual members meetings with expert guest speakers; the formation and encouragement of Special Interest Groups (SIGs) to address particular issues; and the development of funded relevant research work with the assistance of Enterprise Ireland. They have recently established a KM SIG to explore the technological aspects of KM.

KNOWLEDGE MANAGEMENT

Nonaka and Takeuchi (1995) classified two kinds of human knowledge, explicit and tacit. Explicit knowledge can be easily documented and shared and communicated quite easily in document form. Tacit knowledge, they argue is more important, and more difficult to articulate as it is embedded in individual experience. Proponents of managing explicit knowledge favour ICT as the main thrust of the KM initiative, while those favouring the management of tacit knowledge cite social interaction and culture as the most important aspects. While many early

KM initiatives focussed on ICT, it is now acknowledged that technology has an important, supportive role to play in KM. Moving forward, the HRM function in organisations have a vital role to play in creating HR policies to support KM involving the development of human and social capital (Storey, 2005). It is now recognised that an integration of both HR practices and technology presents the greatest potential for advances in the field and from this perspective, 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 organisation’s intellectual capital and performance.”*

Knowledge Management in Construction

There are two categories requiring KM in the construction industry: at inter-organisational level, within projects, across temporary, multi-discipline project organisations; and at intra-organisational level, within individual firms (Kamara et al. 2002). Even within organisations, the project-based, short-term and task-oriented nature of construction work inhibits learning on a continuous basis (Egbu and Botterill, 2002). It is recognised that construction organisations have been managing knowledge informally for years, but that the challenges facing the industry *“mean that most organisations now need a more structured, coherent approach to KM (Hari et al. 2004: 848).”* 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.”* 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 ICT tools to support information sharing and communication. In a survey of large UK construction organisations, it was found that a requirement to share tacit knowledge and disseminate best practice were key drivers of KM and a lack of time and standard work processes within organisations as the main barriers to KM (Carrillo et al., 2004). Other identified barriers to KM include lack of management support, employee resistance to sharing knowledge, poor ICT infrastructure, lack of dedicated resources, poor organisational culture, poorly articulated strategy, and difficulty in evaluating benefits (Robinson et al., 2005; Dainty et al., 2005). In considering KM within organisations, Nonaka and Takeuchi (1995) discuss four ontological levels of knowledge creation, individual, group, organisational and inter-organisational. In a similar vein, Jashapara (2004) discusses how learning occurs at individual, team and organisational levels, the human dimension being central to these.

Individual Knowledge

Knowledge workers should be self-starters, continually striving for creative solutions and building on their educational qualifications and experience repertoire and must be sufficiently motivated to seek out opportunities and design their own work, often with little direction (Storey, 2005). Motivating individuals to learn and share knowledge can be particularly difficult in pressurised environments such as construction where time for reflection is limited (Jashapara, 2004). Storey (2005) discusses knowledge workers in the context of training, empowering, and rewarding them, and more specifically the role of HR in facilitating the use of available knowledge and encouraging people to learn. Training and development is considered an

important aspect of KM by Olomolaiye and Egbu (2004) who cite the need to equip employees with the skills to manage their own learning and development and the development of an effective CPD plan. They also propose that awareness of KM can be improved by using training as a vehicle to focus on achieving quality, creativity, leadership and problem solving. Participation in continuing education, conferences and similar CPD activities can allow employees the opportunity to “*reflect upon their work, trade stories and ideas with co-workers, or catch up on professional theory and practice (Grisham and Walker, 2005: 554).*”

Project Knowledge

Every day on construction projects, new problems are encountered and solutions arrived at which are rarely documented, the lessons learned residing only with those individuals directly involved in the problem-solving process (Kazi et al., 2005). By capturing and sharing project knowledge, the amount of reinventing the wheel and waste can be reduced, whilst improving project performance. Traditional methods for capturing lessons learned include discussion and informal meetings followed by their documentation (Mohamed and Anumba, 2005). In a case study of a Finnish construction organisation, Kazi et al. (2005) identified a number of social processes for sharing project knowledge such as site visits, audits, and meetings.

Organisational Knowledge

In attempting to manage knowledge within construction organisations, there are three key types requiring consideration; product (technical knowledge), process (procedural and regulatory knowledge) and people (identifying people with specific skills and experiences) (Egbu and Robinson, 2005, Kamara et al., 2002). Practices for the sharing of such knowledge are identified in Table 1, many of which dovetail with HRM activities (Dainty et al, 2005).

Table 1: Organisational Knowledge-Sharing Practices

Informal knowledge workshops	Knowledge exchange seminars
Departmental meetings	Site visit programme
Summary Reports	Project award scheme
Coaching and mentoring	Brainstorming
Face to face interactions	Training

In addition to the provision of activities for sharing knowledge, “*there must be opportunity for research, innovation and divergence from the ‘normal’ course (Orange et al., 2003).*” The tension between learning anew, whilst also exploiting accumulated experience and knowledge is discussed by Jashapara (2004) who posits that such learning needs to be become embedded in organisational routines; leading to changes in behaviour, systems, structures and strategies.

Starting a Knowledge Management Initiative

In starting a KM initiative, it is important to consider the development of a strategy, understand the nature of knowledge, develop a knowledge-sharing culture, link KM to existing processes, provide support from both IT and non-IT tools and utilise a KM maturity scale in order to objectively benchmark KM implementation efforts (Robinson et al., 2005, Egbu, 2004).

Knowledge Management Strategy

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 (Carrillo et al 2004). Prior to developing a KM strategy, the effectiveness of current approaches to managing knowledge within the organisation should be explored in terms of people, process

and ICT. In a study exploring KM in construction, it was found that the majority of respondents did not have highly developed KM strategies, structures or an appropriate culture (Egbu 2004).

Technology Supporting Knowledge Management

Technology has an important role to play in managing knowledge in an organisation, particularly in supporting people in accessing, creating, sharing and using knowledge and identifying knowledgeable people (Walker et al., 2004). The role of ICT 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 ICT strategy being important in improving its effectiveness (Egbu and Botterill 2002). Prior to undertaking a KM initiative, Tiwana (2000) suggests that the existing infrastructure should be analysed in order to identify any critical gaps, allowing an organisation to build on what already exists, as opposed to starting from scratch.

Knowledge Management Studies

There have been a number of significant studies into KM in construction, most notably 'KM for Sustainable Construction Competitiveness', a major two-year research study in the UK, which found that people rely heavily upon communication to solve problems; the construction industry values experience very highly; and the industry finds it very difficult to capture knowledge gained from experience (Hari et al., 2004). The role of HRM and IT in KM in construction have been studied separately (Olomolaiye and Egbu, 2004, Egbu and Botterill, 2002). There has been a lack of KM models developed specifically for construction; one of the most noteworthy to date has been the Knowledge Advantage (K-Adv) model (Walker and Wilson, 2004). Developed in partnership with the leading Australian contractors, the K-Adv model was not adopted by the

participating organisations as it was judged to be “*too difficult to implement from the standpoint of challenging current competitive practices within organisations (Walker, 2005: 13).*”

RESEARCH METHODOLOGY

Initial Selection of Research Participants

The structure of the Irish construction industry is inherently complex; the size, range and characteristics of construction firms make obtaining a representative sample of the industry a difficult task. Therefore, it was decided to choose the twenty leading Irish construction companies, based on their turnover for the year 2004. These firms were selected as they are perceived to exert the most influence on the industry in general and it was assumed that by being the leading companies, they would be relatively similar in character in such a disparate industry. In addition, it was decided that any firms chosen must undertake general building and civil engineering works as its core business, and be based in, and undertake the majority of its work in the Republic of Ireland. According to Brannick and Roche (1997: 36), “*the nature of the sample to be drawn will depend to a large extent on the availability of a suitable sampling frame. This term simply refers to lists or other records of the population from which a sample can be selected.*” Two sampling frames were employed (Hayes, 2005; CIF, 2005) to identify these companies, thus increasing the likelihood of the inclusion of all eligible organisations. It should be acknowledged that some companies who are eligible may have been overlooked due to their absence from both lists.

Phase 1 – Survey of Top 20 Contractors

A survey was conducted as the first part of the study, with a focus on strategic and technological aspects of KM within the leading twenty firms. An initial phone survey was conducted in order to identify suitable survey respondents within each of these companies which found that none of the 20 companies had a Knowledge Manager or a director with responsibility for ICT. Based on the outcomes of the phone survey, it was decided to survey both the Director and ICT Manager of each of the selected 20 companies, which would allow a good overview of the company from both strategic and technological perspectives. Due to the time constraints and work loads of the intended respondents and the exploratory nature of the research, a self-administered questionnaire was selected as the means of conducting the survey. Two separate questionnaires were drafted for both the Managing Director and ICT Manager in each company. Following piloting and revision, the questionnaire was sent out to the intended respondents in June 2005, comprising 85% response from (17) Directors and 70% from (15) ICT managers, 13 of the companies returned both questionnaires. The outcome of this study is not intended to be applicable to the rest of the industry, in accordance with Robson's (1993: 140) views that *"small-scale surveys commonly employ non-probability samples. They are usually less complicated to set up and are acceptable when there is no intention or need to make a statistical generalization to any population beyond the sample surveyed."* Therefore no in-depth statistical analysis was utilised.

Phase 2 – Interviews with senior management

Following the survey of the leading twenty organisations, senior managers from ten of these organisations were then interviewed in order to get an overview of current approaches to managing knowledge from both strategic and operational perspectives. Based on literature reviewed, a number of key themes relating to KM formed the basis for the interview questions at

individual, project and organisational levels. Conducted in early 2006, all interviews were transcribed and manual content analysis undertaken allowing for the identification of key, substantive points and the categorization of responses.

Phase 3 – Case Study of a Leading Irish Construction Organisation

The possibility of conducting some a case study emerged from an interview with a director from an organisation who have achieved CPD accreditation from EI, in order to identify and evaluate KM practices. Such an approach was chosen as it seeks a range of different kinds of evidence in a case setting, which when abstracted and collated has the potential to provide the best possible range of answers (Robson, 1993). A multi-method approach to data collection was employed, comprising semi-structured interviews and self-administered questionnaires, which were conducted with a variety of individuals within the case study organisation (Robson, 1993). The representativeness of this study was not of major concern; rather the opportunity to explore the basic properties or dynamics of the organisation upon which to build further research was (Brannick and Roche, 1997). The case study adopted an emergent design, relying on findings from each stage governing subsequent lines of enquiry.

Interview with Director

In order to get a good overview of various KM-related issues, a semi-structured interview was conducted in January 2006 with one of the company's directors. This individual was selected as he is involved in the day-to-day running of construction projects, has an in-depth knowledge of the organisation and is responsible for CPD and training.

Staff Questionnaire

During the course of the interview, a number of topics related to managing knowledge were highlighted by the director including a lessons learned database (LLDB) and knowledge-sharing

seminars. Following the interview, a questionnaire for the organisation's staff was designed to explore the effectiveness of identified KM initiatives within the organisation. Due to a number of constraining factors including the geographical dispersion of staff at various construction site locations, a self-administered questionnaire was deemed the most appropriate data collection method. The selection of a suitable sample was based on discussions with the director and the company's human resource (HR) manager with a view to maximising the response rate (Brannick and Roche, 1997). Subsequently, the questionnaire was administered between February and April 2006, being e-mailed to 180 professional and management staff, achieving a 36% response rate.

Project Team Interviews

With the questionnaire completed, it was decided to undertake in-depth semi-structured interviews with a full project team based on a €70 million commercial development project in the south-east of Ireland. Conducted between May and June 2006, the interviews allowed for expansion upon issues covered in the questionnaire. The interviewees comprised thirteen professional and management staff, including a senior contracts manager, a project manager, three quantity surveyors, three engineers, four foremen and a safety officer.

Phase 4 – Interview with Engineers Ireland CPD accreditation manager

Having identified the important role which CPD accreditation has played in KM within the case study organisation, it was decided to approach Engineers Ireland. An unstructured interview was arranged and conducted with the EI CPD Accreditation Manager in July 2006, to discuss KM in relation to construction organisations. The general aims of the interview were to gain an understanding of the CPD scheme, the role of KM within the scheme and how construction organisations are addressing KM issues.

SUMMARY OF RESEARCH FINDINGS

Phase 1 – Survey of Top 20 Contractors

KM has the potential to bring real benefits in a competitive industry such as construction. It is now recognised that ICT has a supportive role to play in KM initiatives, particularly connecting people in geographically dispersed construction organisations. Prior to attempting to implement a KM strategy, it is prudent to assess the existing ICT infrastructure and tools used for managing knowledge within an organisation. Based on the survey of the leading twenty Irish construction organisations, one of the respondent organisations surveyed have a KM strategy. A further 41% intend to implement such a strategy within the short-term. The required ICT hardware infrastructure appears to be in place within the respondent's head offices, although the level of infrastructure on their sites 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 organisation-wide level.

Phase 2 – Interviews with senior management

Current practices for managing knowledge at individual, project and organisational levels in ten of the leading Irish construction organisations were identified through interviews with senior managers. Based on this investigation, the need for the implementation of KM within the leading Irish construction organisations is well recognised, although uncertainty exists about how to address this need. People are central to KM and the role of HRM is vital to creating a culture of knowledge sharing amongst employees and the development and implementation of KM

practices. The current range of practices employed in managing knowledge within the leading Irish construction organisations varies widely, although participation in the EI CPD accreditation scheme appears to have a positive influence on such practices.

Phase 3 – Case Study of a Leading Irish Construction Organisation

The KM practices of a leading Irish construction organisation were identified and evaluated, and were investigated in relation to the management of knowledge at individual, project and organisational levels. These practices include CPD and training; mentoring; appraisals; a lessons learned database; site visits; and knowledge sharing seminars. The project-based, unstable nature of the construction industry poses significant challenges to the adoption of KM. Geographical dispersion of temporary construction sites, time pressures high staff turnover and internal fragmentation within organisations all contribute to these challenges. As part of Engineers Ireland CPD accreditation scheme, PJH have attempted to address the need to manage knowledge, closely aligned with other CPD activities. This has led to a win-win situation with individual career development objectives being closely aligned to KM. The use of a lessons learned database for project knowledge has not proved as successful as anticipated. In order to improve its effectiveness, use of the database needs to be made part of organisational procedures and measured and made easy to use for all levels of staff. There is a need for improvement in two potentially conflicting areas: the development of more knowledge sharing initiatives focused on specific construction sites and the provision of structured opportunities to visit other sites. It appears that the intricacies of knowledge and KM are not fully understood within PJH. This would seem to indicate the need for further exploration of these issues by the company's senior management.

Phase 4 – Interview with Engineers Ireland CPD accreditation manager

Many of the leading Irish construction firms are currently involved in the CPD scheme, with two having achieved full accreditation. One of the key problems encountered by these firms is that they are struggling with the theoretical concept of KM, many initially believe that KM is solely an IT-based system. The CPD accreditation manager highlighted the fact that the role of the HR function was highlighted as being important in encouraging a knowledge-sharing culture. The prospect of developing guidance documentation and training resources aimed specifically at construction organisations was discussed as a possibility of raising awareness and understanding of KM, and ultimately improving its implementation. This was seen as being a good way of improving the situation, but such interventions would need to be *“from a source that they would see as credible and a source that they would buy into, for example, if they bought into CPD accreditation, then they would buy into what we’re recommending around KM.”* 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.

Summary of Findings

Having conducted the various phases of research, it is evident that the leading Irish construction organisations recognise the need to formally manage knowledge, yet many are unsure about where to begin. Having implemented KM practices as part of the EI CPD accreditation scheme, the case study organisation recognises the need to further improve these practices, and indeed, their understanding of knowledge and its management. The CPD accreditation scheme has a positive impact on the implementation of KM; the alignment of CPD with KM meriting further investigation.

MOVING FORWARD

An agenda for further development of KM now exists, through the development of a KM model with particular focus on CPD, it is hoped to lessen the gap between theory and practice. Indeed, during the interviews with senior managers, many questioned the benefits which academic research could bring to bear in industry. 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 a field. Having initially commenced in October 2004 as an MSc by research, the study has progressed to a PhD.

Aims and Objectives of PhD

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 organisations, 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 organisations.
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 organisation and industry levels within the Irish construction industry.

Proposed 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 anticipated that a number of case organisations 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 organisations 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 recognised as one of the most popular approaches to qualitative data analysis (Gibbs 2002). 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 localised 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 in exploring a wide range of issues about people, their behaviour, relationships and communications (Locke 2001, Goulding 2002). Initially it was proposed that the researcher should have no prior knowledge of the topic under investigation (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). As concepts emerge from the initial field research, theoretical sampling is used in selecting further sites 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. When additional analysis no longer contributes to discovering anything new about a category, theoretical saturation occurs, which is vital if a theory of substance is to be developed (Denscombe 2003, Locke 2001).

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 (Goulding, 2002). 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). In the evolution of grounded theory, the main difference 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:

1. *Open coding*: the text is read reflectively to identify relevant categories;
2. *Axial coding*: categories are refined, developed and related or interconnected;
3. *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 utilised as, “*the design of NVivo was strongly influenced by grounded theory and therefore the program gives good support for the method (Gibbs 2002: 165).*” In 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). Once developed, 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 capitalises on the expressed interests of the leading Irish construction companies, and both EI and CITA, with whom many of the leading companies are involved. To this effect, five of the leading Irish construction organisations have been selected where interviews are to be conducted with HR managers, ICT managers and staff. The utilisation of a case study methodology in conjunction with grounded theory will lead to a number of individual cases which will provide for cross-comparison. In order to benchmark construction organisations against other sectors, EI have provided assistance in arranging interviews with HR managers from nine accredited companies in industries such as manufacturing, local authorities, engineering consultancy and utilities. Upon completion of the interviews with both the construction and non-construction organisations, theoretical sampling shall be employed to select sites for further primary research and the consolidation of the model. CPD accredited education and guidance resources shall be developed based on the 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. It is anticipated that such research will foster stronger relationships between industry and academia, further connecting theory and practice.

CONCLUSIONS

An ongoing study into KM within the leading Irish construction organisations has been presented, identifying progress to date and the future direction of the research as a doctoral study. Based on this investigation, there are a number of conclusions which can be drawn:

1. The need for the adoption of a formal, structured approach to managing knowledge in construction organisations is well recognised in academia, although uncertainty exists about how to implement KM initiatives in practice.
2. In an Irish context, a number of bodies view KM as strategically important to the industry, with Engineers Ireland's CPD accreditation scheme requiring organisations to implement a KM system.
3. Many of the leading Irish construction organisations recognise the importance of implementing formal KM practices but are unsure of how to approach address such an initiative.
4. One organisation which has implemented KM practices as part of CPD accreditation acknowledges the need to further improve these practices, and indeed, their understanding of knowledge and its management.
5. Through further research and the adoption of grounded theory an integrated KM model (combining both HRM ad ICT) for the leading Irish construction organisations will be developed and evaluated in partnership with industry, connecting the theory of KM with practice.

As a result of the proposed research, it is hoped that awareness, understanding and implementation of KM can be improved within the leading Irish construction organisations. Through co-operation with industry, Engineers Ireland, CITA and academia, a new agenda for research may emerge in what is a traditional, conservative industry.

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