

Emerging Issues in Knowledge Management for Irish Construction Organisations: A Grounded Theory Approach

Brian Graham

Submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

School of Engineering
Waterford Institute of Technology

Supervisor: Dr. Ken Thomas

Submitted to the Higher Education & Training Awards Council

November 2010

Declaration

I declare that this thesis, in whole or in part, has not been submitted to any University as an exercise for a degree. I further declare that, except where reference is made in the text, the contents are entirely my own work. The author agrees that the library may lend or copy the thesis upon request for study purposes, subject to the normal conditions of acknowledgement.

Brian Graham

November 2010

Abstract

Emerging Issues in Knowledge Management for Irish Construction Organisations: A Grounded Theory Approach

Brian Graham

Construction organisations rely on the knowledge of their employees to successfully execute projects. Knowledge Management (KM) has been proposed as a means of harnessing such knowledge, yet to-date there has been little guidance on how it should be implemented in practice. The purpose of this research is to investigate the main issues associated with KM for the leading Irish construction organisations through grounded theory.

Emergent in nature, the research comprised four phases, each of which combined a review of relevant literature, primary research (including interviews, questionnaires, focus groups, case studies and action research) and the grounded theory analytical process. The research identified a clear need for improved KM, but also recognised that there is reluctance on the part of senior management to adopt KM in the current economic environment. To overcome this, these organisations need to build KM upon existing practices to effectively manage knowledge of people, projects and the organisation as a whole.

This study makes a contribution to knowledge in three areas; theory, methodology and practice. In terms of theory, this is the first and only comprehensive piece of empirical research to have identified the main issues facing the leading Irish construction organisations in adopting KM. It has also identified the potential to align KM with CPD, where the role and experience of construction professionals and professional body accreditation needs to be taken into consideration. From a methodological perspective, the research has confirmed the constructivist approach to grounded theory as a credible methodology for yielding a deeper insight into understanding the practice of KM in construction. Based on the identified issues, the practice of KM in some of the participating organisations has been improved and an educational module entitled 'KM in Construction' has been developed. Recommendations from the study highlight the need for additional testing and incremental adoption of the developed framework (in construction and other sectors) and further research into the alignment of KM with CPD.

Preface

Initial interest in conducting research arose whilst completing an undergraduate dissertation at Waterford Institute of Technology in 2002, in the area of Construction Process Reengineering. The possibility of conducting further research was discussed with Dr. Ken Thomas at the time, but was not taken further as I embarked upon a Graduate Diploma in Information Technology in Dublin City University to enhance my IT knowledge. Nearing completion of this course, contact was renewed with Dr. Thomas, who in his new role as Head of Department indicated that there was an opportunity to undertake some research. The present study commenced as an MSc by research in October 2004, with the initial objective of researching an aspect of IT in the Irish construction industry. After some consideration, it was decided to explore KM and the potential role of IT in developing a KM system. The primary research originally proposed, was relatively basic in its outlook, comprising a survey of the top twenty Irish construction companies, semi structured interviews with a small number of key individuals, and possibly a case study of the sponsoring organisation. Nearing the completion of the primary research phase for the MSc in January 2006, it became apparent that there was scope to pursue a PhD study. In accordance with the requirements of HETAC, a transfer proposal was submitted to and examined by Professor Charles Egbu, a recognised expert on KM in the construction industry. Following a successful transfer *viva*, and incorporating Professor Egbu's recommendations, the depth and level of primary research and analysis were significantly increased through the adoption of grounded theory. Various aspects of the research were disseminated through a peer-reviewed journal paper, fourteen conference papers and two industry publications (see Appendix R for further details).

Whilst many PhD candidates present their work in a traditional form of thesis, this documents attempts to echo the emergent nature of the research and the continuous interaction between myself, the research participants and the literature.

Acknowledgements

It would have been impossible to complete this research without the support and assistance of many people. In this regard, I would like to acknowledge the contribution of the following:

First and foremost, my supervisor, Dr. Ken Thomas who has provided tremendous support and guidance throughout this learning experience; the opportunities afforded to me over the past six years are greatly appreciated.

My colleagues in the Department of Construction & Civil Engineering at Waterford Institute of Technology, particularly Eugene O’Sullivan for welcoming me as a colleague and mentoring me in all aspects of lecturing and Dr. John Wall for being so generous with his time and advice, even when busy with his own commitments. I would also like to thank Ann Power for her assistance with all issues design and technology-related.

I would like to express my gratitude to the numerous organisations and individuals who participated in the research and gave their time willingly to share their knowledge and experiences, particularly those who opened doors and provided access to participants.

My friends, for providing a welcome distraction from the pressures of study and keeping me grounded!

To my brothers and sisters, who have supported me through my many years of education, especially my sisters Helen & Anne for proof-reading my thesis. Most importantly, my parents, who have encouraged my curiosity and interest in learning from an early age, and have provided me with the support required to pursue my studies.

And finally, Clare, who has been a constant source of motivation to me through the ups and downs that are part of a PhD...I told you it would be worth it in the end!

List of Abbreviations

ACIC	Applied Construction Innovation Centre
CAQDAS	Computer-Assisted Qualitative Data Analysis Software
CIBSE	Chartered Institute of Building Services Engineers
CIF	Construction Industry Federation
CIOB	Chartered Institute of Building
CITA	Construction Information Technology Alliance
CoP	Communities of Practice
CPD	Continuing Professional Development
DoETE	Department of Enterprise, Trade & Employment
EI	Engineers Ireland
FCI	Forum for the Construction Industry
GNP	Gross National Product
HETAC	Higher Education and Training Awards Council
HRM	Human Resource Management
IMI	Irish Management Institute
IT	Information Technology
KM	Knowledge Management
LL	Lessons Learned
LLDB	Lessons Learned Database
NFQ	National Framework of Qualifications
RIAI	Royal Institute of Architects of Ireland
RICS	Royal Institute of Chartered Surveyors
SCS	Society of Chartered Surveyors
SIG	Special Interest Group
VPN	Virtual Private Network

List of Figures

Figure 1: Overview of Thesis Structure	18
Figure 2: Interrelationships of Philosophy, Methodologies and Methods	21
Figure 3: Research Design Overview	53
Figure 4: Interrelationships of Constructivism, Grounded Theory and Methods	54
Figure 5: Literature Review and Research Design	57
Figure 6: The Continuum of Understanding	63
Figure 7: Hardware Infrastructure.....	80
Figure 8: Building a Business Case for Accredited Corporate Learning.....	93
Figure 9: Chapter 4 Overview.....	113
Figure 10: Respondents Hardware Infrastructure	126
Figure 11: Emerging Categories	149
Figure 12: Framework Emerging from Phase 1	151
Figure 13: Chapter 5 Overview.....	156
Figure 14: Age Range of Survey Respondents	158
Figure 15: Highest Educational Qualification of Survey Respondents	159
Figure 16: Job Title of Survey Respondents	160
Figure 17: Professional Body Membership	161
Figure 18: Non-Financial Motivational Factors.....	162
Figure 19: Areas Where Training Has Been Undertaken	163
Figure 20: Factors Influencing Use of Lessons Learned Database.....	166
Figure 21: Identifying Organisational Expertise.....	167
Figure 22: Meeting with Peers	168
Figure 23: Chapter 6 Overview.....	197
Figure 24: Chapter 7 Overview.....	229
Figure 25: Managing Organisational Knowledge	237
Figure 26: Managing Project Knowledge	244
Figure 27: Managing Professional Knowledge.....	252
Figure 28: The Role of IT	254
Figure 29: The Role of HRM.....	257
Figure 30: Framework Emerging from Phase 2	261
Figure 31: Chapter 8 Overview.....	267
Figure 32: Revised HRM Paradigm Model	297
Figure: 33 Chapter 9 Overview	306
Figure 34: The Five Paradigms	308
Figure 35: Integrating the Five Paradigms.....	310
Figure 36: Knowledge Management in Construction	312
Figure 37: Proposed KM Framework	317
Figure 38: Chapter 10 Overview.....	330

List of Tables

Table 1: KM in Construction Studies	5
Table 2: Key Statistics for Irish Construction 2005 – 2009.....	7
Table 3: Elements of the Research Process.....	22
Table 4: Basic Beliefs of Alternative Inquiry Paradigms	26
Table 5: Case Study Protocol.....	38
Table 6: Elements of the Axial Coding Paradigm	40
Table 7: Classifications of Organisation Knowledge	62
Table 8: KM in Construction Organisations – Benefits and Barriers	72
Table 9: Categories of Knowledge.....	75
Table 10: IT Infrastructure for KM.....	79
Table 11: Characteristics of Deep Smarts.....	84
Table 12: Management Levels in the Construction Industry	85
Table 13: Professional Bodies’ CPD Practices	88
Table 14: Recognised CPD Activities.....	90
Table 15: Comparison of CPD and KM.....	92
Table 16: Challenges in adopting LL practices in construction.....	97
Table 17: Comparison of KM Cycle and HRM Processes	107
Table 18: The Contribution of HR in Supporting and Developing KM	108
Table 19: Respondents Software Use	127
Table 20: Comparison of Knowledge Processes with Literature.....	141
Table 21: Additional Knowledge Processes from the Literature	141
Table 22: Survey respondents’ industry experience	159
Table 23: Site Visits versus Years Working for Case Study A	164
Table 24: Respondents Views on the Use of IT within Case Study A	164
Table 25: Reasons for Attending Seminars.....	165
Table 26: Use of Lessons Learned Database	165
Table 27: Company Experience vs. Ability to Identify Expertise	167
Table 28: Project Team Profile	169
Table 29: Knowledge Sharing Research Participants (First Cycle).....	199
Table 30: Focus Group Evaluation	206
Table 31: Lessons Learned Research Participants (Second Cycle).....	208
Table 32: Interview Participants involved in EI CPD Accreditation Scheme	268
Table 33: Reasons for Involvement in EI CPD Scheme	269
Table 34: Framework Evaluation Participants.....	318

Declaration	i
Abstract	ii
Preface.....	iii
Acknowledgements	iv
List of Abbreviations	v
List of Figures	vi
List of Tables	vii
1 INTRODUCTION.....	2
1.1 Knowledge Management in Construction	3
1.2 Research Context.....	7
1.3 Research Overview.....	12
1.4 Summary	19
2 RESEARCH METHODOLOGY	21
2.1 Conducting KM Research in Construction Organisations	23
2.2 Constructivism.....	26
2.3 The Grounded Theory Methodology.....	29
2.4 Research Design	44
2.5 Summary	54
3 LITERATURE REVIEW.....	57
3.1 Managing Knowledge	59
3.2 Knowledge Management in Construction	71
3.3 Continuing Professional Development.....	82
3.4 Lessons Learned Practices.....	95
3.5 Human Resource Management.....	99
3.6 Summary	110
4 SENIOR MANAGEMENT INTERVIEWS	113
4.1 Findings	114
4.2 Discussion	139
4.3 Framework Development and Theoretical Sampling.....	149
4.4 Summary	153
5 CASE STUDY A.....	156
5.1 Staff Survey Findings	158
5.2 Project Team Interview Findings	169
5.3 Management Presentation Findings	189
5.4 Summary	194
6 CASE STUDY B.....	197
6.1 Background	198
6.2 First Cycle Findings	199
6.3 Second Cycle Findings.....	208
6.4 Director Presentation	219
6.5 Summary	225

7	CASE STUDIES DISCUSSION	228
7.1	Managing Organisational Knowledge	230
7.2	Managing Project Knowledge	238
7.3	Managing Professional Knowledge.....	245
7.4	Use of Information Technology	253
7.5	Role of Human Resource Management.....	255
7.6	Framework Development and Theoretical Sampling.....	258
7.7	Summary	263
8	ENGINEERS IRELAND’S CPD ACCREDITATION SCHEME	267
8.1	Findings	268
8.2	Discussion	293
8.3	Summary	303
9	KM FRAMEWORK DEVELOPMENT & EVALUATION	306
9.1	Framework Development	307
9.2	Framework Evaluation	318
9.3	Discussion	325
9.4	Summary	327
10	CONCLUSIONS & RECOMMENDATIONS	330
10.1	Reflection on Aim and Objectives.....	330
10.2	Research Limitations	338
10.3	Recommendations.....	339
10.4	Contribution to Knowledge	341
	REFERENCES	344
	APPENDICES	363

“We are buried beneath the weight of information, which is being confused with knowledge; quantity is being confused with abundance and wealth with happiness.”

Tom Waits

Chapter 1

Introduction

1 INTRODUCTION

In recent times, knowledge has come to the fore of organisational research and government policy, with terms such as ‘knowledge management’ and ‘knowledge economy’ becoming increasingly prominent. Since the mid 1990s there has been a noted increase in Knowledge Management (KM) both in research and in practice with many organisations now employing chief knowledge officers or chief learning officers to develop a KM strategy and to lead initiatives (Ribeiro et al., 2005, Anumba et al., 2005). The concept of a knowledge economy is now a key policy consideration at national and international levels (OECD, 1996, Engineers Ireland, 2005), with a recent report from the Irish government espousing the development of a ‘smart’ or innovation-based economy (DoETE, 2009). With this increasing interest in knowledge and KM, there has been a growth in research seeking to explore the application of KM in the construction industry.

The research conducted within this thesis, which is concerned with the identification of emerging issues in KM for the leading Irish construction organisations, is achieved through a grounded theory approach. The purpose of this chapter is to discuss the background to, and need for this research, within the context of the Irish construction industry. On this basis, research questions are developed, the aim and objectives of the study are then presented, followed by consideration of the structure of the thesis.

1.1 Knowledge Management in Construction

Construction is a project-based industry, within which individual projects are usually custom-built to client specifications (Raidén and Dainty, 2006). Such projects are typically delivered by temporary project coalitions, comprising designers, consultants, contractors, specialist sub-contractors and suppliers, and are often characterised by adversarial and litigious relationships. There are numerous challenges facing today's construction industry: 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, Chen et al., 2005). The industry is recognised as being poor in its approach to learning and performance improvement and is notoriously slow in adapting to change (Chien and Johnson, 2002, 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, Bresnen, 1999).

A fledgling academic discipline, KM has been promoted as a means of harnessing and utilising intellectual resources to address these challenges, and to improve innovation, business performance and client satisfaction. There is, however, uncertainty about how to devise and implement a viable and cost effective KM initiative (Kamara et al., 2002b; Quintas, 2005). Interest in KM has stemmed from a number of issues: a dramatic improvement in data processing capabilities and communications technologies, an increased recognition that businesses must continuously improve, and an acknowledgement of learning as a core strategic competency (KLICON, 1999). Salisbury (2003) ventures that it is a rather vague topic, with as yet no common understanding, apart from organisations becoming 'smarter over time'. Two of the main disciplines to have embraced the KM discourse are information technology (IT) and human resource management (HRM), with an integration of these having the greatest potential for advances in the field (Carrillo, 2005a).

In attempting to approach KM from an integrated 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.”

KM has received significant attention from the Construction Management academic community in recent years, most notably from research groups led by Charles Egbu and Chimay Anumba. Evidence of this has also been seen in a number of recent publications and conferences (Walker, 2005). However, KM is considered to be in its infancy in the construction industry (Carrillo et al., 2004), and is very much a new and evolving practice for construction organisations (Robinson et al., 2005). A distinction is made in the academic literature between two categories requiring KM in the construction industry: within projects (across temporary, multi-discipline project organisations), and within individual firms (Kamara et al., 2002b). As KLICON (1999: 30) states *“there may be much greater potential for use within individual companies.”*

Large contractors have traditionally been labour-intensive organisations employing a full workforce of tradesmen and labourers. They have generally moved away from being a ‘building company’ towards directly employing a core professional and management team to lead teams of outsourced contractors (Raidén and Dainty, 2006). These companies are becoming increasingly involved in challenging and complex, knowledge-intensive procurement routes. In a study of Carillion, a leading UK construction company, Jewell and Walker (2005: 122) found the main motivation 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.”* The lack of a working definition of knowledge within many construction organisations, and little 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 have been a number of studies into KM in construction (see Table 1 for those which had been completed, at the time of the present research commencing), most notably “KM for Sustainable Construction Competitiveness,” a major two-year research study undertaken in the UK. This study highlighted the following points: that people rely heavily upon communication to solve problems, that the construction industry values experience very highly, that most companies regard training as a means to improving their existing knowledge, and that the industry finds it very difficult to capture knowledge gained from experience (KMfSCC, 2004). Other studies into KM practice within the construction industry have focused on both contracting and consultant organisations (Robinson et al., 2004, Kamara et al., 2002a, Hari et al., 2005, Egbu and Botterill, 2002, Boyd et al., 2004). The characteristics of these types of firms are inherently different to each other, and approaches to managing knowledge should be adopted to reflect this.

Research Area	Authors	Participants
KM for Sustainable Construction Competitiveness	KMfSCC (2004)	Contractors, construction associations, consultants, software & computing services, manufacturing and agriculture
CLEVER framework for selecting a KM strategy	Kamara et al (2002a)	Contractors, clients, consultants and manufacturing firms
IMPACT framework for KM	Robinson et al (2004)	Contractors and consultants
The K-Adv concept	Walker and Wilson (2004)	Large construction organisations
Knowledge capture awareness tool for SMEs	Hari et al (2005)	Architects, engineers and contractors
The role of HRM in KM	Olomolaiye and Egbu (2004)	Directors, HR managers, PM.
The role of IT in KM	Egbu and Botterill (2002)	FM, manufacturing, public sector, community housing association, QS
KM Specialists	Hayles and Egbu (2004)	KM construction specialists
Audio Diary and Debriefing in SMEs	Boyd et al (2004)	Site Managers, PM, QS, Consultants

Table 1: KM in Construction Studies

The role of HRM and IT have been studied separately in regards to KM in construction (Olomolaiye and Egbu, 2004, Egbu and Botterill, 2002). According to Walker and Wilson (2004), this discipline-specific approach has led to a lack of workable integrated models for KM in construction. One such integrated approach, the K-Adv model, which was

developed for leading Australian construction organisations was judged to be too difficult to implement by the organisations involved in the research (Walker, 2005). 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 organisations. Participants in the research indicated that a less complicated and shorter guidance document was preferable (Walker and Wilson, 2004). Hari et al. (2005) who developed a computer-based awareness tool for knowledge capture believe that more education and training of construction personnel is required in the area of KM. There is a dearth of empirical research on KM in construction resulting in the continuing need for the development and testing of integrated KM models for construction (Walker and Wilson, 2004, Egbu, 2004). The preceding discussion has indicated that further empirical research should focus on KM within construction organisations, and provide a working definition of knowledge, demonstrate the importance and potential benefits of KM in an understandable manner, and consider the integration of HRM and IT. It is these issues, which this research will address throughout the thesis.

1.2 Research Context

The context within which the research was undertaken is considered, examining the Irish economy and construction industry and the need for KM as highlighted by a number of industry bodies.

1.2.1 The Irish Economy and Construction Industry

Since the 1990s, Ireland has experienced unprecedented economic growth; this period of prosperity has come to be known as the ‘Celtic Tiger’. The roots of this phenomenon goes back to 1987, and the government’s establishment of “The Programme for National Recovery 1987-90,” which focused on curbing inflation through wage stabilisation, which was to be achieved by promoting good relations between employers, trade unions and government. Subsequent partnership programmes have contributed to continuing growth and stability in the intervening years. A key driver and beneficiary of this success in recent years has been the construction industry, with overall output of the industry peaking in 2007 at €38bn, accounting for 24% of the country’s GNP. However, an over-reliance on construction, and the housing market in particular was identified by DKM (2006), as a significant challenge facing both the economy and the construction industry. Other challenges identified, included: the introduction of fixed price government contracts, an increase in the number of foreign-based firms entering the market, and a predicted slowdown in construction output in the coming years. Indeed, DKM (2007: 4) stated that *“construction is a major sector of the economy and has a significant impact on the level of, and growth in, economic activity.”*

	2005	2006	2007	2008	2009E
Irish GNP (€bn)	145,306	154,520	161,244	156,760	142,652
Construction Output (€bn)	33,778	37,611	38,361	32,037	19,857
Direct Employees (No.)	238,000	267,000	261,000	214,000	138,000

Table 2: Key Statistics for Irish Construction 2005 – 2009

To illustrate this point, Table 2 from DKM (2009), demonstrates a number of key statistics for Irish construction for the period 2005 to 2009. It highlights growth in the economy,

construction output and construction employment up until 2007, the culmination of 13 years of continuous growth. At that time, DKM (2007: v) stated: *“the real difficulty for the Irish economy as it enters 2008 is the high reliance of output and employment growth on the construction sector.”* The latest figures suggest that construction output in 2009 was half of that in 2007, with the loss of over 120,000 construction jobs. Further significant reductions in output and employment in the construction industry are predicted by the end of 2010.

1.2.2 Knowledge Management in Irish Construction

Given the challenging times facing the Irish construction industry, it is argued that KM has an important role in ensuring that construction organisations remain competitive, learn from experience and are innovative in their outlook. Such issues have been discussed within the industry in recent years, for example, in 2005 the Chairman of the Forum for the Construction Industry (FCI) 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: 84).”* The Construction Industry Federation (CIF) highlighted the two most important elements in driving the future of innovation within the industry as *“knowledge-transfer and creative or ‘visionary’ thinking”* (CIF, 2004). Allied to the very nature of the industry, one that is presently in sharp decline, there is a need for construction organisations to be more agile, competitive and responsive to the demands being placed upon them. Returning to comments made by Jewell and Walker (2005: 122) who found the main motivation for KM to be the *“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.”* This further reinforces the importance of, and need for KM within the leading Irish construction organisations. Within this context, three leading industry bodies, the FCI, Engineers Ireland (EI), and the Construction Information Technology Alliance (CITA) have all cited the strategic importance of KM and its contribution to the knowledge economy.

Based on the recommendations of the government-led *Strategic Review of the Irish Construction Industry*, the Forum for the Construction Industry was established by the Minister for the Environment and Local Government in October 1997. The FCI is “*broadly representative of private and public clients, the building professions, contractors, the trades unions and the construction products manufacturers (FCI, 2003: 4)*” and acts in an advisory capacity to government on issues relating to the strategic development of the Irish construction industry. In September 2000, the FCI recommended the establishment of an Applied Construction Innovation Centre (ACIC) to “*provide a focus for continuous product and process development in the industry; develop technology transfer; and develop a culture of constant productivity improvements (Fitzpatrick Associates, 2003).*” As a result, the FCI commissioned a study to explore the business case for an ACIC in Ireland. While the unprecedented growth and success of the industry was acknowledged, the lack of innovation and knowledge creation was described as “*systemic, due to the inability to appropriate tangible benefits from the introduction of new ideas (Fitzpatrick Associates, 2003: 12).*”

Following a survey of seventy of the industry’s stakeholders, which included the twenty leading building contractors; it was found that levels of innovation were low, due to a lack of time, networking and idea sharing opportunities. “*The importance of human resources in the innovation process was one of the main findings. Four-fifths of the companies attributed the origin of initial ideas for innovation to their own employees (Fitzpatrick Associates, 2003: 18).*” The report highlighted the key subject areas as strategically important for the development of Irish construction as: new materials and technologies; new (construction) production processes and technologies, information, knowledge and communication, and associated technologies (including knowledge management) and wider strategic issues for the industry such as the environment, energy and sustainability. The work of CITA in the area of information technology in construction was seen as having a potential role within a wider ACIC, particularly in exploring KM for the industry. Despite the identified need for an ACIC, none of the reports recommendations were adopted as neither government nor industry was willing to fund such a venture. Further consideration will now be given to two bodies who have promoted the potential for KM in Irish construction, CITA and Engineers Ireland (EI).

CITA was formed in 2001 with the vision of harnessing the potential of information and communication technologies in the Irish construction industry. CITA's membership comprises of over 100 stakeholders, including leading architectural, engineering, surveying, management, construction, supplier, IT and academic organisations. Their 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. KM is one of the areas that CITA has identified as being important to its activities, establishing a KM special interest group (SIG).

Founded in 1835, EI is the largest professional body in Ireland, with in excess of 22,000 members. The primary role of EI is to be the representative voice of the engineering profession in Ireland, representing all disciplines of engineering. Whilst there are a number of bodies representing construction professionals (such as the CIOB, RIAI and SCS), EI's Continuing Professional Development (CPD) accreditation scheme is particularly relevant to this research. The scheme has the broad aim of supporting lifelong learning in member organisations in a range of sectors, including IT, consultancy, pharmaceutical and medical, manufacturing, construction, utilities, government departments and local authorities. This 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 CPD accreditation scheme requires organisations to have a CPD policy, a performance management system, provide 5 days formal CPD per annum, a mentoring scheme for junior employees, promote staff involvement in professional bodies, a defined system for co-ordinating and controlling CPD practices and, most relevant here, a Knowledge Management System to ensure systematic capture and dissemination of useful knowledge and experience. The KM system is outlined as a systematic process for:

- Determining what knowledge is required by the organisation
- Identifying where this knowledge is located (internal or external)
- Capturing, classifying and modifying knowledge in an appropriate manner
- Disseminating the information effectively within the organisation

Suggestions offered by EI 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. Based on initial desk research (comprising a review of EI's website and contacting their CPD Accreditation Manager by phone), many of the leading Irish construction companies are engaged in the scheme, either fully accredited or seeking accreditation. The importance of this scheme to these organisations will become evident as the thesis progresses. However, at this juncture it is worth quoting a comment made by CPD Accreditation Manager, which confirmed the need for the present study; *“compared to other industries, a lot of construction organisations are struggling with the concept of KM.”*

After a period of unprecedented growth, it is evident that the Irish construction industry, and indeed the country's economy, is currently experiencing significant decline in terms of both output and employment. In addition to increased competitiveness within the construction industry, the loss of employees has led to the loss of valuable knowledge and experience gained in recent years. Furthermore, the industry is recognised as needing to place more emphasis on innovation and continuous improvement through the development of its employees in order to be more responsive to the demands being placed upon them. In this regard, the need for a more structured approach to KM, which integrates both human resources and information technology, is recognised by bodies such as the FCI, CITA and EI. It is against this backdrop that the need for empirical research on KM within the leading Irish construction organisations has been identified as the basis for this study, which will now be given further consideration.

1.3 Research Overview

Having considered the need for KM in Irish construction in the context of a highly competitive industry, this section presents an overview of the research conducted in this thesis including the background to the study, the research participants, consideration of the research problem and research questions, the aim and objectives and the structure of the thesis.

1.3.1 Background

The research conducted for this thesis began as a Masters by Research in late 2004. This research was initially concerned with the role of IT in facilitating KM within the leading Irish construction organisations. Having completed primary research with senior staff in a number of the leading Irish construction organisations, and engaged with EI, it became apparent that there was an opportunity to develop the research into a more in-depth study in the form of a doctoral thesis (further description of the research process is provided in Chapter 2). Through initial research, it emerged that there was significant potential for the alignment of KM with Continuing Professional Development (CPD) for a construction organisation's professionals. During 2006, an MSc to PhD transfer report was developed and examined at a viva by a leading researcher in the field of KM in construction, Professor Charles Egbu. The proposed research was subsequently approved by Professor Egbu as being of PhD standard, with a number of recommendations being made to further enhance the study as work progressed (see Appendix A for further information).

1.3.2 Research Participants

There are two general strategies for selecting participants (such as people, organisations, locations etc.) in research; statistical or theoretical strategy. While a statistical strategy is concerned with sample sizes, theoretical sampling should focus on samples which are large enough to provide meaningful data of depth and quality (Leonard and McAdam, 2001, Birley and Moreland, 1998). With theoretical sampling, it is essential to establish the criteria upon which the selection of participants will be based (Schwandt, 2001; Eisenhardt,

1989). Due to the complexity of the construction industry, particularly in terms of the types and sizes of organisations engaged in construction-related activities, it was decided from the outset to utilise non-probability, theoretical sampling. Initially, it was decided to focus on the leading Irish construction organisations, based on their 2004 turnover. The top twenty contracting organisations were selected from two sampling frames (Hayes, 2005, CIF, 2005), thus increasing the likelihood of the inclusion of all eligible organisations. These leading firms were selected for a number of reasons, as follows:

- They are perceived to exert the most influence on the approach to managing construction projects and the industry in general (Thomas, 1999)
- Many of these organisations are engaged in Engineers Ireland's CPD Accreditation Scheme and are members of CITA, increasing the likelihood of their interest in KM
- Similar criteria were applied in the selection of survey respondents for the FCI-commissioned report for an ACIC in Ireland

Further discussion relating to these research participants will be undertaken in Chapter 2.

1.3.3 Research Problem

It is now recognised that knowledge is a critical organisational resource which, when effectively managed, can offer significant competitive advantage to construction organisations. KM is now acknowledged as being important to both the global and Irish construction industries, having the potential to improve performance within organisations. However, as a relatively young academic discipline, there exists a lack of understanding of both knowledge and KM within construction organisations. In developing a strategic approach to KM, the integration of both technological and cultural issues requires careful consideration. Whilst a number of studies have considered these issues separately, their integration has been highlighted as meriting further investigation (Walker and Wilson, 2004, Egbu, 2004). Furthermore, there is a need for further empirical research on KM in construction, in order to lessen the gap between theoretical models (academia) and practical understanding (industry). Alongside this recognised need for the continuing development of KM in construction, there is also a requirement for empirical research in the Irish

construction industry, with the importance of KM being emphasised by such bodies as the FCI, CITA and EI.

Based on the identified research problem and in order to guide the emergent research design, a number of research questions have been formulated as follows:

1. How effectively are the leading Irish construction organisations currently managing knowledge?
2. What are the main strategic, cultural and technological issues that must be addressed for the adoption of KM in construction?
3. Can construction professionals be encouraged to engage in KM through its alignment with existing organisational processes and activities?

According to Punch (2001: 14), “*research which is not pre-structured typically does not have specific research questions which are clear in advance...these things will emerge or unfold as the study progresses.*” Given the nature of the grounded theory approach (which will be given further treatment in Chapter 2) the questions will act as a guide in the early stages of the research (Chapters 3 to 6), with a shift in emphasis to grounded theory development in the latter stages (Chapters 7 to 9). They will be reflected upon at relevant points throughout the course of the thesis, and more specifically in the concluding chapter (Chapter 10).

1.3.4 Research Aim and Objectives

Through a grounded theory approach, the overall aim of this research is to investigate the issues associated with developing and implementing KM within the leading Irish construction organisations. In order to achieve the stated aim, the following objectives have been formulated:

1. To develop a critical understanding of knowledge and its management in a construction organisation setting
2. To identify existing approaches to managing knowledge within the leading Irish construction organisations and assess how they can be utilised to augment an organisational KM initiative
3. To ascertain how construction professionals can be encouraged to engage effectively in an organisational KM initiative
4. To formulate a grounded theory framework based upon the emerging issues, for improving awareness and understanding of KM within the leading Irish construction organisations
5. To identify whether the adoption of a constructivist approach to grounded theory is a suitable methodology for investigating KM within construction organisations

With regards to hypothesis formulation, Punch (2000: 40) states that “*a theory generation study aims to generate or develop a theory to explain empirical phenomena or findings,*” he continues, “*this has been a common model in some qualitative research, especially where grounded theory is favoured.*” As this study is concerned with theory development, no hypothesis has been formulated.

1.3.5 Thesis Structure

In his study of theses and their macro-structure, Paltridge (2002) identified four main kinds of thesis: ‘traditional: simple,’ ‘traditional: complex,’ ‘topic-based’ and ‘compilation of research articles.’ The ‘traditional: simple’ type, which is generally the most popular, follows the format of an introduction, literature review, materials and methods, results, discussion and conclusions. In the case of this thesis, the ‘traditional: complex’ type has been adopted as it typically reports on a series of studies and comprises an introduction and background to the study, review of the literature, consideration of general methods, a series of sections on each of the individual studies and a general conclusions section. Due to the iterative nature of the grounded theory methodology, this form fits in quite well with the variety of different studies which have been undertaken during the period 2004 to 2010. The ‘traditional complex’ type has been modified, leading to a thesis structure as follows:

- Chapter 1: introduces the background to the research and the problems to be addressed, the context in which the research was undertaken, and the aim, objectives and research questions of the study
- Chapter 2: considers the research methodology adopted, including the constructivist philosophy, the grounded theory methodology and the various data collection methods utilised, namely interviews, focus groups and surveys. Selection of participants through theoretical sampling is dealt with in the context of an emergent research design which also incorporates case study and action research
- Chapter 3: presents a review of literature relevant to the study which was dictated by the emergent nature of the research and undertaken throughout the course of the study. The chapter commences by providing an initial review of literature relating to managing knowledge, KM in construction and associated strategic, cultural and technological issues (which was conducted during 2004 and 2005), with subsequent areas of focus including CPD, Lessons Learned Practices (2006 to 2007) and HRM (2008)
- Chapter 4: presents the findings from interviews with senior managers and a survey of IT Managers (conducted during 2005). These findings focus on existing approaches to managing knowledge and current IT within the leading Irish construction organisations. Subsequent discussion and analysis leads to the development of an emerging theoretical framework upon which to base further empirical research

- Chapter 5: focuses on an in-depth case study of existing KM and CPD related practices within a leading Irish construction organisation, comprising a survey of professional staff and interviews with a construction project team (conducted during 2006). Feedback from a presentation of the case study findings to company management are also included to provide for further refinement of the emerging issues
- Chapter 6: presents the findings from an action research case study of the Pharmaceutical division of a leading Irish construction organisation which concentrates on capturing and sharing specialist knowledge gained on cleanroom projects, through a combination of focus groups, interviews and a questionnaire. This case study was undertaken between 2006 and 2007
- Chapter 7: drawing on the findings from the previous two chapters and building on the emerging framework from Chapter 4, this chapter seeks to discuss and develop the emerging issues further through the process of axial coding
- Chapter 8: based upon the categories to have emerged from the previous research, this chapter explores KM from the perspective of the EI CPD accreditation scheme in a number of both construction and non-construction organisations (conducted during 2008). Specific attention is given to further developing the categories through axial coding, especially the role of HRM
- Chapter 9: through the selective coding process, the five emerging categories are integrated to develop a KM framework for the leading Irish construction organisations. The framework is then evaluated with managers drawn from a leading Irish construction organisation in order to ensure its credibility with industry. Based on feedback obtained, the emerging issues and framework are further refined
- Chapter 10: outlines the major conclusions, limitations and recommendations drawn from the study

An overview of this structure and the time-bound nature of the research are graphically represented in Figure 1.

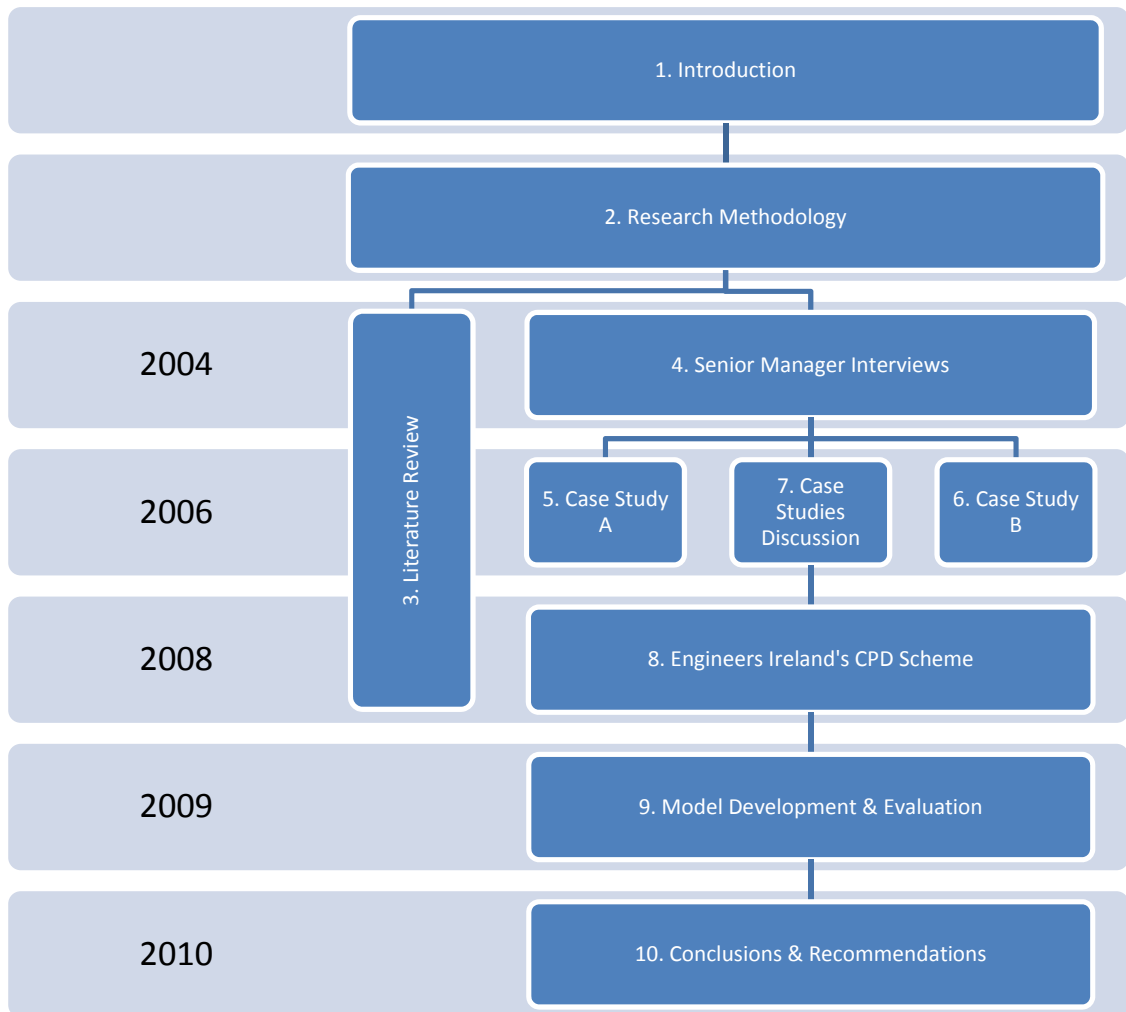


Figure 1: Overview of Thesis Structure

1.4 Summary

This chapter has introduced the research presented within this thesis, the following being a summary of the main points discussed:

- With KM being recognised as important to the construction industry, there is a need for further empirical research in this area
- A number of bodies and reports in the Irish construction industry have recognised the need for a more formal approach to KM; this is particularly relevant in the current challenging economic climate
- This study proposes to investigate the emerging issues associated with KM for the leading Irish construction organisations through grounded theory
- The structure of the thesis reflects the emergent nature of the research design which is guided by theoretical sampling as part of the grounded theory process

In this regard, the next chapter specifically deals with the grounded theory methodology and issues relating to philosophy, research methods and research design.

Chapter 2

Research Methodology

2 RESEARCH METHODOLOGY

Grounded theory has been selected as the research methodology for this study which according to Schwandt (2001: 161) “*occupies a middle ground between discussions of method and discussion of issues in the philosophy of social science.*” The rationale for choosing grounded theory and the interrelationships of philosophy; methodology and method will form the basis for the structure of this chapter (see Figure 2).

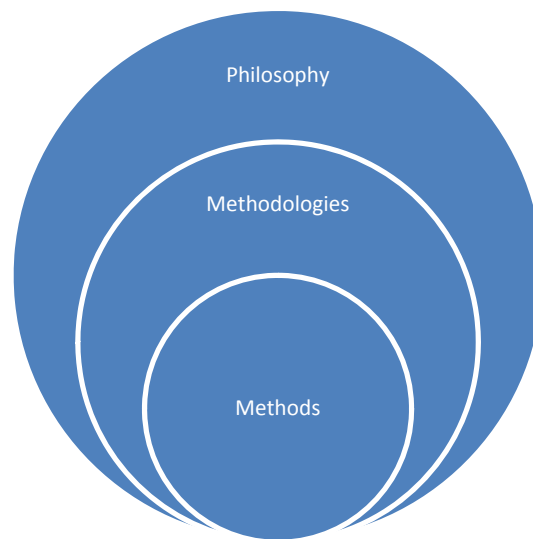


Figure 2: Interrelationships of Philosophy, Methodologies and Methods

As can be seen in Table 3, Denzin and Lincoln (2005) propose similar elements for the research process: theoretical paradigms and perspectives, research strategies, and methods of collection and analysis, offering a multitude of options for a researcher embarking on a study (the primary elements used in this study are highlighted in blue, with the secondary in orange). The purpose of this chapter is to consider the philosophical position of the research (constructivism), the methodology adopted (grounded theory) and methods employed (interviews, focus groups and questionnaires) in the context of the nature of the phenomenon under investigation.

Theoretical Paradigms and Perspectives (Philosophy)	Research Strategies (Methodologies)	Methods of Collection and Analysis (Methods)
Positivism, Post-positivism	Design	Interviewing
Interpretivism,	Case study	Observing
Constructivism	Ethnography	Documents and records
Hermeneutics	Phenomenology	Visual methods
Feminism	Ethnomethodology	Questionnaires
Racialized discourses	Grounded theory	Data management methods
Critical theory	Life history	Computer-assisted analysis
Marxist models	Historical method	Textual analysis
Cultural studies models	Action and applied research	Focus groups
Queer theory	Clinical research	Applied ethnography

Table 3: Elements of the Research Process

In this regard, the chapter explores the challenges of researching knowledge and knowledge management within construction organisations; discusses research paradigms and the adoption of a constructivist position. The grounded theory methodology is considered in terms of its appropriateness to the present study and a mixed-method approach of interviews, focus groups and questionnaires is examined in terms of the rationale for their selection and subsequent utilisation. Specific consideration is then given to the different elements of primary research that were conducted, including a survey of the leading twenty leading Irish construction organisations, interviews with senior managers from ten of these, two in-depth case studies, interviews with HRM/CPD managers from a mix of fourteen construction and non-construction organisations, and a third case study for evaluating the emerging issues and developed framework. In addition to the grounded theory methodology, case studies and action research were also employed during the research, and are considered within the section on research design.

2.1 Conducting KM Research in Construction Organisations

The study of knowledge and KM in any organisational setting is considered a complex undertaking due to the experiential, social and context-specific nature of knowledge (Karami et al., 2006, Kurul et al., 2004). As Sousa and Hendriks (2006: 316) has stated, interest in KM from both industry and academia has prompted the increasing exploration of *“the value and the location of organizational knowledge, promoting its creation, its development, its sharing and its diffusion.”*

With KM being explored by different disciplines such as Information Systems, Management and Systems Thinking, Guo and Sheffield (2008) identify three key perspectives on researching KM in organisations. These are: the identification and examination of different types of knowledge, knowledge being inseparable from knowing how to get things done in complex organizational work, and knowledge and organisational politics being intrinsically linked. Birley and Moreland (1998) also acknowledge the relationship between politics and knowledge, which they contend, is largely ignored because of the difficulty in the honest reporting of empirical evidence in power relations. Indeed organisations are complex entities which are deliberately created to pursue certain objectives and encompass human, structural, political and cultural issues. The formation of social groups with shared norms of behaviour, perspectives and values requires the researcher to *“to identify and examine the different perceptions and understandings that individuals and groups have of situations, their place within them, and what this means for the way they behave and what they do (Birley and Moreland, 1998: 104).”* From this perspective, Sousa and Hendriks (2006) discuss the socially constructed nature of knowledge and the limitations associated with adopting quantitative methods to explore knowledge-related issues. Coupled with the difficulties of researching knowledge in an organisational setting, the multi-dimensional nature of KM in organisations requires the consideration of existing formal and informal KM practices, structure and culture, tools and technologies that support KM and measurement of the effects of KM (Kurul et al., 2004).

In an analysis of research methods employed in 160 KM articles, Guo and Sheffield (2008: 682) found that “*sample survey occurs most frequently, followed by field study, theory building and literature review.*” Based on their analysis, they concluded that KM research is dominated by positivism and the sample survey research method. This is a view that is shared by Karami et al. (2006), who cited the dominance of questionnaires and a leaning towards positivism in KM research. They recognise, however, that qualitative approaches are becoming increasingly popular.

As outlined in Chapter 1, the construction industry exhibits many challenging characteristics which highlight the need for continuing KM research, such as the short-term, project-based nature, instability and chronic knowledge loss. Kurul et al. (2004) add other issues such as fragmentation, inefficiency, lack of innovation and short life-span of companies. Not only do these present an opportunity for the adoption of KM practices, they also pose significant challenges for researchers in engaging with and having impact in the industry.

Dainty (2007) discusses a debate which began within the construction management research community in the mid 1990s focusing on the culture of research within the industry and a tendency towards a positivistic approach. It was suggested that if researchers wished to “*have a role in changing the culture of the industry, then the culture of research must change also (Seymour and Rooke, 1995: 511).*” In taking up the debate, Dainty (2007: 9) suggests that this particular research community is still rooted within the positivist tradition, meaning researchers will be unable to “*grasp the meaning of social action from the perspective of the actors involved.*” In order to redress this myopic approach, Dainty (2007) proposes that methodological pluralism be embraced, whereby multiple theoretical models and methodologies are used to further knowledge. He states that “*a more expansive outlook towards mixing methodologies and research paradigms could yield deeper insights into, and understanding of, the way that practitioners ‘do’ management in the construction sector (Dainty, 2007: 9).*”

From the perspective of the Irish construction industry and the perspective of this research, there has been 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: 84).*” A survey of third level built environment education providers by Thomas et al. (2007) revealed a distinct lack of doctoral level research, particularly in the field of construction management. It was found that there were 78 students in the Republic of Ireland studying for a PhD qualification in the area of engineering, 6 in architecture and none in either construction management or economics. Whilst not conclusive, this would seem to indicate doctoral level research specifically related to construction management is virtually non-existent, in a country where industry have also been noted for lacking in R&D and innovation. It is expected that this research will make a contribution to Irish construction management research from both an academic and industry perspective.

Based on the preceding discussion, it can be surmised that conducting research into KM within construction organisations is challenging due to the complex nature of knowledge. The research methodology outlined in this chapter will attempt to address such challenges and the need to move away from positivism in terms of both KM and construction management research. Furthermore, there is a need to address the distinct lack of academic research specific to the Irish construction industry.

2.2 Constructivism

In undertaking research, Dainty (2007) emphasises the importance of constructing a philosophical position and orientation towards the inquiry. According to Walliman (2001), the adoption of a particular philosophical position will determine the nature of the enquiry and the choice of appropriate research methods. McCallin (2003) recommends reviewing the philosophical background and considering the paradigm of inquiry, early in the research process. Ignoring such issues, according to Amaratunga and Baldry (2001) can have a detrimental effect on the quality of the research. The adoption of a particular paradigm in research is not merely concerned with philosophical debate, according to Guba and Lincoln (1994: 112), but has “*important consequences for the practical conduct of the inquiry.*” They continue by identifying four research paradigms; positivism, post-positivism, critical theory and constructivism, an overview of each being provided in Table 4, where the epistemological, ontological and methodological characteristics are presented, with both critical theory and constructivism falling under the interpretivist umbrella.

	Positivism	Post-positivism	Critical Theory	Constructivism
Ontology	Objective reality	Imperfect reality	Historical reality	Multiple, social realities
Epistemology	Findings true	Findings probably true	Value-mediated findings	Created findings
Methodology	Experimental/manipulative	Modified experimental/manipulative	Dialogue/dialectical	Hermeneutical/dialectical

Table 4: Basic Beliefs of Alternative Inquiry Paradigms (Adapted from Guba and Lincoln, 1994)

A relatively new field of enquiry, construction management is viewed by Dainty (2007) as being firmly rooted within the positivist tradition, leading him to question the ability of the construction management research community to provide a rich and nuanced understanding of industry practice. This view is reinforced by Guba and Lincoln (1994) who identify a number of critiques of positivism including: loss of context, exclusion of meaning and purpose, disjunction from local contexts, inapplicability of general data to individual cases and exclusion of the discovery dimension in inquiry. In the context of attempting to understand knowledge and KM in an organisational setting, constructivism has been adopted as the philosophical position of this research, the rationale for which will now be

outlined. The reasons for adopting constructivism, which will be discussed in further detail, include building a shared construction of knowledge between the researcher and participants. This can mitigate some of the previously identified challenges of KM research such as the complex nature of knowledge, and the recognition of both the individual's perspective and the socially-constructed nature of knowledge.

Understanding the complex world of lived experience and situation-specific meanings from the perspective of those social actors who live and construct it is the principal goal of constructivism. Despite its relatively recent popularity in the social sciences, the roots of constructivism can be traced back to the earliest philosophical arguments over a rational foundation for knowledge (Schwandt, 1994). More recently, according to Morris (2006) the constructivist approach is rooted in the works of Egon Guba and Yvonna Lincoln.

Schwandt (1994: 118) states that *“the constructivist or interpretivist believes that to understand this world of meaning one must interpret it.”* In discussing the constructivist paradigm, Morris (2006: 194) states that human experience is understood as a subjective reality, where individuals understand the world from their own point of view and that *“nobody can stand outside the human experience to observe laws and regulatory mechanisms independent of situation and person.”* Constructivists, she contends, propose that knowledge is a set of shared understandings or constructions. In this regard, Schwandt (1994: 125-126) provides the following definition:

“Constructivism means that human beings do not find or discover knowledge so much as construct or make it. We invent concepts, models and schemes to make sense of experience and, further, we continually test and modify these constructions in light of new experience.”

Guba and Lincoln (1994: 110-111) define constructivism in terms of ontology, epistemology and methodology as follows:

- **Ontology:** reality is constructed by individuals or groups *“in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature”*

- Epistemology: the researcher and research participants interact “*so that the ‘findings’ are literally created as the investigation proceeds*”
- Methodology: through interaction and continuous refinement of the researchers and participants individual constructions, the aim “*is to distil a consensus construction that is more informed and sophisticated than any of the predecessor constructions*”

The adoption of the constructivist approach is suited to research where “*the goal is not to arrive at research findings that can be generalized to other settings but rather to gather valid data about a problem or issue in its context (Morris, 2006: 197).*” This point is pertinent in the context of this research which will specifically investigate emerging issues relating to KM for the leading Irish construction organisations.

In a research setting, knowledge of the inquirer and the participants is continually revised with the aim of moving toward consensus through “*the formation of ever more informed and sophisticated constructions,*” the role of the inquirer being to both participate in, and facilitate this process (Guba and Lincoln, 1994: 113). Schwandt (1994) views this process as moving from the initial identification of participant’s issues and/or concerns, through a process of iteration, analysis and critique, towards a joint construction, which should be evaluated for fit with the data and credibility with the participants.

In creating a shared construction through a collaborative approach, Morris (2006) discusses the constructivist approach as a hermeneutic dialectic; hermeneutic because it seeks out individual interpretations and dialectic because these interpretations are compared and contrasted in order to develop a consensus construction as discussed by Guba and Lincoln (1994). This process involves the identification of a hermeneutic dialectic circle of key informants who are accessible and can offer the researcher access to other stakeholders as the research necessitates. In the early stages of the research, the initial hermeneutic dialectic circle should aid the development of the research focus, in conjunction with the integration of the researcher’s own construction and the literature’s construction (Morris, 2006). Such issues are also particularly pertinent in relation to the grounded theory methodology which recognises the contribution of the research participants, the researcher and the extant literature, which will now be discussed in further detail.

2.3 The Grounded Theory Methodology

The grounded theory methodology was first discussed by Glaser and Strauss in their 1967 text, *The Discovery of Grounded Theory*. Through a set of highly developed analytical procedures, the main aim of grounded theory is to produce formal, substantive theory about the behavioural patterns that shape social processes as people interact (Schwandt, 2001, McCallin, 2003). The central features of grounded theory are identified by Strauss and Corbin (1994: 283) as *“the grounding of theory upon data through data-theory interplay, the making of constant comparisons, the asking of theoretically oriented questions, theoretical coding and the development of theory.”*

In general, the main features of grounded theory, as identified by Denscombe (2003), include:

- Using empirical research as its starting point
- An iterative process of data collection and analysis
- Producing explanations that are recognisable to the subjects of the research
- Being geared to modest localised explanations based on the immediate evidence
- An emergent design
- Being linked with qualitative research, exploratory investigations, small-scale studies and research focusing on human interaction in specific settings

The philosophy of grounded theory lies in symbolic interactionism which posits that meaning is socially constructed, negotiated and changes over time through the reflexive interaction of individuals (Mansourian, 2006, Goulding, 2005, Loosemore, 1999). With the passing of time, the originators of grounded theory have adopted differing approaches to this methodology, leading to an ensuing academic debate over the characteristics and definition of grounded theory. The contrasts between and within the Glaserian and Straussian schools of grounded theory lie in their methodological procedures for coding data and developing categories, memoing and sampling, emergence, researcher distance and theory development (Jones and Noble, 2007; Mansourian, 2006). Strauss and Corbin, according to McCallin (2003: 205), provide *“a clear, explicit framework that is often reassuring for new researchers,”* whilst Glaser’s more open version may be viewed as less

constraining. In fact, Glaser was highly critical of the approach developed by, viewing it as too rigid and not grounded theory. Goulding (1998: 52) furthers this discussion stating that the theory developed using Glaser's approach will "*only explain the phenomenon under study*", while Strauss's approach seeks to "*conceptualise beyond the immediate field of study.*" Strauss and Corbin's (1998) version was deemed the most suitable approach for the present study due to the clear instructions provided and the ability to relate the findings to a broader context.

Despite numerous variations, grounded theory is now recognised as one of the most popular approaches to qualitative data analysis (Gibbs, 2002). In the context of management research, grounded theory can be particularly useful in exploring a wide range of issues about people, their behaviour, relationships and communications (Locke, 2001, Goulding, 2002). The use of grounded theory has proven particularly popular in complex and unfolding scenarios as it develops theory which is relevant to practitioners (Jones and Noble, 2007). This pragmatic orientation requires the researcher to remain as closely as possible to practical, empirical reality (Selden, 2005). The focus on remaining grounded can be useful when dealing with the concept of knowledge management in organisations, especially in conceptualising manager's practices and opinions (Sousa and Hendriks, 2006). The grounded theory approach has also become popular within the construction management research domain, with a number of recent research projects being undertaken in the area of KM (Hunter et al., 2005). Two Doctoral studies which demonstrate the adoption of grounded theory for KM in construction research can be found in Maqsood (2006) and Suresh (2006). Grounded theory has been adopted for this study as it has the potential to offer a pragmatic explanation of KM for the leading Irish construction organisations that can be understood and adopted by them.

2.3.1 *Grounded Theory and Constructivism*

In common with other social science positions, the focus of grounded theory is on the individual's perspectives and interpretations, and those of others (Strauss and Corbin, 1994). As a result, it has been adapted by researchers to fit with a variety of philosophical positions such as constructivism, feminism, critical thinking and postmodernism (Mills et al., 2006). A constructivist approach to grounded theory, which has been adopted in this study, posits that knowledge is constructed to make sense of experience and is continually modified and tested in light of new experiences (Schwandt, 1994). In adopting a constructivist approach to grounded theory, Mills et al. (2006) discuss the need for a sense of reciprocity between the researcher and participants which facilitates the co-construction of meaning, leading to the use of participants stories framed within the written theory. Strauss and Corbin (1994) reinforce such considerations, citing the importance of interplay between the researcher and the participants and the incorporation of multiple perspectives in writing the emerging theory. The inclusion of practitioner insights through a recursive sense-making process capitalises on a rich practitioner knowledge base (Leonard and McAdam, 2001). From this perspective, a constructivist approach to grounded theory capitalises on the hermeneutic dialectic as previously identified by Guba and Lincoln (1994).

2.3.2 *Selecting a Version of Grounded Theory*

There is a need for rigour in the use of grounded theory. Chiovitti and Piran (2003) discuss the numerous versions of the methodology and identify the requirement for clear articulation of the process by which theory was generated. Jones and Noble (2007) criticise the "free-for-all" manner in which grounded theory has been used to-date, citing the need for more discipline in the methodology. Goulding (2005) confirms this position, reporting that many research papers which purport to use grounded theory are nothing more than purposive sampling and interviews, lacking any level of theoretical sensitivity. In a review of empirical studies that have reported using grounded theory, Jones and Noble (2007) found a number had omitted theoretical sampling, leading to a theory lacking in density and variability. This may be due to researchers not understanding the important aspects of the

methodology and concentrating only on coding (Strauss and Corbin, 1994). In attempting to restore integrity to grounded theory, Jones and Noble (2007) recommend that the researcher should clearly state the version of grounded theory they intend to use, and adhere to its procedures.

Given the debate regarding integrity, the present study adopts the version of grounded theory developed by Strauss and Corbin (1998), a key feature of which are the detailed open, axial and selective coding procedures. While Strauss and Corbin's version of grounded theory has been viewed as being too rigid by some, they counter that the "*suggested guidelines and procedures allow much latitude for ingenuity and are an aid to creativity (Strauss and Corbin, 1994: 273).*" In terms of the previous discussion surrounding grounded theory and constructivism, Mills et al. (2006: 9) have noted that "*clearly, Strauss and Corbin's evolved grounded theory has some constructivist intent.*" Bringer et al. (2006: 246) cite this constructivist revision of grounded theory as being particularly suitable for developing theory where a theory which is "*relevant to the specific topic and population of study does not exist.*" In the case of this research, Chapter 1 has demonstrated both a clear need for further empirical KM research, and indeed, research specifically targeted at the leading Irish construction organisations.

2.3.3 *The Researcher's Experience*

Due to the inherent complexities of grounded theory, there are significant challenges for any researcher in adopting this approach (McCallin, 2003). The following challenges were identified by Hunter et al. (2005): management of large amounts of data, remaining open-minded, anxiety over achieving saturation, and the selection of an appropriate version of grounded theory. The time-consuming nature of grounded theory, particularly in relation to analysing data and reaching theoretical saturation can prove problematic in defining a time-scale for the research. Mansourian (2006) therefore recommends that grounded theory is suited to long-term research projects such as a PhD, further reinforcing its appropriateness for the present study.

In addition to the researcher's experience of grounded theory, there has been much debate about the level of a priori knowledge with which they enter the field (Goulding, 2002). Whilst it is impossible to begin research with no preconceived ideas, Eisenhardt (1989: 536) highlights the importance of being as close as possible to having "*no theory under consideration or hypotheses to test...because preordained theoretical perspectives or propositions may bias and limit the findings.*" She recommends that the formulation of a research problem and identification of important variables be made through some reference to extant literature. The widespread availability of information generally negates the ability of a researcher to begin their study with no prior knowledge (McCallin, 2003). Indeed Gibbs (2002: 166) comments "*few users of grounded theory are absolutely strict about keeping out theoretical presuppositions at the start of the analysis.*"

2.3.4 Use of Literature

It is now generally accepted that some prior reading is required to identify initial ideas and concepts, with the literature being incorporated into the emerging theory as the research progresses (Denscombe, 2003). However, if the area of interest has a long, credible and empirically based literature, the application of grounded theory will prove quite difficult (Goulding, 2002). As has already been discussed in Chapter 1, KM in general, and more specifically, in construction is a new field of enquiry making grounded theory an appropriate methodology.

Another problem is the timing of the literature review in grounded theory. McCallin (2003) reports upon previous research in which an initial literature review was undertaken as a basis for comparison with emerging concepts from collected data. It is important that such a review is not exhaustive prior to the research, rather "*the developing theory should direct the researcher to appropriate extant theories and literature that have relevance to the emerging, data grounded concepts* (Goulding, 2005: 296)." Literature should be consulted in order to identify both similarities and conflict with the emerging theory. The identification of similarities between the grounded theory and the literature can help to improve the transferability, validity, and generalisability of the theory (Chiovitti and Piran, 2003). Conflicting literature is equally important, for two reasons, according to Eisenhardt

(1989). Firstly, ignoring such literature reduces confidence in the findings and secondly, conflicting literature can force the researcher “*into a more creative, frame breaking mode of thinking than they might otherwise be able to achieve (Eisenhardt, 1989: 544).*”

2.3.5 Theoretical Sampling

The adoption of a sampling strategy for selection of participants requires consideration in commencing, and throughout a grounded theory study. There are two general strategies for selecting participants (such as people, organisations, locations etc.); statistical or theoretical strategy. While a statistical strategy is concerned with the ability to make generalisations based on the selected sample, theoretical sampling should focus on samples which are large enough to provide meaningful data of depth and quality (Leonard and McAdam, 2001, Birley and Moreland, 1998). Unlike quantitative research, qualitative studies need not be overly concerned with representative, typical or extreme types in the selection process (Denscombe, 2003). With theoretical sampling it is essential to establish the criteria upon which the selection of participants will be based (Schwandt, 2001; Eisenhardt, 1989). In the case of grounded theory, Goulding (2005) suggests initially talking to informants who are most likely to provide information which may lead to provisional concepts and “*direct the researcher to further ‘theoretically’ identified samples, locations, and forms of data.*”

As new theoretical ideas emerge then, theoretical sampling is pursued; this is “*the purposeful selection of a sample according to the developing categories and emerging theories (Goulding, 2002: 66).*” The rationale of theoretical sampling is to gather “*information that will best support the development of the theoretical framework (Locke, 2001: 55).*” Varying levels in the sampling strategy (i.e. organisations, groups and individuals) can facilitate the development of rich, multidimensional conceptual categories, increasing the rigour of the research (Locke, 2001). Indeed Gibbs (2002) recommends that settings, respondents or data sources that are distinctive or different according to the emerging theory should be sought out. The selection of appropriate comparative cases can also help to improve the developing theory, leading to enhanced analysis, identification of the affect of different conditions, ensuring enough information is collected, and helping identify where the theory is more or less useful (Locke, 2001). Theoretical sampling

should direct the researcher to further opportunities for field research, with the theory only being presented once all categories have reached saturation (Goulding 2002). Theoretical saturation occurs when additional analysis no longer contributes to discovering anything new about a category (Denscombe, 2003, Locke, 2001). In order to develop a theory of substance, it is important that theoretical saturation is reached; furthermore the researcher should avoid coming to closure too early (Goulding, 2002).

2.3.6 Data Collection Methods

The chosen methodology, the scope of the study and type of information required will dictate the types of methods used (Clough and Nutbrown, 2002). Eisenhardt (1989) states that research focused on theory building will typically combine multiple data collection methods. It is argued that both qualitative and quantitative research have a role to play in developing grounded theory; Strauss and Corbin (1998: 34) state that “*qualitative should direct the quantitative and the quantitative feedback into the qualitative in a circular, but at the same time evolving, process with each method contributing to the theory in ways that only each can.*” The mixing of qualitative and quantitative methods can be viewed as complementary, echoing the call for methodological pluralism in construction management made by Dainty (2007). Gillham (2000) states that while a multi-method approach can enrich research findings, he suggests that it can be difficult to blend various findings together. This is an issue that will require consideration throughout the thesis.

While Loosemore (1999) places emphasis upon developing grounded theory through qualitative data, Sousa and Hendriks (2006) view it as a fundamental distortion to argue that grounded theory is solely a qualitative research method. In the present study, both quantitative and qualitative methods have been adopted as necessary to suit different stages of the research, as follows:

- Interviews: semi-structured interviews have been adopted in the present study. According to Mason (2002), they have a number of core features: there is an interactional exchange of dialogue; it has a relatively informal style; there are a number of topics, themes or issues to be covered; and situational and contextual knowledge is constructed. Starting with a guiding list of questions, as the interview

progresses, the line of enquiry can be modified in order to probe for expansion on interesting responses (Robson, 1993)

- Questionnaires: the use of questionnaires is a common approach in business and management research where large quantities of data are required in a quick and convenient manner (Remenyi et al., 1998). In using questionnaires, Denscombe (2003) posits that non-probability sampling tends to be more appropriate for small-scale studies, adding that consideration should be given to the logic for the sample size and selection of participants, limitations regarding representativeness, and the use of simple, descriptive analysis
- Focus Groups: are defined by Litosseliti (2003: 1) as: “*small structured groups with selected participants, normally led by a moderator. They are set up in order to explore specific topics, and individuals’ views and experiences, through group interaction.*” They are now recognised in the social sciences as an established and effective method for collecting qualitative data (Morgan, 1997). Focus groups are appropriate for collecting evidence from a highly specialised group of individuals, obtained in an intense or concentrated manner (Remenyi et al., 1998). Litosseliti (2003) contends that focus groups should be comprised of people who have similar characteristics and levels of understanding of a topic

The researcher can also write memos as part of the data collection process which provides a bank of ideas that help to map out the emerging theory and are used to identify concepts and their properties (Goulding, 2002).

Given that multiple research methods have been adopted, the issue of triangulation is important. There are a number of issues to consider in selecting and using methods, such as validity, reliability and ease of use (Birley and Moreland, 1998). The purpose of triangulation is to confirm findings through convergence of different perspectives, check the integrity of inferences drawn and ensure validity (Jack and Raturi, 2006; Schwandt, 2001). Triangulation in the “*social sciences attempts to explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint and/or using a variety of methods, even combining qualitative and quantitative methods (Burns, 2000: 419).*” There are five basic types of triangulation; data, investigator, multiple, theory

and methodological triangulation (Jack and Raturi, 2006), the central focus of all being to “*examine a conclusion (assertion, claim, etc.) from more than one vantage point (Schwandt, 2001: 257).*”

By employing both qualitative and quantitative approaches in methodological triangulation, the disadvantages of individual approaches can be reduced or eliminated whilst gaining the advantages of each (Fellows and Liu, 2008). Jack and Raturi (2006) identify the main benefit of triangulation as improved insight into the phenomenon under study due to the incorporation of multiple perspectives as opposed to intrinsic biases resulting from single method, observer or theory studies.

2.3.7 Case Study Research

During the research, three case studies were undertaken to support the emergent design of the grounded theory. The use of a case study approach is appropriate for in-depth investigation of particular instances of a phenomenon to secure theoretical, as opposed to statistical validity and can be used as part of grounded theory, where theory “*is inductively derived from the study of the phenomenon it represents (Fellows and Liu, 2008: 112).*”

There is some debate surrounding the positioning of the case study within the research vernacular; Fellows and Liu (2008) discuss it as a method, while both Denzin and Lincoln (2005) and Proverbs and Gameson (2008) position it as a research strategy or methodology. For the purposes of this research, case study is viewed as a methodology, albeit complimentary to the main grounded theory methodology.

When designing case studies, Proverbs and Gameson (2008), state that consideration must be given to time, availability of information, access to persons involved, thrust of the investigation and number of cases. Both Fellows and Liu (2008) and Yin (2003) cite the need for the clear identification of the unit of analysis (e.g. organisation, project, individual, small group) and the embedded units (where the same case study may involve more than one unit of analysis, e.g. case study of single organisation which analyses data from individuals, departments etc.)

	Case Study A	Case Study B	Case Study C
<u>Overview</u>			
Objective	Evaluate LL practices Evaluate CPD practices	Improve knowledge sharing Develop LL practices	Evaluate KM framework
Relevant Readings	Literature Review 3.2, 3.3, 3.4	Literature Review 3.2, 3.3, 3.4	
<u>Field Procedures</u>			
Access/Key Informant	HR Manager	Contracts Manager C	Learning & Development Manager
Record Keeping	Dictaphone & note-taking	Dictaphone, note-taking & video camera	Dictaphone & note-taking
Location	Construction site & head office	Regional offices, WIT & construction site	Head office
Data	Mixed	Mixed	Qualitative
Data Collection	Questionnaire and semi-structured interviews	Questionnaire, semi-structured interviews & focus group	Focus group
Data Analysis	Open coding	Axial Coding	Selective Coding
<u>Case Study Questions</u>			
General	All Research Questions	All Research Questions	
Specific	Potential for alignment of CPD with KM?	Potential for alignment of LL with KM?	Acceptability of framework?
Reporting	See Appendix D & E	See Appendix H, I & J	See Appendix N
<u>Reporting</u>	Presentation of findings & recommendations to CPD team (see Appendix F & G)	Lessons Learned Report (see Appendix K) Presentation of findings & recommendations to senior management (see Appendix L)	N/A
<u>Unit of Analysis</u>	Organisation	Organisation	Organisation
<u>Embedded Units</u>	Individual Professionals Project Team CPD Team	Pharma Division Individual Professionals Project Team	Select group with interest in KM

Table 5: Case Study Protocol

In this regard, Yin (2003: 67) states that preparation for case study research is of paramount importance and identifies the development of a protocol as important for “*increasing the reliability of case study research*” and supporting data collection and analysis. The

protocol, he continues should include an overview of the case study, a description of the field procedures, case study questions (both general and specific), and a guide for the case study report. Table 5 illustrates the protocol and outlines the units of analysis (and embedded units) for each of the three case studies. These case studies are given further consideration within section 2.4, 'Research Design' which illustrates the emergent nature of the research and provides further contextual information on the case studies.

2.3.8 Data Analysis

In attempting to follow a specific approach to grounded theory for this project, two key texts have been utilised throughout the analytical process; Strauss and Corbin (1998) and Gibbs (2002). The former has been selected as the 'version' of grounded theory adopted, while the latter provides detailed guidance on supporting Strauss and Corbin's analytical process with the NVivo software program. There are three general stages to data analysis developed by Strauss and Corbin (1998); open coding, axial coding and selective coding.

Open coding is "*the analytic process through which concepts are identified and their properties and dimensions are discovered in the data (Strauss and Corbin, 1998: 101).*" Through a process of micro-analysis, the data is broken down in order to identify and name concepts in the text, which as the process progresses are grouped under more abstract, higher order concepts to form categories which represent real-life phenomena. As categories emerge, they should be developed in terms of their properties, which "*are the general or specific characteristics or attributes of a category*" and dimensions, which "*represent the location of a property along a continuum or range (Strauss and Corbin, 1998: 117).*" Gibbs (2002: 169) proposes that the researcher should go through the text line-by-line, asking questions such as "*who, when, where, what, how, how much, why and so on?*" Strauss and Corbin (1998) maintain that while this is a time-consuming exercise, it is an extremely important process in the early stages of a study as it enables the quick generation and development of categories. The constant comparison of emerging categories with each other is central to grounded theory; Gibbs (2002) recommends systematically comparing concepts as well as using extreme ideas to further develop properties and dimensions.

The use of a computer-assisted qualitative data analysis software (CAQDAS) package, such as NVivo, can aid the analytical process. It facilitates the labelling of categories of information (nodes) with theoretical names, which may be “*in vivo*” terms (i.e. concepts used by the participants themselves) or conceptual names provided by the researcher (Gibbs, 2002). Through open coding and the process of conceptualisation, similar concepts are grouped together and patterns emerge through the identification and development of properties and dimensions. This provides “*the foundation and beginning structure of theory building (Strauss and Corbin, 1998: 121).*”

Axial coding begins “*the process of reassembling data that were fractured during open coding (Strauss and Corbin, 1998: 124).*” In seeking to uncover relationships among categories, they have developed a paradigm in which to systematically gather and order data during axial coding, the components of which are outlined in Table 6 (adapted from Gibbs, 2002 and Strauss and Corbin, 1998).

Component	Explanation
Causal conditions	Conceptual way of grouping answers to the questions, why, where, how come and when.
Phenomenon	The central idea, event, happening, incident which a set of actions or interactions is directed at managing or handling, or to which the set of actions is related.
Context	Location of events.
Intervening conditions	Shaping, facilitating or constraining the strategies that take place within a specific context.
Action/interaction	Strategic or routine responses made by individuals or groups to issues, problems, happenings, or events that arise under a set of perceived conditions.
Consequences	Outcomes or results of action or interaction, result from the strategies.

Table 6: Elements of the Axial Coding Paradigm

The process of axial coding can be a difficult one, particularly in distinguishing between conditions, actions/interactions and consequences. Furthermore, researchers tend to code rigidly for the paradigm components; Strauss and Corbin (1998: 129) advise “*to let it happen. The rigor and vigor will follow.*” The use of diagrams is also a useful in tool in helping to develop categories and potential relationships; these can be drawn with pen and paper or in NVivo (Gibbs, 2002).

Selective coding, which is “*the process of integrating and refining the theory (Strauss and Corbin, 1998: 143),*” can be both the easiest and the hardest stage of grounded theory, according to Gibbs (2002), dependent on the amount of axial coding which has been completed. This choice relates to selecting the central or core category, which represents the main theme of the research. In choosing the central category, Strauss and Corbin (1998) provide the following criteria: all other categories can be related to it, it must appear frequently in the data, the explanation is logical and consistent, the phrase which describes it should be sufficiently abstract to be used in other settings, and the concept should be able to explain variation.

To facilitate the identification of the central category and the integration of concepts, Strauss and Corbin (1998) advocate writing the storyline, using diagrams and reviewing and sorting through memos. Selective coding consists of systematically relating the central category to other nodes, albeit with much less reference to the text, much of the activity being analytic and theoretical (Gibbs, 2002). The emerging theory should then be refined through a review for internal consistency and logic, the filling in of poorly developed categories and trimming excess ones, and validating the theoretical scheme.

Open, axial and selective coding should be supplemented by the use of memos, which are written records of analysis, and which forms an essential part of the analytical process in grounded theory (Strauss and Corbin, 1998). In composing memos, Gibbs (2002) recommends that researchers write them when ideas occur, continue to write them throughout the process, keep them separate from data and at a conceptual level of discussion, differentiate between hunches and statements supported by evidence, modify during analysis, cross reference with nodes, put the date and time on the memo and be flexible.

In order to facilitate analysis of the data, NVivo can 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).*” Indeed, NVivo has been widely reported as being particularly suited to grounded theory studies which adopt Strauss and Corbin’s approach (Bringer et al., 2006, Hunter et al., 2005, Dainty et al., 2000). However, Blismas and

Dainty (2003: 457) caution researchers against using a particular CAQDAS package as justification of the methodology adopted; rather it is “*a tool to aid the larger research strategy.*” Gibbs (2002: 13) warns that on its own, the use of CAQDAS will not improve the quality of research, “*good qualitative analysis still relies on good analytic work by a careful human researcher, in the same way that good writing is not guaranteed by the use of a word processor.*”

The main benefits of using CAQDAS are to be found in the software’s facilitation of data management, coding, search functionality and the use of large data sets for analysis. Conversely, the potentially limitless computational possibilities offered may in fact inhibit theory development, resulting in extremely complex and numerous categories (Dainty et al., 2000).

In addition to utilising qualitative data sources such as interview and focus group transcripts, Bringer et al. (2006) reported the incorporation of survey data and literature review notes into NVivo allowing for closer integration with the research process. In terms of grounded theory, NVivo is useful in facilitating the “*iterative process of data collection, analysis and theorizing*” particularly for coding, writing memos and modelling (Bringer et al., 2006: 251).

It is evident that the use of a CAQDAS package such as NVivo is complimentary to the analytical procedures espoused by Strauss and Corbin (1998) and has thus been adopted for use in this research project. Despite the recognised benefits of using such software it is important to be aware that its use alone will not lead to good quality research.

2.3.9 Writing and Reviewing Grounded Theory

A difficulty encountered in the grounded theory approach is in the writing up stage. At this point, structure, amount of data to present, theoretical elements, extant literature and methodology all need to be considered (Locke, 2001, Goulding, 2002). The style of presentation should move backward and forward between extensive theoretical presentations and illustrative live excerpts from the research setting (Locke, 2001).

Qualitative research does not lend itself easily to summary, according to Goulding (2002), who recommends the use of diagrams to aid presentation.

Once written, a further consideration is whether or not the proposed theory is pragmatically useful and credible (Locke, 2001). Credibility, in particular “*is not only a property of the developed theoretical frame but also its interaction with its intended audience (Locke, 2001: 61).*” As a check for credibility, Goulding (2002), recommends returning to the original informants to obtain their opinions of the developing theory.

2.4 Research Design

The grounded theory methodology provides for a research design which emerges through the constant comparison of data and theoretical sampling, leading to four ‘phases’ of research (an overview of which is presented in Figure 3 at the end of this chapter). At a macro level, this design was guided by the three research questions outlined in Chapter 1, that is the effectiveness of existing approaches to managing knowledge, the main issues to be addressed for adopting KM and encouraging construction professionals to engage in KM. The emergent design will now be discussed with specific information relating to the research participant’s profiles is included at the start of the relevant chapters.

2.4.1 Phase 1 – KM in the Leading Irish Construction Organisations

The research conducted within this thesis initially began as a Masters by research in 2004, focusing on the role of IT in supporting KM and comprising a survey of the IT Managers from the leading twenty Irish construction organisations, followed by interviews with ten senior managers from a number of these organisations. In progressing to a PhD study, the interviews with the ten senior managers form the basis for beginning the grounded theory, whilst relevant findings from the IT Manager survey are used to support its development, particularly in the technological area.

Survey of Twenty Leading Irish Construction Organisations: based on the discussion in Chapter 1, concerning the rationale for selecting the leading twenty Irish construction organisations, a survey of their IT managers was conducted. This was influenced by the technological focus of the original study and sought to evaluate the potential for existing technology to support current and/or future KM initiatives. Due to the exploratory nature of the research, a self-administered questionnaire was selected as the means of conducting the survey (see Appendix C for a copy of the survey). Based on the technological literature reviewed (see section 3.2.7), a questionnaire was composed to identify the organisation’s existing IT infrastructure. Following piloting and revision, the questionnaire was sent out to the intended respondents in June 2005, achieving 15 responses. This response rate (75%) is considered to be satisfactory, particularly as the outcome of this study is not

intended to be applicable to the rest of the industry. This is 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.

Interviews with Senior Managers: the second element of primary research comprised interviews with ten senior managers from the leading Irish construction organisations. In the early stages of grounded theory, Goulding (2005: 296) suggests initially talking to informants who are most likely to provide information which may lead to provisional concepts and "*direct the researcher to further 'theoretically' identified samples, locations, and forms of data.*" In order to build a dense and tightly structured theory, Strauss and Corbin (1998: 281) suggest that ten good interviews during the early phases of research should "*provide the skeleton of a theoretical structure,*" which can be "*filled in, extended, and validated through more data gathering and analysis, although coding can be more selective.*" Following the initial survey of the leading twenty Irish construction organisations, ten senior managers from these organisations were interviewed in order to address the issues outlined in the research questions (i.e. effectiveness of current approaches to KM, main strategic, cultural and technological issues, and encouraging professionals to engage in KM) from both strategic and operational perspectives (see Appendix B for a copy of the interview questions). The positions held by these individuals differ depending on the organisational structure of each of the companies, with titles such as Senior Contracts Manager, Regional Director, Contracts Director and Area Manager. Despite these different titles, all identified participants operate either at board level or directly below the main board of directors, and are heavily involved in the day to day operations of a number of construction projects within their respective organisations. An academic colleague who has been involved in organising student work placements with these leading organisations for over 25 years provided assistance with selecting, and gaining access to, appropriate interviewees. The interviews were conducted in early 2006, and, with the interviewees consent, were recorded. All interviews were transcribed and imported into NVivo for coding, in order to identify initial categories, their properties and dimensions, and potential relationships between them. Initially, in excess of 700 codes

were developed, which were further refined through merging and renaming duplicate codes. As analysis progressed, a written record of the analytical process was maintained using memos.

As evidenced in Chapter 4, following analysis of the survey and interview findings and literature, theoretical sampling led to potential sites for further research, specifically the engagement of construction professionals in KM and CPD related activities.

2.4.2 Phase 2 – CPD & Lessons Learned Practices in Two Organisations

Based on the findings from Phase 1, a more refined review of literature relating to CPD and lessons learned practices and their potential links to KM preceded two in-depth case studies of leading Irish construction organisations (which again, sought to address the identified research questions), hereafter referred to as A and B.

Case Study A: following an interview with a director from the first phase, the possibility of conducting some in-depth research within his organization emerged. 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), the role of CPD and knowledge-sharing seminars. A case study 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). Through consultation with the company's HR Manager it was decided to undertake a survey of 180 professional staff based in the Dublin region and to carry out semi-structured interviews with staff on an ongoing construction project. This case study was conducted during 2006.

This company, hereafter referred to as Case Study A, are one of the leading Irish construction organisations. Founded in 1925, they had a turnover of €320 million in 2006, making them the sixth largest Irish contracting company that year. The company's primary activity is undertaking large and complex construction projects in the commercial, industrial and civil engineering sectors. Employing in excess of 700 staff, the company undertake a range of large construction projects throughout Ireland, from offices located in

Dublin, Cork, Limerick and Galway. In 2004, they became the first construction company in Ireland to be awarded EI accreditation for CPD. 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 purpose of the questionnaire was to explore the effectiveness of identified KM initiatives within the organisation, such as the LLDB, knowledge-sharing seminars and CPD (see Appendix D for a copy of the staff survey). 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 maximizing the response rate. Subsequently the questionnaire was e-mailed to 180 professional and management staff based in the Dublin region, achieving a 36% response rate. 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. The interviewees comprised eleven professional and management staff; a senior contracts manager, a project manager, three quantity surveyors, three engineers, two foremen and a safety officer. The interviews allowed for expansion upon issues covered in the questionnaire, which all eleven interviewees had completed (see Appendix E for the semi-structured interview questions).

Following the compilation of the case study findings, a report was prepared and a presentation made to company management in their Head Office in Dublin (a copy of the presentation is available in Appendix F, with the report in Appendix G). The participants included the Director who had been previously interviewed, the HR Manager who had assisted in administering the research, and the company's Administration Manager, who was also responsible for the Lessons Learned Database (LLDB) and the research supervisor. Following the presentation, a discussion took place which sought to get feedback from the managers to aid the further development of the framework. The discussion was recorded and the transcript imported into NVivo for coding.

Case Study B: the opportunity to conduct a second case study arose when the author supervised a student who was undertaking a minor dissertation for a part-time MSc in Construction Project Management. The student in question, was working as a Contracts Manager on a multi-million euro cleanroom development for Case Study B, and wished to

explore the concept of 'best-practice' in the procurement and construction of cleanrooms. Following lengthy discussion, it was decided to explore the potential for improved KM practices within the company's Pharma Division through action research, an approach which was mutually beneficial to the student and the author. This case study was conducted over a 15 month period from October 2006 to December 2007.

Founded in 1859, the company taking part in Case Study B had a turnover exceeding €1 billion in 2005, they employ over 1500 people directly, making them the leading construction company in Ireland at that time. The company have a number of regional offices throughout Ireland, as well as operations in the United Kingdom and South Africa. With continued growth in the bio-pharmaceutical sector in Ireland, Case Study B have completed numerous projects for some of the world's leading companies including Johnson & Johnson, Pfizer, Takeda, Wyeth, Guidant, and Abbott. Having developed an expertise in delivering bio-pharmaceutical projects, Case Study B have been retained by a number of these clients for repeat projects in a management contracting role. In 2005, such projects accounted for approximately €250 million of the company's overall turnover, making it a key area of business. Traditionally, projects have operated on a regional basis; however, recently the company restructured, establishing new divisions which specialise in Civil Engineering and Transportation, Pharma and Residential construction. The new Pharma Division is led by a director and two senior contracts managers with many years experience in the sector. At the time of this research, there were three major, multi-million euro cleanroom projects underway.

The need to identify and share specialist cleanroom knowledge is particularly relevant to Case Study B's Pharma Division in the management contracting route, where the exploitation of experience is crucial to winning and completing projects. In order to address the current challenges faced by Case Study B in the procurement and construction of cleanrooms through management contracting, action research was adopted as the overall research strategy. This approach was chosen as it is based on a collaborative approach between the researcher and the practitioner, with the aim of solving a problem and generating new knowledge. Action research is viewed as a significant strategy for organizational research in commercial organizations, community work, education and

healthcare (Coghlan and Brannick, 2001). Robson (1993: 438) identifies action research as involving “*a spiral of cycles of planning, acting, observing and reflecting.*” According to Denscombe (2003) it is normally associated with ‘hands-on’, small-scale research projects where practitioners wish to use research to improve their practices, identifying the following characteristics:

- *Practical*: aimed at dealing with real-world problems in organizational settings.
- *Change*: specifically geared to changing current practice.
- *Cyclical process*: a process of research in which the application of findings and an evaluation of their impact on practice become part of a cycle of research.
- *Participation*: practitioner’s active participation in the research process is crucial.

Consisting of two phases, the participants in the action research comprised members of the Pharma management team in the first phase and a site management team based on a cleanroom project. The research was conducted jointly by the author and the practitioner in a collaborative manner. Denscombe (2003) discusses the participatory nature of action research and the relationship between the researcher and practitioners, viewing the practitioner as the dominant partner, with the academic acting as a facilitator in the research. In Case Study B, the practitioner led and directed the focus of the research, while the academic facilitated the research enquiry as it proceeded.

From a KM perspective, Robey et al. (2000: 135) contends that “*action research is one of the primary instruments for increasing organisational learning. In action research, researchers try to improve practice through systematic feedback of their research observations to a client organisation.*” The practitioner sought to improve both his own knowledge and that of the Pharma Division through the research. In the initial stages, the participants seemed sceptical towards the research, but as it evolved, they bought into the research process, leading to active participation and change in their work practices. Denscombe (2003) discusses this in the context of any change in organisational practice being relatively small, with great potential for professional self-development of the participants.

The action research consisted of two cycles, the first focused upon sharing knowledge between the members of the Pharma Division management team, while the second cycle was concerned with capturing lessons learned from a large cleanroom project.

The first cycle of the research focused upon the six members of the Pharma division's management team. A three-stage approach to primary research was devised, comprising of interviews, a focus group and a questionnaire. Firstly, each member of the management team was interviewed in order to identify their knowledge and experiences of pharmaceutical projects. The interviews were then analysed to identify high-grade knowledge and recurring problems across pharmaceutical projects. Through further refinement, an agenda was drafted to form the basis for a knowledge-sharing focus group (see Appendix H), which was facilitated by the academic collaborator in the research. The management team participated in the focus group with the aim of sharing knowledge and experiences in order to improve the delivery of pharmaceutical projects. Finally, a brief one page questionnaire was administered to all of the focus group participants in order to clarify a number of issues and to help with making recommendations for future KM activities within the division.

One of the recommendations from the first cycle was the need for the organization to conduct post-project reviews and document the lessons learned. With the collaborating practitioner's €100 million project just recently completed, it was decided that the second cycle would focus upon the lessons learned on this project. The four main members of the project team were interviewed: the Contracts Manager (also the collaborating practitioner), Site Agent, Site Foreman and the Building Services Engineer. The purpose of these semi-structured interviews was to identify and document the main lessons learned from each individual's perspective (see Appendix I for a copy of the interview questions). Following analysis of the interviews, the main lessons learned were identified, and these formed the basis for a post-project review session with the four project team members, again facilitated by the academic collaborator (the agenda for the post-project review is contained in Appendix J). Following analysis of the research findings, the author and practitioner presented the research findings and recommendations to the Director of the Pharma Division and two Regional Directors from Case Study B (the author's presentation can be

seen in Appendix L). The discussion which ensued during the course of the presentation was recorded and incorporated into the emerging grounded theory.

The findings from both case studies are presented separately, Case Study A in Chapter 5 and Case Study B in Chapter 6, before discussing and analysing the findings in Chapter 7. Through axial coding, five paradigm models emerged including professional knowledge, project knowledge, organisational knowledge, the role of IT and the role of HRM. Theoretical sampling identified Engineers Ireland's CPD scheme as important, with the need for further development of the HRM paradigm and identification of the interrelationships between all five paradigms necessitating further consideration.

2.4.3 Phase 3 – The Role of HRM in KM

With both HRM and Engineers Ireland's CPD Accreditation Scheme being identified as an important influence on the adoption of KM within the leading construction organisations, it was decided to explore this further. A further review of literature was undertaken in the areas of HRM and KM, followed by semi-structured interviews with HRM/CPD professionals from fourteen organisations engaged in Engineers Ireland's CPD accreditation scheme. Initially, an unstructured interview was conducted with EI's CPD Accreditation Manager to discuss the scheme and its background, the current status of construction organisations and how KM was being implemented by both construction and non-construction organisations. The Accreditation Manager offered to facilitate access to a number of organisations whom she felt would be beneficial to the researcher. As a result, individuals with responsibility for the CPD scheme were identified and contacted in five construction organisations and six non-construction organisations, with the majority of the interviewees being involved in the area of human resource development. Of the five construction organisations, the Human Resource Managers from both previous case studies participated in this phase of the research. With one of the non-construction organisations, a utilities group, it was decided to interview the relevant people in each of the four subsidiary companies, power generation, international operations, customer supply and networks. The semi-structured interviews (see questions in Appendix M), which were conducted during 2008, were recorded and subsequently transcribed and imported into NVivo for analysis

and comparison with the emerging categories. Further axial coding of the HRM paradigm was undertaken and a number of important issues in the other four paradigms were also confirmed by analysis of the interviews.

2.4.4 Phase 4 – Framework Development & Evaluation

To facilitate the integration of the emerging issues, the analysis then moved to selective coding and the development of a KM framework. In order to ensure the credibility of these issues, the framework was evaluated with staff from another leading Irish construction organisation, hereafter referred to as Case Study C. Founded in 1958, they are now part of a leading European construction group, operating in sectors including civil engineering, building, property development and rail. With offices in Kildare, Dublin, Cork and Galway, their turnover in 2008 was €460 million, placing them in the top 5 Irish construction organisations. The company, whose HR Manager participated in Phase 3 of the research as ‘Contractor C,’ have achieved accreditation under EI’s CPD scheme and organise bi-annual knowledge sharing sessions for their staff to fulfil the KM criteria.

Through discussions with the company’s Learning & Development Manager, staff members from across the organisation were chosen to participate in the evaluation, using a focus group as a framework. This involved a presentation, based on the developed framework, being given to the staff (see Appendix N) in the company’s head office and the participants being asked to provide feedback on the various emerging issues. A guidance document, which summarised the framework was also evaluated by the participants, with all feedback provided being used to refine the model further. The session lasted for approximately two and a half hours and was recorded to allow for a fluid group discussion, which was analysed at a later date.

The emergent nature of grounded theory has led to a research design guided by theoretical sampling, moving from a broad-ranging survey of IT managers from the leading twenty Irish construction organisations and interviews with senior managers from ten of these, to two in-depth case studies (comprising interviews, questionnaires and focus groups) and interviews with fourteen HR/CPD specialists who are responsible for the Engineers Ireland

CPD scheme within their organisation and finally evaluation of the identified issues with a third leading construction organisation. In this regard, Figure 3 provides an overview of the emergent nature of the research design, identifying the focus, key informants, participants, methods, analysis, relevant chapters and date conducted, for each phase of the research.



Figure 3: Research Design Overview

2.5 Summary

KM has received increasing attention from both the construction industry and the construction management research community in recent years. It should be noted, however, that a significant gap exists between the theory of KM and its practice. There is a recognised need for continuing empirical research into KM, specifically in investigating emerging issues facing KM for the leading Irish construction organisation. It has been established that conducting research into KM in construction organisations is a complicated undertaking, which requires the careful consideration of issues of philosophy, methodology and methods. At this point, it is worth reflecting on and discussing the research approach adopted in this study, more specifically the interrelationship between the constructivist philosophy, the grounded theory methodology and the mixed methods utilised (an overview of which can be seen in Figure 4).

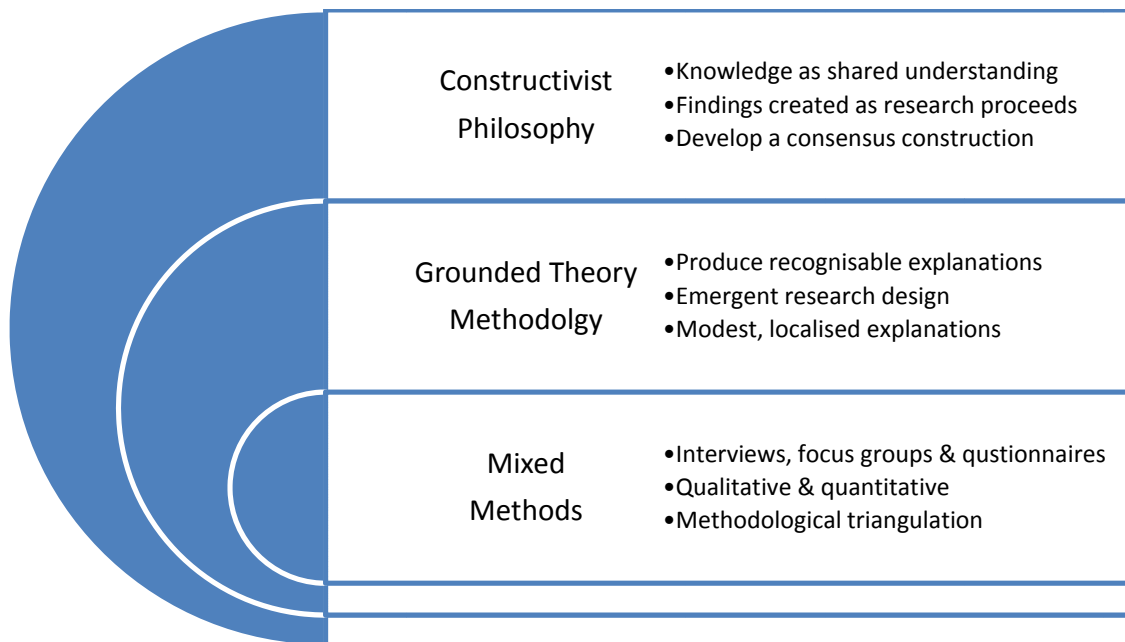


Figure 4: Interrelationships of Constructivism, Grounded Theory and Methods

In both KM and construction management research there has been a tendency towards positivism as the dominant research paradigm. The main criticisms of such an approach to research is that it leads to a loss of context, exclusion of meaning and purpose, disjunction from local contexts, inapplicability of general data to individual cases and exclusion of the discovery dimension in inquiry. Therefore, a constructivist approach to grounded theory

utilising multiple methods has been adopted for a number of reasons which shall now be considered. Ontologically, knowledge is socially constructed and from an organisational research point of view tends to be very much local and specific in nature. From epistemological and methodological perspectives, knowledge is created between the researcher and participants through interaction and continuous refinement, moving towards a consensus construction. The constructivist research process facilitates a hermeneutic dialectic whereby individual interpretations are compared and contrasted with each other, the researchers own construction and the literature.

As a methodology, grounded theory seeks to develop theory through an iterative process of data collection and analysis which is geared towards contextual explanations that are recognisable to the research participants. It can be argued that the version of grounded theory developed by Strauss and Corbin (1998) has constructivist intent, facilitating the incorporation of the researcher's experience and literature with the participant's constructions through a hermeneutic dialectic. In terms of research methods, the grounded theory approach can be complimented by the use of both quantitative and qualitative methods, as both have distinctive strengths in particular situations. In order to assist the development of the grounded theory, three methods have been adopted during the research, namely interviews, questionnaires and focus groups, facilitating the hermeneutic dialectic through methodological triangulation. For example, a questionnaire can be useful for gaining an overview of topic, potentially engaging a large number of participants, although they lack in terms of the level of depth that can be achieved. Interviews are particularly useful for collecting information on an individual's experience through an interactional exchange of dialogue, whilst focus groups are extremely useful for sharing experiences through group interaction. Through such a combination of methods and continuous interaction, the researcher-participant relationship becomes closer as knowledge is constructed. The rationale behind this approach being that in order for the emerging KM issues to remain grounded in practice, industry must be engaged with in a meaningful manner.

Chapter 3

Literature Review

3 LITERATURE REVIEW

As discussed in the previous chapter, reference to literature is an ongoing process during a grounded theory study. In the early stages, it is used to identify initial ideas and concepts, becoming more focused as the research progresses in support of the emerging theory. Throughout the process, the review has been guided by two of the research questions identified in Chapter 1 relating to identifying the main strategic, cultural and technological issues, and encouraging construction professionals to engage in KM initiatives. While this chapter comprises all of the literature reviewed during the research, it should be noted that different themes were reviewed at different stages of the research, depending upon the focus of the grounded theory analysis. As the research proceeded and theoretical sampling directed areas for further sampling, a more focussed review of literature was undertaken. Recognising the time-bound nature of the literature review, Figure 5 illustrates the relationship between the different sections of the literature review and the phases of the research (as discussed in Chapter 2).

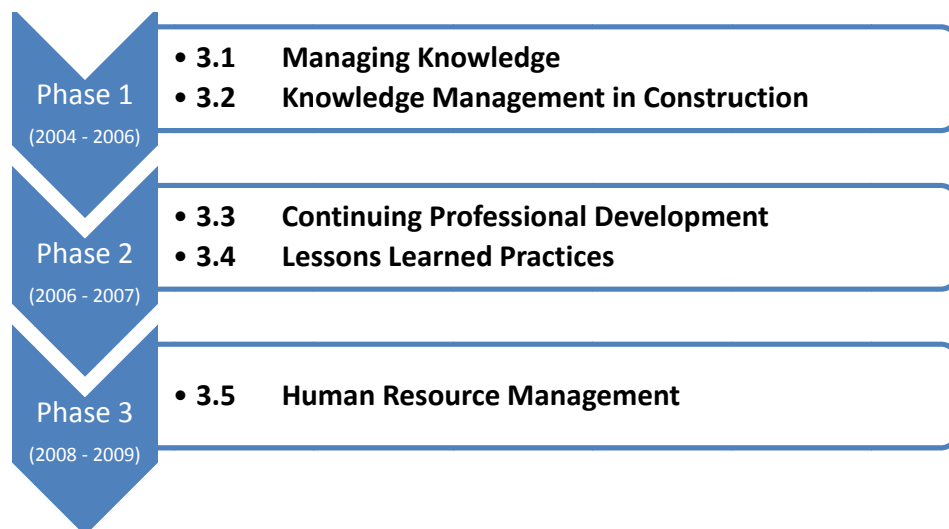


Figure 5: Literature Review and Research Design

A review of literature relating to knowledge, KM and its relevance to construction and associated strategic, cultural and technological issues was initially conducted (Phase 1). Following analysis of the senior management interviews and IT manager survey, the focus of the literature review turned to continuing professional development, lessons learned practices and the potential for aligning KM with CPD (Phase 2). Further analysis of the

case studies identified the need to investigate the role of HRM within KM, an issue that was explored in greater detail during interviews HRM/CPD specialists drawn from fourteen construction and non-construction organisations (Phase 3).

3.1 Managing Knowledge

The term ‘knowledge management’ which, according to Wiig (2008), was first coined in 1983, has its roots in the work of Peter Drucker in the 1960s, who highlighted that the most valuable asset to a company was its knowledge and a knowledgeable workforce. Newell et al. (2002) also discuss the influence of Drucker in this regard, as well as the shift from an industrial to a post-industrial society, which brought more attention to the importance of ‘knowledge work.’

It is argued by Tiwana (2000) that KM, as a discipline, evolved from a variety of management philosophies which have developed since the 1950s, including Management by Objectives (1950s), Centralisation and Decentralisation (1960s), The Experience Curve (1970s), Corporate Culture (1980s), The Learning Organisation (1990s) towards KM in the 2000s. This is a view which is shared by Wiig (2008), who also provides such examples of twentieth century efforts to improve organisational effectiveness.

The emergence of managing knowledge as a business and academic concept was crystallised in two seminal publications. Nonaka and Takeuchi (1995) explored the dynamics of innovation and knowledge creation in Japanese companies, while Davenport and Prusak (1998) popularised the concept of KM (Tiwana, 2000). During this period, according to Quintas (2005: 10) there was a “*surge of interest,*” with a growth in academic articles, books and conferences on KM; including the periodicals *Knowledge Management*, *Knowledge Management Review* and the *Journal of Knowledge Management*.

On a broader level, the concept of a knowledge economy has come to the fore in recent government and economic reports, for example the OECD (1996) report entitled *The Knowledge-Based Economy*. The implications of this increasing focus on knowledge are, according to Egbu and Robinson (2005), an increased demand for knowledge, skills and learning, and growth of learning organisations. This interest in KM stems from a number of issues: a dramatic improvement in data processing capabilities and communications technologies, an increased recognition that businesses must continuously improve, and an acknowledgement of learning as a core strategic competency (KLICON, 1999), indicating

strategic, technological and people aspects. Quintas (2005) confirms this by identifying six key drivers of the KM agenda in recent years:

1. Wealth being demonstrably and increasingly generated from knowledge and intangible assets
2. The rediscovery that people are the locus of much organisational knowledge
3. Accelerating change in markets, competition and technology, making continuous learning essential
4. The recognition that innovation is key to competitiveness, and depends on knowledge creation and application
5. The growing importance of cross-boundary knowledge transactions
6. Technology limits and potentials: the limits of information technology and the potentials of communications and knowledge technologies

3.1.1 *Defining Knowledge*

Before considering KM in further detail, it is worth exploring the issues surrounding knowledge raised in Chapter 2. The subject of philosophical debate for thousands of years, knowledge is highly complex (Egbu, 2004). Considerable attention is given to the philosophical perspectives on knowledge by Jashapara (2004), from Plato and Aristotle, through to those espoused in modern KM literature such as Nonaka (1994) and Davenport and Prusak (1998: 5), the following definition provided by the latter:

“Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information.”

This would appear to be complementary to the concept of constructivism, which was discussed in Chapter 2, where Schwandt (1994: 125-126) contends that people *“do not find or discover knowledge so much as construct or make it. We invent concepts, models and schemes to make sense of experience and, further, we continually test and modify these constructions in light of new experience.”* Experience is a recurring theme in these definitions, as the entry in the Oxford English Dictionary (OED, 2008) confirms:

“noun. 1. information and skills acquired through experience or education. 2. the sum of what is known. 3. awareness or familiarity gained by experience of a fact or situation”

From this brief consideration of knowledge, it can be surmised that knowledge is experientially based and is constantly altered in light of new experiences. Furthermore, as Sousa and Hendriks (2006) have stated, knowledge is socially constructed in nature, a view shared by a number of authors (Styhre, 2003, Rabelo, 2004). This line of thought is furthered by Quintas (2005) who considers three key issues regarding the nature of knowledge; the tacit nature, the social nature and the stickiness of knowledge. Tacit knowledge, he posits, is acquired through experience and internal reflection and cannot be easily shared with others who have not been through similar learning experiences. Knowledge also *“has a social dimension – it may be created and held collectively (Quintas 2005: 22).”* The stickiness of knowledge refers to context in which it exists, and the difficulty with which this type of knowledge may be transferred to other situations or contexts, *“what has value or meaning in one context may have little or no meaning in another context (Quintas 2005: 23).”* Context is also identified as important by Fong (2005: 195) who reflects the constructivist perspective in discussing the concept of knowledge sharing, which, *“relies on reaching a shared understanding of the underlying knowledge, not just the content but also the context of the knowledge (Fong, 2005: 195).”*

One of the most popular definitions of knowledge in literature on this subject is provided by Nonaka and Takeuchi (1995), who introduced two dimensions of knowledge in their theory of organizational knowledge creation. The ontological dimension considers the levels of knowledge creating entities as individual, group, organization and inter-organisation levels. The epistemological dimension comprises two types of human knowledge; explicit and tacit:

- *Explicit* – can be readily codified into words and numbers, easily shared, easy to distribute, and can be managed as information
- *Tacit* – not easily visible or expressible, highly individualised and context specific, difficult to share and manage, and more valuable than explicit knowledge

This is a theme continued by Caddy (2001), who provides examples of both explicit and tacit knowledge in an organisational context, in relation to both individuals and collectively within groups (see Table 7).

Knowledge Type	Possessed by:	
	Individuals	Collectively within groups
Explicit	Formal training and education; personal notes and documentation	Mutually agreed upon and documented business rules; registered patents
Tacit	Problem solving skills, communication skills; negotiating ability	Group heuristics; intra-group cohesion and stability

Table 7: Classifications of Organisation Knowledge (adapted from Caddy, 2001)

While much of the literature on this subject separates tacit and explicit knowledge as two distinct entities, Jashapara (2004) contends that they exist together on a continuum. He cites the more contemporary philosophical work of Ryle and Polanyi as forming the basis for Nonaka and Takeuchi's (1995) conception of knowledge. The complexity of knowledge is treated in a novel fashion by Prusak (2005) who discusses the four different types of knowledge identified by the ancient Greek philosophers as:

1. Episteme: from which we derive epistemology, and meaning repeatable rules, codified and universal i.e. scientific knowledge
2. Techne: akin to a craft or capability, indicating that the individual possessing techne is able to actually do something
3. Phorensis: most closely related to emotional intelligence or social skills, something that good managers should possess
4. Metis: whilst not having a direct translation into English, it is closest to savvy or being street smart

This suggests that aside from the scientific aspect, knowledge infers the ability to do something, possessing good social skills and being savvy. Indeed, Malhotra (2003) identifies knowledge as the potential for action based upon insights, intuition and experience.

Continuing the tacit-explicit debate, Walker (2005: 27) suggests that *“there may well be no such thing as purely explicit knowledge. Most codified knowledge is in fact merely information because it is generally stripped bare of any meaningful context.”* Furthermore, Quintas (2005: 11) cites the need for a clear distinction to be made between information

and knowledge, “*the nature and scope of human knowledge is rather broader than that which can be encoded.*”

The oft-cited work of Ackoff (1989) attempts to deal with this quandary by placing knowledge in a linear model which distinguishes between data, information, knowledge and wisdom, whilst demonstrating a progression from one to the next. This continuum of understanding (see Figure 6), according to both Jashapara (2004) and Tiwana (2000) helps to place the concept of knowledge in a practical sense:

- Data: known facts or things used as a basis for inference or reckoning
- Information: the act of informing or telling, or systematically organised data
- Knowledge: could be considered as ‘actionable information’ which is provided at the right place, at the right time and in the appropriate format
- Wisdom: the ability to act critically or practically in a given situation

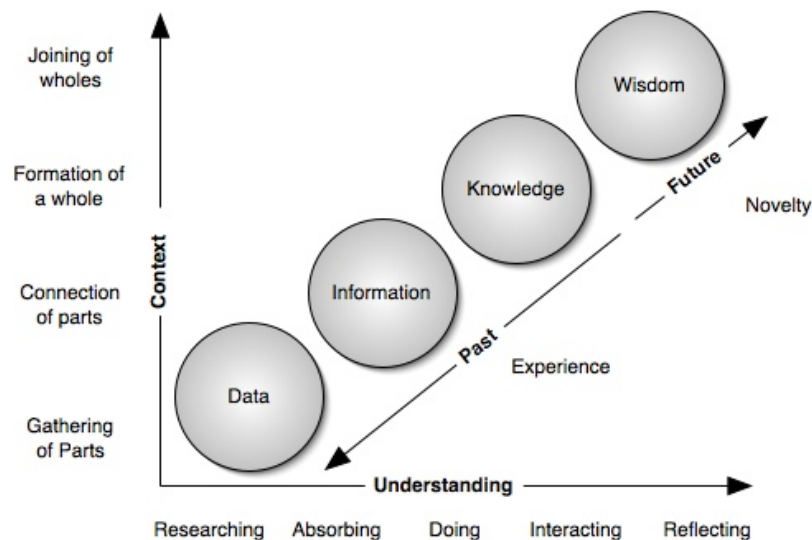


Figure 6: The Continuum of Understanding (Clark, 2004)

Whether this model provides a working definition of knowledge is questionable, however it helps to differentiate knowledge from other concepts, especially information. Styhre (2003: 33) contests the assumption that “*data and information is immanent in knowledge and that the successive steps between data, information and knowledge are continuous and linear...knowledge is not a matter of putting together discrete items of data into a coherent*

body of knowledge...to merely conceive of knowledge as data accumulated, is prevalent because many knowledge management theories are concerned about codification.”

Therefore it can be contended that knowledge is a complex subject, the definition of which continues to be debated, with as yet no consensus on its nature (Jashapara, 2004). Given the constructivist position adopted in this study and following a review of relevant literature, knowledge can be defined as experientially-based, continuously modified, socially constructed and context-specific in nature.

3.1.2 Defining KM

The definition of KM previously provided by Jashapara (2004: 12) refers to a number of interesting concepts such as learning, processes associated with managing knowledge, tacit and explicit, technology, culture, intellectual capital and performance. In order to further appreciate the complexity of KM, it is worth exploring a sample of other definitions. Salisbury (2003: 103) states “...in its simplest form, knowledge management is about encouraging people to share knowledge and ideas to create value-adding products and services.”

Al-Ghassani et al. (2004) contend that there are two main perspectives on KM; the process perspective and the outcome perspective. The former focuses on controlling the associated KM processes, while the latter espouses the benefits that an organisation can derive from managing its knowledge. From an outcome perspective, Offsey (1997) identifies the four direct benefits of KM to organisations as:

- Awareness: everyone knows where to go to find the organisation’s knowledge
- Accessibility: all individuals can access it
- Availability: knowledge is usable wherever it is needed
- Timeliness: knowledge is available whenever it is needed

The need for organisational change is highlighted by Bhatt (2001: 73): “...knowledge management refers to changing corporate culture and business procedures to make sharing of information possible. It becomes as much a feat of developing technological solutions as

working through the social and culture subsystems.” Interestingly, information is used interchangeably with knowledge in this definition, perhaps indicating an oversimplification.

There are four pillars of KM, according to Mohamed et al. (2004); leadership, to promote KM and enact necessary change; organisation structure, which influences the ability for employees to exchange ideas and share knowledge; technology, to enable KM; and learning, to equip staff with the skills necessary for collaboration and knowledge sharing.

While Wiig (1997: 8) also identifies top management support, he identifies four areas of emphasis for KM:

1. *“Top-down monitoring and facilitation of knowledge-related activities*
2. *Creation and maintenance of the knowledge infrastructure*
3. *Renewing, organising, and transforming knowledge assets*
4. *Leveraging (using) knowledge assets to realise their value”*

SAIC (2004) state that KM *“is about systematically making use of the knowledge in an organization, and applying it to your business problem; tapping into what your company knows to help you deliver your business results. It consists of never making the same mistake twice, and making every decision in the light of the full knowledge base of your company, business unit and/or group.”* This definition highlights the need to focus on a particular business problem, delivering results and learning from the experience of the knowledge base of the organisation.

Emphasis is placed on processes for managing knowledge by the BSI (2003: 2) who define KM as: *“the creation and subsequent management of an environment which encourages knowledge to be created, shared, learnt, enhanced, organized and utilised for the benefit of the organization and its customers.”*

A similar importance is placed upon processes by Suresh (2006: 23), who following an extensive literature review defines KM as *“a process by which knowledge is identified, captured, codified, stored, disseminated (shared/transferred), implemented (adapted, transformed, synthesised) and its impact measured for the benefit of the organisation.”*

With regards to such processes, she contends that KM “*consists of distinct but interrelated processes that are not linear but can be cyclical and iterative (Suresh, 2006: 23).*”

Egbu et al. (2005) identify and go into further detail on a number of these KM sub-processes including:

- Identification: identifying people with specific skills, abilities of suppliers and subcontractors, and knowing who to contact when there is a problem are key challenges of KM. Communities of Practice (CoP) can aid the identification of such knowledge, whilst skills databases can also prove useful
- Capture: where tacit knowledge is transformed into explicit form, including mechanisms such as minutes of meetings, a database for project reviews, and staff reports on external CPD events they have attended
- Storage: involves recording valuable experience in electronic form to avoid repeating mistakes; train new staff and retain knowledge of staff who leave the organisation
- Mapping: utilises lists and visual representations of the organisations knowledge including pointers to people, documents and databases
- Dissemination: comprising the sharing and transfer of knowledge, there are a variety of techniques and technologies which support the dissemination of tacit and explicit knowledge: telephone communications, storytelling, mentoring and job shadowing can all contribute to sharing tacit knowledge, while a company newsletter can expedite the transfer of events, best practices and lessons learned
- Creation: concerned with adding value to previous knowledge through innovation, particularly in developing new skills and competencies of employees

Hussain and Lucas (2004) discuss KM as a process that helps organisations identify, select, organise, disseminate and transfer knowledge. In this regard, they refer to a number of organisational knowledge initiatives:

- Sharing knowledge and best practices
- Instilling responsibility for sharing knowledge
- Capturing and reusing best practices

- Embedding knowledge in products, services and processes
- Producing knowledge as a product
- Driving knowledge generation for innovation
- Mapping networks of experts
- Building and mining customer knowledge bases
- Understanding and measuring the value of knowledge
- Leveraging intellectual assets

In attempting to define KM, it is evident that there are processes associated with managing knowledge. Wiig (1997) refers to renewing, organising, transforming and leveraging knowledge assets; whilst the BSI (2003) cites creating, sharing, learning, enhancing, organising and utilising knowledge. Kazi and Hannus (2002) identify processes for KM as: identify, collect, organise, share, adapt, use and create. Jashapara (2004) discusses the processes of discovering, generating, evaluating, sharing and leveraging knowledge, which he contends occur in a continuous cycle. Both Suresh (2006) and Egbu et al. (2005) focus upon similar processes including; identifying, capturing, codifying, storing, mapping, disseminating, creating and measuring its impact. Senge (1990) places significant emphasis on sharing knowledge, which he discusses in terms of learning processes: *“sharing knowledge occurs when people are genuinely interested in helping one another develop new capacities for action; it is about creating learning processes.”*

Given the range of terms utilised, it is important that a common set of processes are identified; this is an issue that will be given further consideration as the research proceeds.

3.1.3 Approaches to Managing Knowledge

The classification of knowledge as tacit and explicit according to Nonaka and Takeuchi (1995) has led to the ‘socio-technical debate’ which has its roots in the differing perspectives of Western and Eastern management philosophy towards knowledge (Egbu, 2004). Central to this debate, is how the knowledge is managed, with proponents of explicit knowledge in favour of IT as the main thrust of the KM initiative. Those favouring

the management of tacit knowledge, cite social interaction and culture as the most important aspects.

Utilising technology, most early KM initiatives focused solely on managing explicit knowledge and were seen as nothing more than ‘*information*’ systems (Malhotra, 2000). Progressively, the management of tacit knowledge has featured more prominently (Egbu, 2004). However, Davenport and Prusak were making the assertion as early as 1998, that “*the assumption that technology can replace human knowledge or create its equivalent has proven false time and again.*”

Offsey (1997: 115) contends that there are “*two distinct factions in the KM world:*” firstly those who believe that change management, culture and leadership are important and secondly, the “*information technology evangelists,*” emanating from human resources and information systems fields respectively.

Technology focused strategies concerned with managing explicit knowledge have been termed as mechanistic; whilst people-centred strategies focusing on tacit knowledge have been termed organic (Kamara et al., 2002a). Similarly, Robinson et al. (2005) identify two distinct strategies; codification and personalisation. Codification involves capturing knowledge in an explicit form and leveraging it, using IT tools such as a database; whilst personalisation focuses on sharing tacit knowledge through human interaction. Kaski et al. (2004) identify four approaches to KM as:

1. The repository model: managing and reusing explicit knowledge in document form
2. The communities of practice approach: building expertise through interpersonal interaction between experts
3. The continuous learning approach: enhancing an individual’s ability to acquire and use knowledge for problem solving and decision making
4. Business intelligence: gathering valuable information by mining enterprise-wide databases

The “repository model” and “business intelligence” are considered to be codification; the “communities of practice” and “continuous learning” approaches focus on personalisation.

It is now accepted that an integration of both of these perspectives is required for successful KM, with IT playing a more supportive role (Carrillo 2005a, Al-Ghassani et al., 2005). However, there has been a scarcity of solutions about how to effectively marry social processes with technology (Dixon, 2004).

A number of authors have attempted to move beyond the socio-technical debate, to develop a broader, more holistic perspective on KM. Jashapara (2004) proposes that in addition to culture and technology, organisational learning and strategy are also important dimensions of KM. Davenport (2003) provides a more succinct synopsis of the main issues regarding KM, which include integrating it into business processes; motivating people to share their knowledge; developing organisational learning; and developing a framework that integrates human resource management, organisational management and information management.

A hybrid framework developed by Wiig (1999) provides an overview of the key concepts as well as providing steps to follow for 'Comprehensive Knowledge Management.' Wiig (1999) discounts the use of an incremental approach to KM which builds upon existing practices, espousing a more ambitious approach, something which construction organisations may be unable to comprehend and implement. There are, however, a number of concepts which will prove useful to the current research including the adoption of a cyclical/process-based approach to KM and a focus on specific approaches such as cultural change, collaborative working practices, communities of practice, the capture and transfer of expert knowledge, lessons learned systems and performance support systems.

Two contrasting views of the KM process, which extend the socio-technical debate are presented by Newell et al. (2002); the cognitive model and the community model. The cognitive model, they argue, whilst useful is limited by the assumption that knowledge is an object that can be managed by technology. The community model, which "*highlights the importance of relationship, shared understandings and attitudes to knowledge formation and knowledge-sharing (Newell et al., 2002: 107),*" aids our understanding of the characteristics of knowledge work and reflects the constructivist position of this study. They argue that these two approaches are not mutually exclusive and through their discourse conclude that KM is dependent upon cognitive factors (the distribution of

knowledge); social factors (the development of social relations and networks); and organisational factors (politics, roles and structures).

It is clear that knowledge is a conceptually complex phenomenon, which has been the subject of philosophical debate for thousands of years. Much of the KM literature attempts to reduce knowledge to two dimensions; tacit and explicit, which can be argued is a tendency towards over-simplification. The concept of explicit knowledge has been criticised as being nothing more than information, a theme continued in the debate surrounding knowledge in relation to data, information and wisdom. In light of the constructivist position adopted in this study, knowledge is viewed as being personal, yet socially constructed, accumulated through experience and education, it is continuously modified and context-specific. From an organisational perspective, the management of knowledge has received increasing attention in recent years due to the recognition that knowledge is a critical resource in a highly competitive environment. Against this backdrop KM has become a key management tool, although given its emergence it is still a rather vague topic, with as yet no common understanding, apart from organisations becoming 'smarter over time'. A sample of KM definitions highlighted that there are various processes associated with managing knowledge, including identifying, capturing, codifying, storing, mapping, disseminating, creating and measuring its impact. The challenges in effectively marrying social and technological for managing knowledge are well recognised, necessitating the need for further research in this area. More specifically, the unique nature of construction, the continuing need for development of KM within the industry, and the grounded approach to the research which recognises the importance of context, all infer the need for a bespoke KM framework for construction.

3.2 Knowledge Management in Construction

There are significant challenges facing today's construction industry; increasing competition, globalisation of the construction market, demands from clients, customers and society, and the pace of change in IT. A further challenge lies in maintaining a highly skilled workforce at all levels from operative and technical, to managerial and professional (Egbu and Robinson, 2005).

In addition to the impact of technology and new market opportunities, Chen and Mohamed (2005) highlight the impact of economic swings, and protection against competitors, as being major external elements which strategically affect construction organisations. Tan et al. (2005: 578) go so far as to state that "*a construction organisation's only sustainable advantage lies in its capability to learn faster than its competitors and the rate of change imposed by the external environment.*" In a study of KM in North American construction organisations, Carrillo (2005a: 560) identified the main driver for KM as "*the need to leverage knowledge to win work and provide a better service to their clients.*" However, the environment within which construction organisations operate exhibit a number of distinct characteristics which make the management of knowledge difficult:

- The temporary, project-based nature of construction projects inhibits knowledge sharing (Egbu and Botterill, 2002, KLICON, 1999). Craig et al. (2004) venture so far as to term the construction project environment 'hostile' to the promotion of KM and learning
- The geographical dispersion of construction sites from the organisations main and regional offices has a further detrimental effect, particularly in relation to forming social networks and contacts (Hari et al., 2004, Constructing Excellence, 2004)
- The pressures to complete projects often leaves little time for reflection and learning (KLICON, 1999, Constructing Excellence, 2004)

The most valuable form of knowledge for construction organisations is tacit, the accumulated experience of construction professionals, which manifests itself through social interaction (Kazi et al., 2005). Yet the project-based nature of the industry inhibits participation in, and limits contact between different projects (Knauseder et al., 2005). The

staff employed on construction projects have experience “*that spans years, geographical locations, cultures, languages, technical expertise, education and political experiences, to mention a few. Each person also has different people skills and attitudes, and different ways and speeds of learning. In short, there is a wealth of information and knowledge that resides in the individuals on the project (Grisham and Walker, 2005: 553).*” Further obstacles to effective project knowledge transfer include: lack of incentive to appraise performance, pass on learning to others, and ultimately improve project delivery (KLICON, 1999).

Given that there are significant obstacles to the implementation of KM within construction organisations, it is important to not only understand such barriers, but for the organisations to recognise the potential benefits also. According to Palmer and Platt (2005), if properly implemented, KM can offer construction firms the following benefits: a major competitive advantage, avoid repeating mistakes and reinventing the wheel, reduce the time taken to find information, allow faster decision making, and improve client satisfaction, employee morale and teamwork.

Benefits	Barriers
<ul style="list-style-type: none"> • Cost/time reduction • Process & product improvement • Innovation, success & market leadership • Client orientation & satisfaction • Improved decision support & problem solving • Less repeated mistakes and duplication of work • Improved staff quality, satisfaction, motivation & retention • Increased awareness, accessibility and availability of knowledge • More effective teamwork 	<ul style="list-style-type: none"> • Lack of time & money • Temporary, project-based & dispersed • Employee resistance • Poor organisational culture & structure • Piecemeal, ad hoc adoption • Problems of measurability and validation • Lack of incentives to encourage knowledge sharing • Lack of understanding of the benefits of KM • Conflicting orientations to change and lack of sensitivity to context

Table 8: KM in Construction Organisations – Benefits and Barriers

A summary of the potential benefits that KM can bring to construction projects, along with some barriers to successful KM implementation are identified in Table 8 (adapted from Al-Ghassani et al., 2004, Bresnen, 1999, Carrillo, 2004, Mohamed and Anumba, 2004, Payne and Sheehan, 2004). In order to capitalise on the reported benefits and overcome the

identified barriers, when developing a formal KM initiative there are a number of issues to consider, according to both Robinson et al. (2005) and Egbu (2004):

- 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
- Utilise a KM maturity scale in order to objectively benchmark KM implementation efforts

These issues will now be considered in more detail, based on a more focused review of literature.

3.2.1 Strategy

Many construction companies have had problems in formulating an effective strategy to capture, retain and reuse knowledge in such a way that allows learning on a consistent basis, whilst improving organisational performance (KLICON, 1999). In attempting to integrate people and technological issues more successfully, the formulation of a well-defined KM strategy is required; one which must be integrated into the overall strategy of the business, as a means of improving organisational performance (Carrillo et al., 2003). The main features of a KM strategy are the promotion of a knowledge sharing culture, a suitable IT 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 organisation should be explored in terms of people, process and technology (Sheehan et al., 2005). In a study exploring KM in construction organisations, it was found that the majority of respondents did not have highly developed KM strategies, structures or an appropriate culture (Egbu, 2004).

3.2.2 *Knowledge in Construction Organisations*

Whilst knowledge has already been given consideration from a philosophical perspective, there is also much literature surrounding the practical manifestations of knowledge within organisations. Knowledge is classified into four types by Bolisani and Scarso (1999):

1. Know-what: knowledge about facts – quite close to what is defined as information
2. Know-why: scientific knowledge of principles and laws
3. Know-how: practical capability to execute specific activities
4. Know-who: information about who knows what and who knows how

Some of these classifications echo those posited by Prusak (2005); for example episteme as know-why and techne as know-how. From an organisational perspective, both Siemieniuch and Sinclair (2005) and Egbu and Robinson (2005) offer similar concepts of technological or product knowledge which is concerned with characteristics of the services or goods to be produced; organisational or process knowledge of the organisation and its management systems; and network or people knowledge which deals with the skills, problem-solving and the characteristics of staff and the inherent alliances and relationships with suppliers, subcontractors, clients, consultants, universities etc. In a similar vein, Kamara et al. (2002b) identify knowledge that needs to be managed as: organisational processes and procedures, statutory regulations and standards; clients business; prediction of outcomes, team management, client focus and motivation; technical or domain knowledge of design, materials, specifications and technologies, know-who; people with specific skills; abilities of suppliers and subcontractors.

Based on a comparison of the knowledge categorisations in Table 9, it appears that there are four main categories of knowledge which are of primary concern to construction organisations; scientific, technical, people and organisational knowledge. Scientific is concerned with knowledge that is codified and universal, while technical refers to possessing knowledge of, or the ability to do something in a particular area or domain. Knowledge of people and their skills and characteristics, is quite important, both within and outside the organisation. Knowledge of the processes, procedures and regulations that govern how an organisation functions is also relevant.

Knowledge Category	Bolisani and Scarso (1999)	Prusak (2005)	Siemieniuch and Sinclair (2005)	Egbu and Robinson (2005)	Kamara et al. (2002b)
Scientific	Know-why	Episteme			
Technical	Know-how	Techne	Technology	Product	Technical
People	Know-who	Phorensis	Network	People	Know-who
Organisational			Organisational	Process	Organisational

Table 9: Categories of Knowledge

In considering knowledge 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. In light of the earlier comments by KLICON (1999), this study focuses on intra-organisational KM, thus the individual, group (project) and organisational levels are considered most appropriate to construction organisations and will now be examined.

3.2.3 *Individual Knowledge*

Storey (2005) discusses the role of ‘knowledge workers’ in KM, who should be self-starters, continually striving for creative solutions and building on their educational qualifications and experience repertoire. He continues by stating that they must be capable of learning and making sense of large amounts of complex information and must be sufficiently motivated to seek out opportunities and design their own work, often with little direction. 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 the management of 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 Continuing Professional Development (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).*” Further to this, the development of technical knowledge in the specialist subject area, personal transferable skills and attributes such as team working and problem solving; and general managerial skills are identified as the main areas of learning for professionals (Roscoe, 2002).

3.2.4 Project Knowledge

On construction projects on a daily basis, 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). One of the main challenges encountered, is the inability to capture and retain lessons learned from a project in such a way that they can be reused by the rest of the organisation in flattening the learning curve, avoiding the possibility of repeating similar mistakes, and ‘reinventing the wheel’ (Kamara et al., 2002b, Chien and Johnson, 2002, Fong and Wong, 2005). On construction projects, new and non-standard problems are frequently encountered which result in specialist and technical knowledge being developed within the project team, however “*this knowledge is socially constructed and may lose context and meaning as the project team is split on completion of the building (Orange et al., 2003).*” 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 documentation and registration on the project file (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; such activities merit further investigation in the context of Irish construction organisations.

3.2.5 Organisational Knowledge

As part of the CLEVER research project, Kamara et al. (2002a) identified processes for managing knowledge in construction as a 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 or divisional heads to disseminate knowledge and the use of IT tools to support information sharing and communication. Dainty et al. (2005) identified a number of HRM strategies for knowledge sharing within a large construction organisation in Hong Kong as informal knowledge workshops, knowledge exchange seminars, departmental meetings, site visits, summary reports, coaching and mentoring, communities of practice and an intranet. Communities of practice have proven to be a popular approach to knowledge-sharing within organisations. Wenger et al. (2002: 4) define them as “*groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis (Wenger et al., 2002: 4).*”

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). He posits that such learning needs to be institutionalised at organisational level; that is, learning becomes embedded in organisational routines over time leading to changes in behaviour, systems, structures and strategies.

It can be surmised, therefore, that the categories of knowledge which are of concern to construction organisations are technical, people and organisational, which can reside at a variety of ontological levels; individual, project and organisational (Jashapara, 2004, Nonaka and Takeuchi, 1995).

3.2.6 Culture

Trust, respect and reciprocity are vital for inculcating an environment for managing tacit knowledge (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).*” A knowledge sharing culture is one which is characterised by the following: it is acceptable to ask for help, it is reasonable to make mistakes, it is possible to share lessons in a culture of continuous improvement, and people actively seek and apply new learning (Sheehan et al., 2005). In attempting to create and sustain such a culture, Egbu and Robinson (2005) cite a number of important issues:

- Top management support
- Link to economic performance and strategy
- Clear purpose and shared language and meaning of KM
- Flexible communications and a risk-tolerant climate
- Staff ‘ownership,’ involvement and job security
- Technical infrastructure (e.g. intranet, databases and video-conferencing)
- Organisational structure (e.g. teams, relationships, networks)
- A culture of sharing information, experience and knowledge across project teams and the organisation
- Staff motivation (e.g. performance management and team-based rewards)
- An environment that supports and promotes education and training

3.2.7 Technology

Technology has an important role to play in managing knowledge in an organisation; in supporting people in accessing, creating, sharing and using knowledge, and in aiding the identification of knowledgeable people (Payne and Sheehan, 2004; Walker et al., 2004; Tiwana, 2000). According to Prusak (2006): “*IT systems do not manage knowledge, they manage data and information.*” The role of IT in KM is to facilitate the identification and sharing of knowledge, 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).

Further to this, the BSI (2003) argues that “*KM does not necessarily need complex and expensive technologies.*” 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, stating that “*knowledge management efforts and initiatives that will gain management support, continue funding, and keep risks low will have to build upon existing systems (Tiwana, 2000: 116).*” In order to explore the existing technological infrastructure, the work of Walker et al. (2004) and Al-Ghassani et al. (2005) are used as the basis upon which to define the technological requirements for KM (see Table 10). The IT Hardware and Software Infrastructure is a key part of the K-Adv model developed by Walker et al. (2004), comprising four main sub-elements: hardware, software, networks and portal interfaces. KM technologies are discussed by Al-Ghassani et al. (2005) who make the distinction between hardware technologies and software technologies.

IT Hardware & Software Infrastructure (Walker et al., 2004)	KM Technologies (Al-Ghassani et al., 2005)	IT Infrastructure (Present Study)
Hardware	Hardware Technologies Computers Servers	Hardware Computers Servers
Networks	Network Technology ISDN & Fibre Optics	Network Technology Data Communications
Software Groupware	Software Technologies Groupware Data and text mining Knowledge Bases Taxonomy	Software Groupware Email Instant Messaging Voice over IP Video Conferencing People Finder/Skills Database Virtual Meeting Space
Portal Interfaces	Intranet	Intranet

Table 10: IT Infrastructure for KM

Walker et al. (2004) in discussing hardware and networks, state that they need to be available and accessible, supportive, user-friendly, and above all, secure. Al-Ghassani et al. (2005), describe the hardware requirements of a KM system as: computers and workstations for access to the system, servers for networking the organisation, communications infrastructure such as ISDN and fibre optics for high speed access, and the use of public and private network technologies. The hardware infrastructure required to support KM is illustrated in Figure 7, which must be in place in order to obtain the full benefit of a software infrastructure, depending heavily on it as the “*main platform for implementation (Al-Ghassani et al., 2005: 86).*”

Collaborative working through the use of internet technologies and advances in communications technologies have led to the increasingly supportive role of software technologies in KM (Payne, 2003). Some of the technologies which support KM include: email, groupware, virtual meeting spaces, instant messaging, video conferencing, voice over IP telephone (VoIP), a skills database or corporate people finder and an intranet (BSI, 2003; Payne and Sheehan, 2004; Carrillo et al., 2004; Payne, 2003). However, Egbu et al. (2005) contend that simple applications such as Microsoft Office and email can be used to aid KM, particularly as many advanced technologies such as virtual meetings still have a relatively low level of usage in the construction industry.

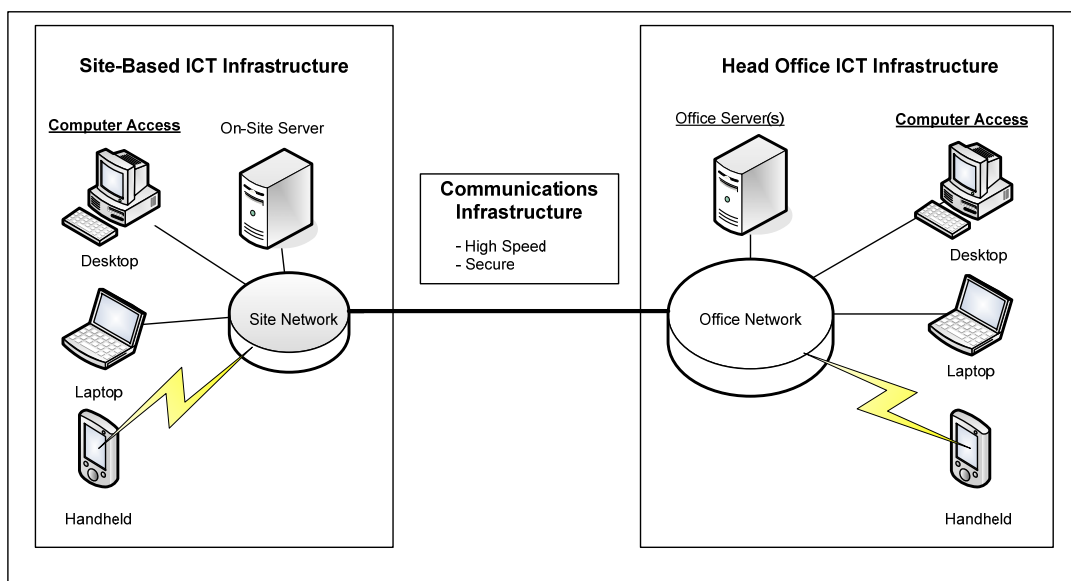


Figure 7: Hardware Infrastructure

Intranets, according to Payne and Sheehan (2004: 15) “*are widely used as the single point of access to an organisation’s knowledge.*” They are particularly useful, as Al-Ghassani et al. (2005: 89) point out “*in large construction organisations that are often geographically dispersed.*” A study by Dainty et al. (2005) which focused on the role of Human Resource activities in KM cited an intranet as being a very important resource. This demonstrates further the supportive role that technology has to play, as well as the integrative nature of people and technology issues in a KM initiative. Many of these technologies now act not only to connect people with information, but people with other people, “*to encourage the sharing of tacit knowledge and the generation of new ideas (Payne and Sheehan, 2004: 7).*” The software and portal components of the K-Adv model are deemed to fall under this heading, with Walker et al. (2004), specifically identifying groupware as software infrastructure, with portal interfaces being taken in this instance to be represented by an intranet.

3.2.8 Measurement

Measuring the performance of KM can demonstrate business benefits and cost savings, and make the case for further resources and support (Robinson et al., 2005). However, the need to link KM initiatives with their impact on business performance can prove to be problematic (Sheehan et al., 2005). According to Robinson et al. (2005: 149), this is due to “*the complexities involved in understanding the dynamics of knowledge and its management.*” They suggest that there are two aspects of measuring KM performance: knowledge stocks i.e. talent of employees, efficiency of processes used, nature of products etc. and knowledge flows, KM projects or initiatives, measured against expected outputs of initiative. Sheehan et al. (2005) introduce the measurement paradox, quantitative measures they argue may be limiting and too indirect, whilst qualitative measures tend to be difficult to assess. They suggest that anecdotal evidence, case study evidence and feedback from users may be more appropriate methods of gaining and maintaining senior management support. This is a view supported by Robinson et al. (2005) who question the suitability of a full-scale measurement framework for KM and suggest that organisations at the lower end of KM implementation should rely on qualitative evaluation.

There are significant challenges facing the construction industry which require a more concerted approach to KM. However, the very nature of the industry, being temporary, project-based, geographically dispersed and highly pressurised, inhibits the effective adoption of KM. In order to derive the reported benefits of KM, and overcome significant barriers, construction organisations need to appreciate the type and nature of knowledge to be managed, and consider a variety of strategic, cultural and technological issues.

3.3 Continuing Professional Development

Increased profitability, improved project delivery and client satisfaction can be achieved by construction organizations that employ highly skilled staff (Ellis et al., 2004). The development of technical knowledge in their specialist subject area, personal transferable skills and attributes such as team working and problem solving, and general managerial skills are identified as the main areas of learning for professionals (Roscoe, 2002). In order to develop these skills, CPD is important and is defined as: “*the planned acquisition of knowledge, experience and skills and the development of personal qualities necessary for the execution of professional and technical duties throughout a construction professional’s life* (Wall and Ahmed, 2005: 1290).”

Rothwell and Arnold (2005: 30) contend that CPD is particularly important “*given the increasing complexity of working life, the accelerating pace of change, and the declining half-life of knowledge.*” Three of the main stakeholders in CPD are the individual professional, the professional body to which they belong, and employers of professional staff who are concerned with maintaining the competence of their staff (Roscoe, 2002).

3.3.1 Professional’s Engagement in CPD

Individuals undertake CPD, not only to satisfy their professional body’s requirements, but to ensure credibility with colleagues and employers, improve current job performance, widen and deepen the capacity to perform in the current role and develop future capacity to enable promotion and progression (Roscoe, 2002). According to Rothwell and Arnold

(2005), the three main reasons for undertaking CPD are to keep up to date, maintain competence and value within the organisation, and enhance labour market mobility.

CPD requires significant time and effort on the individuals' part; trying to balance study and learning with full-time work commitments and domestic life can prove challenging (Tennant and Field, 2004). The propensity of an individual to engage with CPD activities may be influenced by a number of factors. Age and experience is viewed as a key determinant in the uptake of CPD by Rothwell and Arnold (2005) who identify less experienced practitioners as having a higher uptake. In a more general vein, for example, a study of dental practitioners by Buck and Newton (2002) found that gender, age, length of time since qualification, current working hours and career breaks may have an impact upon engagement with CPD activities, particularly post-graduate courses.

Positive engagement with CPD cannot be assumed for all professionals, according to Rothwell and Arnold (2005), who contend that the individual's ability to learn, lack of a perceived need, and over-stringent professional body requirements, particularly record-keeping, may inhibit engagement. There are numerous problems for professionals in recording CPD activity, according to Sadler-Smith and Badger (1998); knowing what to record, confusion about the use of record keeping forms and the time taken to complete such forms. In general, Smith (1999) believes that the uptake of learning opportunities by managers can be quantified as follows: 15% are active continuous learners, 60% have potential for learning if they can be convinced of its necessity and 35% are blocked from learning for various reasons.

A study on barriers relating to the uptake of continuing education for physicians by Thomas et al (2006) found that a lack of time, geographical constraints, reluctance to change and a lack of interest all featured prominently. Problems regarding access to CPD activities due to geographical dispersion were also highlighted in a study of dental practitioners by Best et al. (2005), who propose that e-learning solutions may help to overcome some of these problems.

3.3.2 Professional's Experience and Management Level

As employees move from junior to more senior positions, they accumulate a wealth of experience, progressing from 'novices' to 'experts' in their chosen field. Leonard and Swap (2005) discuss the concept of 'deep smarts' which is deeply embedded, experience based tacit knowledge that cannot be made explicit, and entails knowledge of the business, customers, and products both on an overall and an in-depth level. Experience plays a central role in developing 'deep smarts,' and it is difficult to transfer to less experienced people, as they may not have the required frameworks, domain knowledge or prior experience on which to base the 'deep smarts' knowledge.

Gary (2005), as shown in Table 11, identifies the difference between experts and novices in the context of the characteristics of 'deep smarts'. Organisations have difficulty managing this type of asset, "*perhaps because it's difficult to pin down and measure (Leonard and Swap, 2005: 157).*" In order to develop and pass on the knowledge of experts, Gary (2005: 4) states that companies need to move beyond formal training to "*forms of knowledge transfer that call for active participation of workers in the learning process.*"

	Experts	Novices
Speed of Decision Making	Make decisions swiftly, efficiently, without reviewing basic facts	Need to review all facts and choose deliberately among alternatives
Context	Take context into account; knowledge is "contextualized"	Rely on rules of thumb that minimize context
Extrapolation	Able to extrapolate from novel situation to find a solution	Lack of receptors limits basis for extrapolation
Discrimination	Able to make fine distinctions	Use of rules of thumb obscures fine distinctions
Awareness of Knowledge Gaps	Know when rules do not apply	Do not know what they do not know
Pattern-Recognition Ability	Have large inventory of patterns drawn from experience	Limited experience constrains number of patterns
Tacit Knowledge	Extensive tacit knowledge drives decision making	Knowledge is largely explicit

Table 11: Characteristics of Deep Smarts (adapted from Gary, 2005)

As previously discussed by Rothwell and Arnold (2005), younger professionals might be more interested in CPD than older professionals, which suggests that more suitable approaches should be adopted for more experienced staff. Indeed, Maxwell-Hart and

Marsh (2001) contend that depending on their experience and management level, the individual will have differing training and development requirements. They provide a simple, yet effective framework for defining the various management levels within construction (as seen in Table 12), which comprise: executive management, senior management, middle management, supervisory management and junior management.

Management Level	Typical Job Title	Typical Responsibilities
Executive	Managing Director	Strategy
Senior	Director	Functional Management
Middle	Contracts Manager	Management of Project(s)
Supervisory	Project Manager	Project Team Management
Junior	Graduate Engineer	Obtaining Experience

Table 12: Management Levels in the Construction Industry (adapted from Maxwell-Hart and Marsh, 2001)

The following passages highlight the important role of middle managers construction, and more specifically, KM initiatives. Despite this, middle management, according to Styhre and Josephson (2006: 521), is predominantly viewed in a negative light in much of the management literature, remaining “*one of the most marginalised fields of interest.*” This negative sentiment, they continue, arises from middle managers being seen to occupy “*an intermediary role in between the ‘thinking’ (top management) and the ‘doing’ (subordinate workers),*” unable to affect influence at tactical or strategic levels (Styhre and Josephson, 2006: 522).”

From a construction perspective, Maxwell-Hart and Marsh (2001) identify middle management as Contracts Managers, who are responsible for the overall management of a project or a number of projects. Styhre and Josephson (2006) give the label ‘Site Managers’ to middle managers within the construction industry, but broadly agree with the role defined by Maxwell-Hart and Marsh (2001). In their study of middle managers in construction, Styhre and Josephson (2006: 527) conclude that they are central players within the industry, who “*are expected to integrate a number of different skills and take charge of a series of activities which include leadership issues, technical expertise, administrative operations, planning and control procedures.*”

In the broader management domain, middle managers are viewed as being important to KM by a number of authors. In their seminal publication, Nonaka and Takeuchi (1995) dedicate significant time to the central role of middle managers in KM. They contend that it is precisely this intermediary role which is crucial, *“knowledge is created by middle managers, who are often leaders of a team or task force, through a spiral conversion process involving both the top and the front-line employees (Nonaka and Takeuchi, 1995: 127).”*

This is a view held by Mohamed et al. (2004: 128) who state *“KM involves changes that may not easily gain the organisation’s acceptance unless the leadership mobilises middle managers to provide an environment conducive to the widespread sharing of knowledge.”*

In terms of project-based organisations, Davenport and Volpel (2001: 215) contend *“since knowledge is typically managed in the form of a project, firms will need a cadre of knowledge project managers – a middle management layer within the knowledge structure.”*

These statements serve to highlight the potentially important role of middle managers within construction organisations, which are characterised by a project-based structure. Indeed, Koch (2003) found the role of middle managers to be important with regard to exercising leadership, communicating knowledge and information and by enabling cross-departmental cooperation within a large consulting engineering organisation.

The important role of middle managers in KM would seem to suggest their function as KM champions: *“the success of any KM initiative is likely to be critically dependent on having suitably motivated people taking an active role in the process (Theriou and Chatzoglou, 2007: 191).”* Furthermore, Jones et al. (2003) cite the important role of ‘knowledge champions’ in KM initiatives, specifically in facilitating the acquisition and dissemination of knowledge throughout the organisation.

3.3.3 Organisations

Gary (2005) highlights the impact of knowledge loss due to experienced workers being promoted, moving to another company or retiring, which can range from subtle to more profound. While CPD offers obvious benefits for individuals, it can also provide employers with staff who possess up-to-date knowledge and can aid succession planning and retention (Rothwell and Arnold, 2005). Training and development, according to Smith and Rupp (2004) should not only focus on developing present skills, but also on developing leaders of the future through soft skills training for employees.

From an organisational perspective, the importance of a supportive learning environment is discussed by Shipton and Shackleton (1998: 278), who identify the following factors; *“support and encouragement of the line manager, the attitude towards learning of the immediate work group, the availability of equipment to allow the use of newly acquired skills, and the opportunity that the learner has to apply recently trained skills to the job.”*

3.3.4 Professional Bodies

CPD is an integral part of the activities of all professional bodies, and ensures that members have kept their knowledge and skills up-to-date (ICPD, 2006). In terms of the leading Irish construction organisations, the main focus of their professional and management staff is on the following professional bodies (based on primary research in both phases 1 & 2):

- Engineers Ireland (EI): one of the oldest professional bodies in Ireland, EI represent all disciplines of engineering, including civil and structural (Engineers Ireland, 2007)
- Chartered Institute of Building (CIOB): with an international focus, the CIOB represent managers and professionals involved at all levels of the building process (CIOB, 2007)
- Society of Chartered Surveyors (SCS): is the professional body for Chartered Surveyors practicing in the Republic of Ireland. It has strong links with the Royal Institute of Chartered Surveyors (RICS) with whom it has a mutual recognition agreement for membership (SCS, 2007)

Table 13 presents an overview of the CPD practices of these three professional bodies (at the time of the Phase 2 research). It is interesting to note that only the SCS have a mandatory requirement on members to complete 20 hours of CPD per annum. Both the SCS and the CIOB provide an online system for members to record their CPD activity, whilst all three monitor these activities on a random basis. Guest (2007) confirms this trend towards web-based recording of CPD, which can be combined with online CVs and personal websites. The monitoring process is viewed by professional bodies as highly resource intensive, and to review all members CPD activities would be a costly exercise (ICPD, 2006).

Body	Members	CPD Policy	Annual CPD	Monitoring	Recording
EI	23,000	Obligatory	5 days	Random	Paper
CIOB	42,000	Obligatory	30 hours	Random	Online
SCS	1,800	Mandatory	20 hours	Random	Online

Table 13: Professional Bodies' CPD Practices (CIOB, 2007, EI, 2007, SCS, 2007)

In 2006, the Institute of CPD conducted a major research project into CPD which found that there is now a move away from measuring CPD activity in terms of numbers of hours towards a more output driven, self-managed mode, whereby professionals decide what and how much CPD they require through self-reflection and evaluation. As a result, the research identified the increasing role of employers in supporting staff's CPD activity. Staff appraisals and training activities that are related to the professional's work have the potential to be aligned with the needs of the employer and the professional's CPD obligations (ICPD, 2006). Such issues correlate with the previously identified criteria of EI's CPD accreditation scheme (see Chapter 1), which shall now be considered in further detail.

3.3.5 *Engineers Ireland CPD Accreditation Scheme*

While the main focus of professional bodies is on individual members, as previously mentioned, EI have introduced a CPD accreditation scheme for member organisations in a range of engineering-related sectors. EI (2007) identify a number of potential benefits of their CPD accreditation scheme in the context of the individual, organisation and the economy in general, as follows:

- Maximise employee potential
- Improved recruitment and retention of staff
- An innovatory and dynamic culture
- Raise the profile of the organisation
- Sustain the economy within the Knowledge Economy
- Optimise return on learning and development spend
- Align business goals with personal development
- Supports career planning and promotion procedures
- Benchmarking against industry best practice

These identified benefits of CPD accreditation converge with the perceived benefits of KM identified earlier in this chapter (see section 3.2). As part of the scheme, organisations are required 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. 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 (Engineers Ireland, 2007).

3.3.6 *CPD Activities*

Whilst much informal learning occurs through on-the-job experience, there are a number of activities which can account for formal CPD, such as completion of training courses, mentoring and post-graduate academic studies. Smith and Rupp (2004: 153) found that the training and development programs of leading companies included “*onsite education,*

succession planning, executive coaching, management training, and most importantly, a true commitment to the program [sic].”

According to Gregson (1994: 26), mentoring “*is an attempt to transfer experience and expertise from experienced individuals in an organisation to the less experienced.*” Mentoring is commonly used in organisations to develop and nurture potential future managers from an early stage (Mondy and Noe, 1996), but has also proven effective in developing employees at more senior levels (Gay, 1994). “*Research shows that mentored individuals are more likely to be the organisation’s future leaders* (Scandura et al., 1996). Mentoring must be seen as more than merely assigning a novice to a more senior member of staff, it requires the careful selection and training of the mentor in the first instance (Gregson, 1994).

Other activities which can contribute to formal CPD and are recognised by professional bodies are included in Table 14 (CIOB, 2007, Engineers Ireland, 2007, SCS, 1996, ICPD, 2006). As previously mentioned, participation in such 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).”

Conferences and lectures	Workshops and seminars
Private study and reading	Involvement with professional body
Tutoring and mentoring	Teaching and examining
Tours & site visits	Membership of working groups
Open distance learning	Research publications & presentations

Table 14: Recognised CPD Activities

Many professional bodies treat formal training as the primary source of CPD, but Roscoe (2002) questions whether such courses are the best way to develop technical, personal and management skills. Leonard and Swap (2005) argue that most organisations do not understand the fundamentals of how people learn, leading to most of their training and development programs focusing on the transfer of explicit technical or managerial knowledge. The evaluation of CPD activities typically focus on learner satisfaction and acquisition of knowledge, according to Tennant and Field (2004), rather than the impact such activities have on practice.

Rothwell and Arnold (2005: 25) found that the most popular CPD activities were “*informal and related to the respondent’s organisation and job role, suggesting that these concern organisational-procedural matters (reading work-related documents, sharing knowledge) rather than generic professional knowledge.*” This is a theme continued by McDougall and Beattie (1998) whose case study of learning within an organization found that informal learning between staff occurred in areas such as technical and market knowledge, coping with change, management and intra-organizational communications.

In a similar vein, the work of Gibbons et al. (1994) identified two modes of knowledge production, mode 1 is concerned with the production of discipline-specific, scientific knowledge, whilst mode 2 knowledge is socially generated and is anchored in practical, context-specific here-and-now problems. It would appear that formal training activities are generally concerned with mode 1 knowledge production, whilst more informal activities contribute to mode 2 (such as problem-solving, workshops and seminars). In this regard, Burns and Chisholm (2003: 181) contend that mode 2 knowledge production, which is “*transdisciplinary, involving teams and largely concerned with developing tacit knowledge skills*” is particularly relevant for the construction industry.

3.3.7 *Aligning CPD with Knowledge Management*

Teare and Neil (2002) argue that the organisation provides the best place for learning, allowing for the consideration of issues that are relevant to the business. Further to this they state that by adopting a learning approach within the organisation, shared learning between managers and individuals and small groups can focus directly upon real work challenges. Therefore, it is worth comparing CPD with KM, particularly as both are concerned with knowledge and learning. While the primary focus of CPD is on the individual professional, and KM is concerned with the organisation as a whole, there is considerable overlap in terms of the activities which contribute to both, as evidenced in Table 15. It is reasonable to suggest that CPD has an important role to play in KM within construction, and indeed, other industries, at individual, project and organisational levels (Harrison and Kessels, 2004).

	CPD	KM
Focus	Individual	Organisation
Definition	Planned acquisition of experience, knowledge and skills	Learning processes associated with exploration, exploitation and sharing of human knowledge
Activities	Conferences and lectures Private study and reading Tutoring and mentoring Tours and site visits Open distance learning Workshops and seminars Teaching and examining Working groups Research publications	Knowledge exchange seminars Departmental meetings Coaching and mentoring Site visit programmes Staff appraisals Intranet and databases Recruitment and training Communities of practice Post-project reviews

Table 15: Comparison of CPD and KM

The relationship between individual and organisational learning is discussed by McDougall and Beattie (1998) who view individuals at the core of learning within organisations. CPD has a role to play in facilitating the integration of mode 2 knowledge production that is relevant to employees, their role and the company's objectives, according to Burns and Chisholm (2003). They recommend that a work-based knowledge transfer strategy for CPD is established. The link between knowledge and learning is discussed by Gourlay (2001) who cites the need for the involvement of HRM specialists in KM projects if they are to be successful, particularly as the design and delivery of formal training is complimentary with the dissemination of explicit knowledge within organisations. McDougall and Beattie (1998) suggest that there is a role for training and development professionals in increasing awareness of informal learning strategies within organisations, which can lead to effective knowledge transfer and organisational learning.

A central problem of promoting learning across an organisation is that, despite people acting collectively, they actually learn individually (Kleiner and Roth, 1997). Bhatt (2001: 70) comments, "*individual knowledge is necessary for developing the organisational knowledge base; however, organisational knowledge is not a simple sum of the individual knowledge.*" He continues by discussing how organisational knowledge forms through a mix of people, techniques and technologies, which "*are shaped by the organisation's unique history and culture.*" In attempting to align personal and organisational development, Teare and Neil (2002: 344) propose a framework for action learning:

“Action learning is never a solitary, competitive process as it is organized and facilitated via small groups that share openly, and compare outcomes. The key point here is that organizational benefits must also flow from small group activity that help build and sustain cohesive networks with common goals. Here, group members discuss and share insights and use a questioning approach to find, then implement solutions that enhance team (and organizational) performance.”

Within the framework proposed by Teare and Neil (2002) in Figure 8, the concept of action learning is central; whereby employees drive learning based on their own experiences and needs as opposed to the traditional input-based learning provided by external courses.

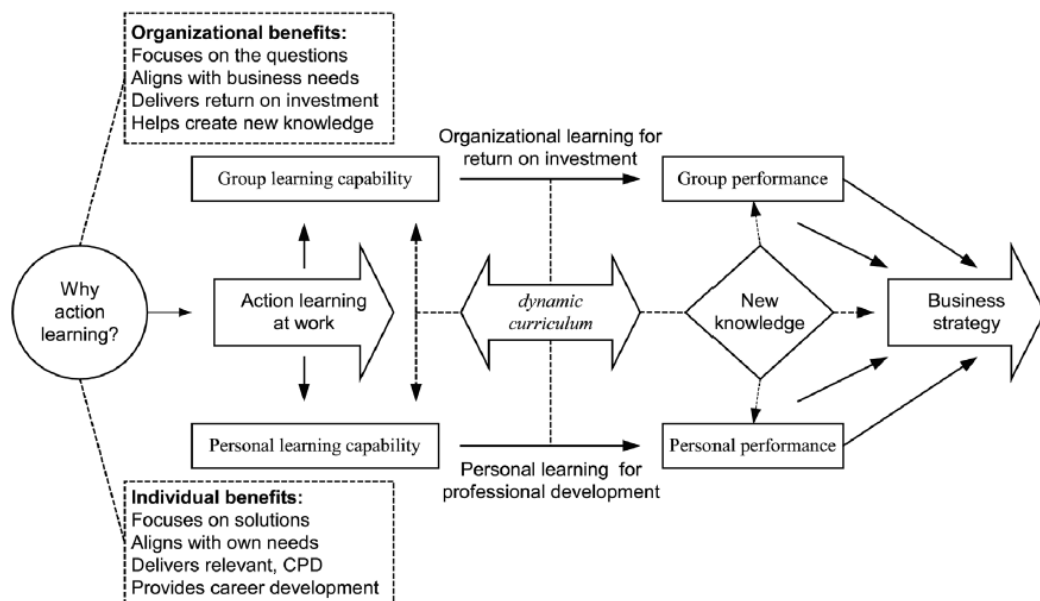


Figure 8: Building a Business Case for Accredited Corporate Learning (Teare and Neil, 2002)

The concept of action learning or active-based learning is one that is continued by Thomas et al. (2006); rather than attempting to educate practitioners through the traditional lecture, they propose a more individual approach whereby learners’ educational needs are assessed and supported by multifaceted techniques such as small group or one-to-one sessions.

Shipton and Shackleton (1998: 277) also discuss the potential for action learning in an organisational setting, “*where managers come together to discuss real problems and possible solutions, guided by a facilitator.*” Furthermore, Teare and Neil (2002) contend that by focussing on their own personal development, the learning for an individual will be more timely, relevant and meaningful. The challenge, they continue, is to add value to such learning through external recognition, by providing professional qualifications for managers that are “*fully aligned with their work, the organizational direction and focus* (Teare and Neil, 2002: 345).”

CPD is an area that is of increasing importance to both construction professionals and their employers. In this regard it is necessary to ensure that construction professionals are equipped with the required, up-to-date knowledge to execute their responsibilities as effectively as possible. Whilst there is much attention placed on formal CPD activities and mode 1 knowledge production, there is a recognition that focus on mode 2 knowledge production and action learning within the organisation may be more effective for more experienced professionals and their organisations. Indeed, the experience and management level of a construction professional appears to be an important determinant of the knowledge and experience they possess and their engagement with CPD and KM-related activities. Specifically, middle managers have an important role to play in KM initiatives in project-based organisations given the skills they are expected to have and the intermediary role they play between senior management and their subordinates. Further to this, there appears to be potential for further integration and alignment of CPD activities with KM in providing a framework for such activities.

3.4 Lessons Learned Practices

In terms of learning from experience in a project-based environment, Salisbury (2003: 115) states, “*once the project is finished, the key challenge is learning, that is to capture all the lessons learnt in this project so that they can be re-used by other teams.*”

Lessons learned (LL) practices are an important aspect of KM and refer to “*the activities, people and products that support the recording, collection and dissemination of lessons learned in organizations (Snider et al., 2002: 291).*” The purpose of LL is to capture experiences, successful or otherwise, allowing an organisation to avoid repeating costly mistakes, improve future performance and ultimately, their profit (Carrillo, 2005b, Kartam, 1996). In a study of American construction organisations, Fisher et al. (1998) identified a number of other reasons for implementing a formal LL process. They include:

- High staff turnover leading to loss of experience
- Large size of organisations make sharing knowledge difficult
- Departmental silos and fragmentation within the organisation

Two key issues were identified by Kartam (1996) in the development of LL practices: a manageable format for organizing, storing, retrieving and updating information; and an effective mechanism for collecting, verifying, categorizing and storing information. In devising such practices, Robinson et al. (2005) identify two distinct strategies; codification and personalisation. Codification involves capturing knowledge in an explicit form and leveraging it using IT tools such as an LL database (LLDB). Personalisation focuses on sharing tacit knowledge through human interaction. A number of authors state that combination of both codification and personalisation is most appropriate (Kamara et al., 2002a, Fisher et al., 1998, Voit and Drury, 2006). However, Dixon (2004) contends that there has been a scarcity of solutions about how to effectively marry social processes with technology.

3.4.1 The Lessons Learned Process

Fisher et al. (1998) developed an LL process comprising three stages: collection, analysis and implementation:

- **Collection:** the identification and capture of a lesson is an extremely difficult process, with a variety of tools identified, such as post project reviews and debriefings (Disterer, 2002, Kartam, 1996). Two approaches have been identified for collection of LL; “*a ‘sought input’ type collection process, where a custodian of the LLP obtains input from various agencies (Fisher et al., 1998: 45)*” and a requirement for individuals to submit LL themselves (Kartam, 1996).
- **Analysis:** a lesson must be important, valid in that it is factually and technically correct and applicable in that it identifies something that eliminates the potential for future failures or reinforces a positive result (Weber and Aha, 2002). The analysis of contributed LL is vital, considering that “*construction practitioners will not accept an assertion that a certain method is superior to another, without a sound rationale (Kartam, 1996: 19).*” Fisher et al. (1998) recommend that analysis of LL be carried out by a team of senior staff with extensive industry experience. In documenting a lesson, Kartam (1996) identifies three key components required, a title describing the lesson, information regarding the source and context from which the lesson is collected, and a means for sufficiently classifying the lesson in a manner that allows fast, clear retrieval by multiple parameters.
- **Implementation:** the dissemination of LL can occur by two methods, push and pull. Push methods deliver the LL directly to the user based on their role, interests, training and experience, whilst pull methods leave the burden of search to the user, who must devote their attention to the source (Weber and Aha, 2002). In this context, Weber and Aha (2002: 292) discuss the distribution gap which refers to “*the difficulty of transmitting lessons between a lessons learned repository and its prospective user.*” This can occur for a number of reasons: distribution is not part of organisational processes, users may not know or be reminded of the repository, users may not have the time or skill to retrieve and interpret textual lessons, and subsequently apply the lessons successfully (Weber and Aha, 2002). A study by Fong and Yip (2006) identified e-mail

or written documents as the most suitable distribution channels for lessons to construction professionals, intranets or websites being the least suitable.

3.4.2 *Implementing Lessons Learned Practices*

In attempting to implement LL practices, and other KM initiatives, a number of challenges have been identified (see Table 16 for LL specific challenges), including poor organisational culture, lack of top management support, lack of dedicated resources such as staff, time and money, and poor IT infrastructure (Fisher et al., 1998, Snider et al., 2002, Kartam, 1996, Carrillo, 2005b, Weber and Aha, 2002).

Lack of time to capture and use learning experiences
Usually captured at the end of the project when many people have moved on
Loss of insight due to time lapse between lesson and recording
Failure to uniformly document LL in a useful manner
Lack of proper classification system
Difficulty integrating with existing operations and procedures
Difficulty sharing lessons between experienced and inexperienced individuals
No motivation or perceived benefits for individual employees
Failure to deliver lessons when and where they are needed
Requires people to internalise LL and apply them at work
Difficult to measure and communicate benefits

Table 16: Challenges in adopting LL practices in construction

To improve LL practices, Davidson (2006) advises that the lessons should be regularly reviewed to ensure accuracy, reliability and relevance. He also proposes that appropriate lessons be incorporated into business processes, training and checklists. Furthermore people should be educated in the use of the LLDB, shown the value in sharing LL and positive feedback given to contributors and users. Voit and Drury (2006) identify two key aspects of LL programs as influencing program effectiveness; information usefulness and human intermediary activities. Information usefulness is the perceived usefulness of the lesson learned, particularly in relation to an individual's current job responsibilities. To reinforce the importance of the LL program, human intermediaries (e.g. managers) should monitor and review their staff's use of the LL. In order to create an environment conducive to learning, senior management need to visibly support an LL initiative, assess the organisation's culture, eliminate barriers, set goals, get departmental buy-in, designate a

champion, empower workers, allocate resources, and measure and track results (Robinson et al., 2005, Fisher et al., 1998).

3.4.3 *Linking Lessons Learned to CPD*

Terrell (2000) contends that far from being learned, lessons are at best, observed, particularly in project-based organisations who have found it extremely difficult to capture and reuse the LL. Leonard and Swap (2005: 163) go further by stating that presentations, repositories, on-line training and lectures are inadequate because much of the knowledge managers need is “*tied to specific contexts and has tacit dimensions.*” In order to move beyond this, Dixon (2004: 18) believes that LL need to be connected to social processes, “*the development of relationships, reflective conversations, probing questions and in-depth interactions – that are the backbone of knowledge sharing.*” In an attempt to address this issue, Lemons (2005) cites Turner Construction, a leading American contractor, who has devised a knowledge network to develop and train individual employees, aligning learning with the overall business strategy, improving both individual and organisational performance. Adopting a blended learning approach, Turner utilises its own experiences and knowledge to develop both face-to-face and web-based CPD courses for its staff (Lemons, 2005). Training is viewed as an important part of LL practices, in promoting the use and benefits of LL practices and incorporating actual LL into training (Fisher et al., 1998, Fong and Yip, 2006). This further reinforces the preceding discussion (in section 3.3.7) regarding the alignment of KM activities with CPD, which can lead to improved engagement from professionals, whilst addressing issues that are of concern to the business.

One of the key challenges for project-based organisations lies in transferring learning derived from a completed project to the rest of the organisation. The adoption of lessons learned practices can help to avoid repeating mistakes and improve performance and profitability. Despite the recognised benefits of lessons learned practices, there appear to be significant challenges in their implementation, particularly regarding the appropriate mix of social processes (personalisation) and technology (codification). In order to overcome some of these challenges, it has been suggested that lessons learned practices could be linked to CPD and other existing business practices.

3.5 Human Resource Management

According to Gloet (2006: 403), “*interest in the relationship between KM and HRM has increased over recent years as both KM and HRM have grown more sophisticated and complex.*”

While Theriou and Chatzoglou (2007) acknowledge this relationship, they contend that human issues are neglected in many KM initiatives, and that the KM literature has made only partial and limited use of HRM concepts and frameworks. It is in this regard that a number of authors have identified different areas where KM and HRM overlap. Edvardsson (2008: 553) posits that “*knowledge is dependent on people and that HRM issues, such as recruitment and selection, education and development, performance management, pay and reward, as well as the creation of a learning culture, are vital for managing knowledge within firms.*”

Storey (2005) identifies HR-related interventions which can be linked to knowledge work as staffing, work and organisation design, development (including training, learning, personal development and career management), and performance management. Koch (2003) identifies recruitment and training as important means of developing organisational knowledge resources, while Jashapara (2004) identifies a number of HR interventions which can aid the successful implementation of a KM initiative including: employee involvement, employee communication, training and development, reward and recognition, and performance appraisals. Appraisals and reward systems, job design, organisational culture, job security and internal promotion and career opportunities are areas recognised as requiring further consideration in terms of the role of HRM in KM (Hislop, 2002).

As identified in Chapter 1, Olomolaiye and Egbu (2004) have conducted research into the role of HRM in KM within construction organisations. In a study of Scottish construction organisations, Olomolaiye and Egbu (2005) found that organisational culture, retention of staff, trust, rewards, recruitment and selection, training and skills development, and performance appraisals all present challenges in managing HRM for KM. A further case study by Olomolaiye and Egbu (2006) of a large international construction company, found

that the following HRM practices contributed to the success of the company's KM initiative:

- Recruitment and selection: involving the identification of desired competencies and skills, recruiting suitable candidates and maintaining a high retention rate
- Performance management: productivity and knowledge sharing are monitored through the company's performance management system
- Reward and remuneration: the company has a variety of incentive schemes, including a long-term initiative to attract and retain high calibre employees
- Training and development: recognising the link between individual and organisational capabilities, the company places emphasis on identifying and sharing excellent practices and facilitating knowledge networks and knowledge-sharing through its training and development programme

Hislop (2002) suggests that HRM practices are important in developing the organisational commitment of employees, which can in turn lead to successful KM initiatives. Organisational commitment, he contends, can influence the attitudes of employees towards knowledge-sharing activities, their participation in KM activities; and the likelihood that they will remain with the organisation. The following sections consider a number of HRM practices including induction, performance appraisals, training and development, networks and relationships, and the important role of HRM in developing and supporting both IT and KM.

3.5.1 Induction

Considerable time and resources are expended by organisations in the selection and recruitment of new employees, therefore the retention of these individuals is of the utmost importance (Fowler, 1990, Davis and Kleiner, 2001). *“Whether an organisation is large or small, it must have an effective orientation system. It can help instil in those who join any company a sense of purpose and a feeling that they are part of a professional and caring organisation (Davis and Kleiner, 2001: 48).”*

For new recruits in the organisation, Lengnick-Hall and Lengnick-Hall (2005: 309) discuss the need for an effective orientation programme which can help to create and foster social connections that *“facilitate job performance long after the program is completed.”*

Orientation, or induction, aims to ensure that new employees adjust to the company, their job and work group, settle in effectively, and become productive as quickly as possible (Mondy and Noe, 1996, Fowler, 1990). Predominantly, orientation has been undertaken by the HR function, but increasingly the belief has been that a new employee’s supervisor should be involved in this process, with adequate training afforded to them (Fowler, 1990, Davis and Kleiner, 2001). Mondy and Noe (1996) identify three different stages in an effective orientation programme, and the parties responsible for each stage:

1. HR Department: general information about the organisation and its structure, company overview, policy and procedure, and salary
2. Supervisor or Senior Manager: overview of the department or work group, job requirements, safety, tour of the department, a question and answer session, and introduction to other employees
3. HR Department and Supervisor or Senior Manager: evaluation and follow-up, with ongoing clarification of information to ensure employee’s integration into the work group

Although there is no set format for orientation, the use of an induction course is seen as important in aiding this process. According to Fowler (1990), avoiding information overload, ensuring relevancy of information provided, and interaction with the new employees work environment are issues which need to be addressed. Davis and Keiner (2001: 43) contend that *“each employee should be oriented according to their position as well as a mass orientation that includes general information that pertains to everyone.”*

3.5.2 Performance Appraisals

Performance appraisals allow an organisation to measure an employee’s behaviour and accomplishments over a period of time (Wiese and Buckley, 1998). According to Smith and Rupp (2004: 154), appraisals *“can be a critical part of a company’s success because*

they allow the company to retain and reward high performers and offer guidance and improvement to poor performers.”

Historically, the main focus of performance appraisals has been on development, motivation and recognition of achievement (Smith and Rupp, 2003). Increasingly they used by organisations to make decisions relating to performance planning and goal setting, pay increases, promotion and transfers, training and employee development, and feedback and counselling (Cleveland et al., 1989; Longenecker, 1997).

A performance management system which promotes a culture of learning and development should, according to Shipton and Shackleton (1998), recognise and reward those who give subordinates time and attention, provide for regular formal performance reviews, promote in-house developmental activities such as job rotation, and involvement of staff in setting performance targets.

There are a number of perspectives which must be taken into account when using performance appraisals, namely: the organisation, the appraiser and the employee (Wiese and Buckley, 1998). Rather than a one-way appraisal, Walsh and Fisher (2005) suggest an inclusive, two-way appraisal will lead to improved employee satisfaction. Effective managers will use appraisals to “*motivate, direct and develop subordinates,*” as opposed to merely measuring employee performance (Wiese and Buckley, 1998: 244).

Both Wiese and Buckley (1998) and Walsh and Fisher (2005) identify four general purposes for performance appraisals:

1. Between individuals: to distinguish between individual employees in relation to performance, rewards, promotion etc.
2. Within individual: to provide feedback on strengths and weaknesses and identify training and development needs
3. Systems maintenance: to evaluate and maintain the organisation’s HR system
4. Documentation: to create a paper trail for legal and personnel reasons

There can, however, be conflicting uses when employing performance appraisals, they may be used for comparison between individuals when considering promotional opportunities, whilst simultaneously considering within-individual issues such as training and development needs. According to Cleveland et al. (1989), this may lead the appraiser to focus on what they perceive to be the most important issue at hand to the detriment of others when conducting an appraisal.

In a study of performance appraisals for sales staff, Pettijohn et al. (2001) identified two categories of evaluative criteria, namely input and output. Input criteria are generally concerned with personal qualities, activities and strategies, whilst output criteria relate to quantitative results such as sales volumes. They found that input criteria, which include communication skills, product knowledge, attitude, selling skills, initiative and aggressiveness, enthusiasm, knowledge of competition, time management and motivation, are generally preferred over output criteria. However, developing metrics of knowledge is a difficult task; particularly as much professional knowledge is substantially tacit, making it impossible for staff to articulate what they know (Smith and Rupp, 2004).

There are a multitude of potential benefits to be derived from performance appraisals for both the individual and the organisation. At an individual level, it assists in developing employees, and it may increase employee performance, motivation, commitment and satisfaction. At an organisational level, it can facilitate other HR functions, such as an evaluation of recruitment effectiveness, facilitation of organisational decision making relating to reward, promotion/demotions, recruitment/layoffs, transfers, and the identification and evaluation of training and development needs (Wiese and Buckley, 1998, Pettijohn et al., 2001).

Wiese and Buckley (1998) discuss the potential negative impact of appraisals by focusing on individual performance as opposed to those of teams. According to a study completed by Longenecker (1997), unclear performance criteria, a poor working relationship with your manager, lack of information, lack of feedback, an overly negative review, a lack of focus on development, an ineffective link to reward systems, and a lack of structure and consistency can render performance appraisals ineffective.

3.5.3 Training & Development

Human resource development is seen as one of the functional roles of the HR department within an organisation (Mondy and Noe, 1996). Raidén and Dainty (2006: 63) offer the following definition: “*HRD is concerned with the provision of learning and development opportunities that support the achievement of business strategies and improvement of organisational, team and individual performance.*” At a more practical level, HRD can be simply referred to as training and development, where training is concerned with staff acquiring knowledge and skills needed for their present jobs, while development involves learning that looks beyond their current role within the organisation (Mondy and Noe, 1996).

Much of the HRM function is concerned with the provision of CPD, which according to Ng (2005: 150) is “*essential for graduates and workers to remain competent and competitive.*” This is a view that is shared by (Edvardsson, 2008: 555), who states: “*continuous professional development is considered to be essential to professional and knowledge workers.*”

The imperative for training and development in construction is cited by Maxwell-Hart and Marsh (2001) as a requirement to create the vision, abilities and skills to match the future demands of such a dynamic industry. Research into skills development within an engineering design consultancy by Matsumoto et al. (2005) found that staff CPD was based on a training strategy derived from the company’s business plan. Areas identified as being critical in terms of training and development include information and communications technologies, standardised and prefabricated construction methods, complex and risky financial solutions and client focused relationships (Maxwell-Hart and Marsh, 2001).

Olomolaiye and Egbu (2004) identified aspects of training and development to encourage effective KM:

1. Equipping staff with the skills to manage their own learning and development
2. Build awareness of KM into training by focusing on achieving quality, creativity, leadership and problem solving
3. Building team-working skills and co-operative workplace systems
4. Developing an effective continuous professional development plan

Gourlay (2001) identifies the design and delivery of formal training as being complimentary with the dissemination of explicit knowledge within organizations. McDougall and Beattie (1998) suggest that there is a role for training and development professionals in increasing awareness of informal learning strategies within organizations, which can lead to effective knowledge transfer and organizational learning.

Matsumoto et al. (2005) discuss the development and acquisition of skills by individuals, which initially occurs through training and the award of qualifications, which are then reinforced by practical experience. With regards to the latter, Storey (2005: 215) highlights the role of HRM in staff learning and development, stating *“with planning and careful thought, it is possible for teams to be engaged in learning while they are attending to what is largely perceived as business as usual.”*

There has been considerable discussion surrounding the link between individual learning and organisational performance. Afiouni (2007: 129) states that *“HR activities do not directly increase organizational-level performance; rather, they help increase employee’s knowledge and skills (i.e. human capital), facilitate group interaction and knowledge sharing (i.e. social capital), and enable organizations to store knowledge in systems, routines, processes, and cultures (i.e. organizational capital), which, in turn, drive organizational performance.”*

Stewart and McGoldrick (1996: 1) offer that *“organisations can be constructively conceived of as learning entities, and that the learning processes of both organisations and*

individuals are capable of influence and direction through deliberate and planned interventions.”

According to Raidén and Dainty 2006, previous studies have shown that HRD practices in construction organisations have improved staff retention and organisational performance; both of which are important in the context of construction organisations and are also recognised benefits of KM.

3.5.4 Networks & Relationships

Lengnick-Hall and Lengnick-Hall (2005: 299) believe that HR has a role to play in promoting informal networks, where *“people know each other and help each other regardless of rank, function or job title.”* According to Olomolaiye and Egbu (2004: 536), *“if KM is to succeed in organisations, HR practices and policies should be designed to facilitate a mechanism that brings people together, either formally or informally.”* Training can provide HR with an opportunity *“to mix together employees from different parts of the company who do not normally interact with one another (Lengnick-Hall and Lengnick-Hall, 2005: 305).”* Other areas where HR can become involved include meetings, conferences, social events, employee roundtables and internal electronic communication networks, many of which contribute to mode 2 knowledge production. In this context, the interrelationship between HRM and KM is discussed by Svetlik and Stavrou-Costea (2007: 201), who identify common *“activities and goals when creating work units, teams, cross-functional cooperation, as well as communication flows and networks inside the organisation and across its borders.”* Communities of practice are identified by Lengnick-Hall and Lengnick-Hall (2005) as an important type of informal group of individuals in an organisation where HR can support their development.

3.5.5 IT & HRM

Matsumoto et al. (2005) report on an engineering design consultancy which had developed three IT-based information systems for managing and organising its employee’s skills: a

database which stored details of employee's experience, qualifications and CPD, an online 'expert users' database, and a training database which lists details of training courses. All of these systems are clearly linked to HRM-related issues; furthermore, Bartholomew (2008) contends that IT-based KM systems such as directories of expertise can be initially populated with information from existing HR databases, but need to be owned and populated by staff in the long term.

3.5.6 *The Integration of HRM and KM*

It is argued that there is a need for complementarity between KM strategies for accumulating and disseminating knowledge and HR strategies for recruiting and retaining knowledge workers (Haesli and Boxall, 2005). As can be seen in Table 17, Svetlik and Stavrou-Costea (2007) provide a comparison of the KM cycle, which includes the acquisition, creation, transfer and utilisation of knowledge and HRM processes. Theriou and Chatzoglou (2007) also discuss KM-related processes and the important role which HR practices play in facilitating employees' absorption, transfer, sharing and creation of knowledge.

KM Cycle	HRM Processes
Acquisition	Recruitment; professional development, encouraging employee participation in external professional networks and CoPs
Creation	Creating a supportive environment where individuals, groups and teams are challenged by organisational problems
Transfer	Creating a knowledge-sharing environment, establishment of training, and moving towards a learning organisation
Utilisation	Deployment of human resources by means of proper leadership, division of tasks and responsibilities, remuneration systems, and performance appraisal

Table 17: Comparison of KM Cycle and HRM Processes (adapted from Svetlik and Stavrou-Costea, 2007)

Specific areas where HRM can be involved in KM include: selecting an appropriate KM programme, creating a supportive environment, enabling technologies for KM, and creating a KM team (Theriou and Chatzoglou, 2007). Mayo (2006) cites the important role of the HR function in supporting and developing KM in a number of areas, which are presented in Table 18. Olomolaiye and Egbu (2006) contend that the HRM function can improve organisational knowledge-sharing by including it in job descriptions, employee selection,

employee evaluation and training. Specific attention, they continue, should be given to developing and integrating new employees, as well as current ones, into knowledge sharing systems.

Develop a knowledge-sharing culture	Foster innovation and experimentation
Encourage systematic on-the-job learning	Facilitate Communities of Practice
Develop a 'yellow pages' of knowledge	Provide training in KM skills
Tap into the knowledge of experts	Build KM into learning programmes

Table 18: The Contribution of HR in Supporting and Developing KM (adapted from Mayo, 2006)

Gloet (2006) states that there are four key areas where the HRM function can develop linkages with KM:

1. Roles: the role of the HRM professional can be significantly broadened by KM. As a human capital steward, they recognise the value of intellectual capital, as a knowledge facilitator, emphasis is placed on learning and development and an environment conducive to KM. The relationship builder focuses on creating and sustaining networks and CoPs, whilst the rapid deployment specialist responds to dynamic change
2. Responsibilities: HRM should be responsible for developing relationships across business functions and outside of the organisation
3. Strategic focus: the development of core competencies, strengths and capabilities should be aligned with the organisation's strategic focus through the integration of individual, team and organisational learning
4. Learning focus: learning and the development of human capital within the organisation are key aspects of KM. Employee development, building quality, creativity, leadership and problem solving skills can fall under the remit of the HRM function. Other areas of focus include; developing expertise in how to manage learning, reusing knowledge through lessons learned, know-how and best practice, facilitating continuous learning, identifying sources of employee knowledge, understanding the mediators that facilitate knowledge sharing and making information available to employees

It is evident from the preceding literature that HRM has an important role to play in KM in a number of areas, including: developing and implementing KM initiatives, supporting the various stages of the KM process, facilitating specific KM activities and technologies, embedding KM into existing organisational practices and developing an environment which recognises the importance of knowledge and learning. However, as a number of authors have highlighted, the role of HRM requires further integration with KM (Svetlik and Stavrou-Costea, 2007, Haesli and Boxall, 2005, Hislop, 2002).

HRM has an important role to play in supporting and developing KM in a number of areas including: inducting new employees (to find knowledge), managing the performance appraisal process (to capture knowledge), providing training and development opportunities for staff (to create knowledge), building networks and relationships (to share knowledge), and supporting the development and maintenance of IT systems (to store knowledge). This reinforces the need to consider HRM in terms of both its alignment with IT and within an integrated KM framework (as outlined in the research objectives).

3.6 Summary

It has been shown that KM has evolved from a number of management philosophies over the past 50 years, coming to the fore of management research through a variety of academic publications and government policies in the last 15 years. More recent research indicates that the construction industry could benefit greatly from the adoption of KM. While a number of KM frameworks have been developed in the general business domain, the unique nature of construction, and the need for further empirical research in both Irish construction and KM in construction, all point to the need for context-specific research. The overall purpose of this chapter has been two-fold, firstly to understand KM and its related concepts in the context of construction organisations through a review of relevant literature and secondly, to support the emerging grounded theory through the process of theoretical sampling. More specifically, the chapter has sought to address two of the research questions as follows:

1. What are the main strategic, cultural and technological issues that must be addressed for the adoption of KM in construction?

In order to manage their knowledge, construction organisations need to appreciate knowledge and the strategic, cultural and technological issues associated with KM as follows:

- Knowledge is a complex phenomenon, the management of which has the potential to bring considerable benefits to organisations. There is a need for a construction-specific framework for adopting KM and its related processes, which recognises the importance of both social and technological interventions
- The temporary, project-based, highly-pressurised nature of construction inhibits the effective management of knowledge within construction organisations
- In order to effectively manage knowledge, construction organisations need to develop a KM strategy which identifies the type and nature of knowledge that needs to be managed, develops a knowledge-sharing culture, is linked to existing incentives and performance measures and is supported by existing processes and systems

- Lessons learned practices, which facilitate the management of project knowledge, require the integration of social processes and technology, and alignment with CPD and other existing business practices
- Much of the work undertaken by the HRM function is concerned with managing people and their knowledge, indicating a significant opportunity to integrate KM with existing HRM practices

2. Can construction professionals be encouraged to engage in KM through its alignment with existing organisational processes and activities?

Both construction professionals (e.g. engineers, project managers, quantity surveyors) and construction organisations place significant emphasis on CPD activities. The experience and management level of construction professionals are important determinants for engaging in LL and CPD activities, which allow them to keep their knowledge up-to-date. The literature suggests that there is an opportunity to align individual learning (through both CPD and LL) with organisational KM, whilst simultaneously satisfying professional body requirements. As above the HRM function has a significant role to play in providing and supporting such developmental opportunities for staff.

The early parts of this literature review (sections 3.1 and 3.2) have sought to aid the identification of the key variables relating to KM in the formative stages of the research, whilst subsequent sections have been included on the basis of the concepts to have emerged as a result of the analytical process. It is anticipated that the rationale for such an approach will become clearer as the thesis progresses.

Chapter 4

Senior Management Interviews

4 SENIOR MANAGEMENT INTERVIEWS

In the early stages of grounded theory research Strauss and Corbin (1998) suggest that ten interviews can provide a skeleton of a theoretical structure upon which to base further development. This chapter presents the findings and analysis of semi-structured interviews with senior managers from ten of the leading Irish construction organisations which were conducted in early 2006 (and which are supplemented by survey findings of IT managers from the leading twenty organisations). These sought to address the research questions outlined in Chapter 1, relating to the effectiveness of current approaches to KM, the identification of the main issues in adopting KM and encouraging construction professionals to engage in KM. A copy of the interview questions can be found in Appendix B and the IT Manager survey questions, in Appendix C. As can be seen in Figure 9, the findings are initially presented according to the eight categorisations developed through open coding and are subsequently discussed in the context of the initial literature review (sections 3.1 & 3.2). The discussion and subsequent grounded theory analysis leads to what Strauss and Corbin (1998: 121) term as “*the foundation and beginning structure of theory building,*” and areas for theoretical sampling. The chapter concludes by reflecting upon the most salient points which have emerged from the research.

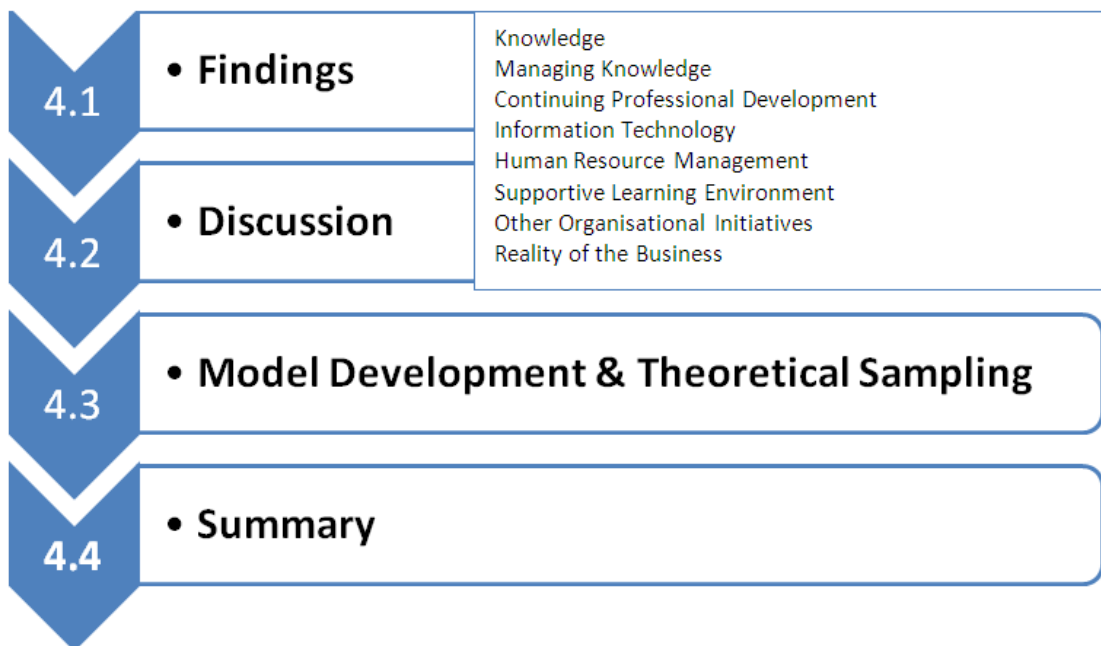


Figure 9: Chapter 4 Overview

4.1 Findings

Through open coding and the process of conceptualisation, concepts have been grouped into eight categories, each of which will now be considered individually, based upon the coding process and the memos written. It should be noted that the technological issues from the survey of IT Managers (discussed in Chapter 2) were incorporated in the IT category to further enhance its development.

4.1.1 Knowledge

Three main subcategories of knowledge have emerged through the analytical process. They are format, domains and levels.

In relation to the format of knowledge, a number of the interviewees discussed this concept within their organisation, with two distinctions emerging; “documented” and an in-vivo term “face-to-face.” Differentiating between information and knowledge was also a particular theme, with one of the respondents stating *“we have our own intranet, but that would tend to be more technical information than actual knowledge.”* Whilst none of the respondents were able to define knowledge, many referred to face-to-face interaction as being central to the sharing of knowledge, indicating an emphasis on tacit knowledge. In this regard, one individual stated a preference for face-to-face: *“it’s not so much the paper that works, it’s physical sitting down, I mean you can’t beat sitting down and talking about something.”* Indeed most respondents agreed that tacit knowledge was the preferred format for knowledge, supplemented by documented or explicit knowledge.

Knowledge domains refer to the variety of subject areas which emerged as being of concern to construction organisations. Those identified include environmental, management, organisational functions, people, regulatory, subcontractor performance, and technical knowledge. Within these domains further areas were identified: people and project management, safety and certification, sustainability and waste management, and concrete technology.

The levels of knowledge are the same as those identified in the literature review, i.e. individual, project and organisational. Individual knowledge refers to the experience, role, personal issues and workload of staff within the organisation. A further property which may be considered important is the educational background of the individual.

From the interviews, experience of an individual was found to have two properties; level and range. The interviews yielded much interesting discussion on the progression of staff from novices, upon joining the workforce to veterans, with many years experience. In terms of the range of experience, there were suggestions that some staff members were specialists in particular knowledge domains. Contrary to this, an individual may have quite a general range of experience. The concept of career progression is one that appears to be closely linked to the level and range of experience an individual possesses as a result of direct experience in the workplace and through continuing education. Career progression figured frequently during the coding of experience, but was subsequently merged with a similar node in the CPD category.

The category of personal issues was created to accommodate a number of themes which were highlighted regarding an individual's propensity to share knowledge with others. In an organisational setting, knowledge may be viewed by some people as power; one interviewee commented: *"it depends, some individuals are very good at sharing knowledge, and don't see any threat by sharing, others are hoarders and very much feel threatened by releasing that knowledge."* Personal pride, an in-vivo term, refers to an individual being unwilling to share their knowledge if they have made a mistake. Motivating individuals to share their knowledge is an issue which requires further investigation.

Construction organisations employ a range of professional and management staff to execute their projects, from directors, contracts and project managers, quantity surveyors, engineers, safety officers, foremen and tradesmen. One of the most interesting findings relating to individual knowledge is the role of middle managers in managing knowledge within these organisations. *"If you have a contracts manager who's looking after 3 or 4 jobs, and he's in the head office with other contracts managers who are also looking after 2*

or 3 jobs, it's far easier to share and disseminate that knowledge." Another respondent, a Senior Contracts Manager commented: *"with confidence I could say that I know what's going on at board level and my guys on site would say that they know what's going on, because we all feed into each other."*

The workload of an individual may also have an impact on their propensity to develop knowledge. *"Usually when you get involved in a project you don't have enough time."* Conversely, another commented *"if a site manager is between jobs, one of the things we would ask him to do is look around and visit all the other sites, see what you can pick up."*

Project knowledge, according to many of the respondents, is very much context specific, *"it's very difficult to pick up trends, a lot of it tends to be project-based and down to the foreman and manager on that particular job."* The location, type and size of project, design features, consultants and project teams were all cited as variables which change from project-to-project. Knowledge on the performance of projects is one of the key concerns of senior management, particularly in terms of finance, programme, quality, safety, the project team, subcontractors and suppliers.

Organisational knowledge consists of three subcategories; location, size and type. Apart from individuals and projects, the main 'locations' of organisational knowledge include head office, departments, international, local, regional and site. Indeed, there are suggestions of differences between office-based and project-based staff: *"as a company, we're very much project orientated and yet there's the departments and the department heads, so it's the whole cross-fertilisation of knowledge, bringing the two different cultures, the project culture and the office culture together and the sharing of that knowledge between projects and departments."*

A number of respondents also hinted at the size and type of the organisation as having a possible impact on how knowledge is managed. For example, whilst discussing the use of an online staff yellow pages to identify expertise, one interviewee felt such a tool was not justified *"in the size of an organisation like ours."* In terms of the type of organisation,

another respondent discussed the culture of his organisation “*which probably goes back to the family run, private owned nature of the company.*”

Whilst the main focus of the research is upon intra-organisational KM, it must be acknowledged that organisations are not impervious to their external environment as a source of knowledge. In this regard, a number of external sources were identified as being potentially useful for this purpose, including business consultants, clients, design teams, suppliers, CITA and trade exhibitions. Business consultants have been used by a number of the organisations in areas such as technical issues, waste management and environmental services, to varying degrees of success. Trade exhibitions also provide a useful source of knowledge, “*we travel quite extensively to the UK to see what they’re doing and further afield if required.*”

The interviews have highlighted a number of themes relating to knowledge, its format can be documented or tacit, there are different domains (e.g. project management, health and safety, environmental etc.), there are different levels (e.g. individual, project and organisational) and it is context-specific.

4.1.2 *Managing Knowledge*

The interviews identified four key processes associated with managing knowledge; creating, capturing, sharing and finding as well as a number of associated challenges.

In terms of purposefully creating knowledge, the main focus was upon research and development (R&D), although most interviewees acknowledged that this occurs on an ad-hoc basis. In relation to researching new products and systems, the role of the contracts manager is crucial in this regard: “*in my experience, that happens when you get the job, you suddenly go “how am I going to do that, I’d better go and look into it!” It’s reactive rather than proactive!*” One respondent indicated that his organisation are “*in the process of setting up an R&D department, we’ve one full-time guy at the moment...we recognized quite a number of years ago that given the changing strategy of tendering for jobs we need to be innovative in our thinking.*”

In attempting to capture knowledge gained, one interviewee commented *“I would like to see a database there, that we can tap into and everybody’s pool of knowledge is there.”* The need to capture knowledge is particularly relevant to construction which *“by its nature, there’s always people coming in and going out, my view is that there’s a need maybe somewhere for a central library or repository.”* Post-project reviews were identified as the main mechanism to capture knowledge at the end of projects, with one organisation having recently implemented formal post-project reviews which are captured and stored on a central lessons learned database for staff to review.

The interviewees identified a variety of formal and informal activities for sharing knowledge. In terms of formal activities, meetings were identified, with different types and levels including site progress meetings, departmental meetings and senior management meetings. In some cases the directors have annual away days, *“which is limited to senior management, about 35 people attending for a full day, and there’s a different topic each year. It could be staff retention, quality; it generally looks at what we need to do to improve going forward.”* Two of the organisations identified the use of multi-discipline work groups to share knowledge and develop particular aspects of company policy based on their collective experiences: *“we’ve brought 3 or 4 different disciplines from different sites together and we’ve given them a task. The first was site setup they reviewed what we do, they then came up with a plan for what we should do, they then had it approved by the board, stating this is what we are going to do and they then presented it to the whole company and said that this is our new set up procedure...we’ve also covered things like waste management, environmental management, subcontractor control, the use of small tools and plant.”*

Five of the interviewees indicated that their organisation holds an annual conference for all staff, the common theme being discussing experiences in the area of health and safety. All of the organisations arrange regular workshops and seminars for staff which focus on different topics, the success of which *“depends on how well they’re prepared, how well they’re attended. We would generally run workshops and seminars across all levels, from graduate right through to senior management and I think they work well.”*

One respondent spoke of his experiences of site visits in a South African construction organisation; *“every 3 months we would visit another site and we would get taken through the site...you’d spend the best part of half a day there, just looking at the job and what problems they had, and that was the best sharing of knowledge.”* However, in the cases of the Irish organisations, site visits are generally organised on an informal, as-needed basis, rather than being planned and structured. In one instance, *“we do cross auditing of all sites, each contracts manager will visit one of the other sites over the course of the year, and walk around with that contracts manager...so we try and share the knowledge there.”*

Whilst a lot of emphasis was placed upon sharing tacit knowledge, a number of activities were identified which aimed to share explicit knowledge, such as safety bulletins, a knowledge library, and lessons learned databases. A company newsletter was also seen as an effective way of sharing knowledge *“there’s normally a contribution from each department, a contribution from each project and then the social activities, new starts, people that left, people that got married, and a wee bit of gossip, normally quite light hearted.”* In a similar vein, regular safety bulletins are issued by a number of the organisations: *“we have a system of sharing safety knowledge, so if something goes wrong on one of our sites and it’s obvious that there’s potential there for it to be repeated, we would circulate a safety bulletin on that issue to every single site.”*

Many felt that informal activities such as just getting people together, informal meetings and social activities were equally as important for sharing knowledge. Informal channels of communication were seen as a valuable source of knowledge, with one respondent commenting *“we’re very open as a company like that it’s very much based on personal networks. Our work is Dublin-based, we’d all know each other, there’s good interaction there.”*

Finding knowledge, however, can be a challenge, with one interviewee encapsulating the problem very well *“there’s a huge amount of knowledge out there, but a lot of it is staying in individuals heads or even within the project teams, who may have fantastic knowledge*

about a particular way of doing things, and they don't even realize they have it...you say to yourself, if everyone knew this it would be great."

As with sharing knowledge, word of mouth was seen as the most effective way of finding knowledge by all of the interviewees, yet one acknowledged that while *"the informal network is there to cover it, there'd be no harm by having it more documented."*

CVs are one such documented method, which are useful in finding people with particular knowledge or expertise, according to one interviewee: *"if I were to phone up the HR department and say 'I'm starting a project and it's quite complex foundation design, there's a lot of temporary works, a lot of bank support systems' they'll say 'oh yeah, we've got two engineers who worked on this project.'"*

The interviews sought to identify challenges specifically related to managing knowledge. In this regard, absorptive capacity, individual vs. organisation, knowledge need, and loss of context, relevance and sensitivity emerged through the analytical process.

Absorptive capacity refers to the willingness of the organisation and its staff to accept new knowledge and learn from experience, with two dimensions identified. The 'not invented here' mentality refers to the unwillingness of an organisation to accept ideas from outside its boundaries. One interviewee refers to a consultant that was hired to review their waste management practices: *"they told us a lot of stuff but a lot of useless information, and we ended up researching it ourselves, and we found out more about it internally, and by bringing in the waste contractor in here, to go through how best to improve our system through him."* At the other end of the continuum is receptive, which indicates that people are receptive to new ideas and knowledge.

The potential tension between an individual and the organisation was identified, *"if you tell somebody that "you're doing this for the company's benefit" that'll put them off side, you've got to convince them that "you're doing it for your benefit, it's going to make your life easier" and then you're on a winner."*

Having a need for particular knowledge was identified, with many referring to knowledge in the context of a 'need to know' basis, particularly when a problem arises or there is a specific requirement for a new system, *"if you've people coming along with different systems on offer, the timing may be wrong...it's more an a needs be basis really."* While there could be a planned need for knowledge, one respondent returns to the project-based nature of the industry, stating *"it's reactive rather than proactive."*

Loss of context was discussed as a result of time lapse and attempting to document knowledge; *"I think that if you were to summarise it and condense it too finely, you may lose some of it."* Time lapse can be an issue on projects of a long duration, for example *"2 years down the road, you'll forget that somebody had such an experience, even if you've been involved in it or aware of it, time will take its toll."*

However, the respondent from the company who conduct post-project reviews and document the lessons learned, believe that *"it's really at the end of the job that you look back and say "what were the big issues here?" I mean, you can't log everything, if you catch the big issues, you're doing well."* Another respondent discussed the challenges associated with documenting knowledge, *"well it can go out on a sheet...but if someone new comes in, or somebody gets the piece of paper, reads it and throws it away...I think we need something better."*

The relevance of knowledge was noted in a number of interviews, with one respondent discussing the use of a new information system in the company, he cited his interest in only the financial aspect, *"we have a lot of information on other levels, safety, maintenance, but at the moment, this is all that interests me."*

The sensitivity of knowledge appears to vary dimensionally from confidential to public. A number of respondents expressed concern about making sensitive information or knowledge available to a wider audience within the organisation. For example, some companies collated performance information on subcontractors for future use, *"if in that you slate a subbie or a supplier, and that goes to another party, you can't take that back. It's sensitive what you let out there..."* Another highlighted the problem of having an

online skills database, which could potentially be exploited if the information was given to a recruitment agency, who *“are always poaching and looking, all they want to do is get a hold of something like that and circulate it around...”*

In terms of managing knowledge, the key themes to have emerged include the identification of four processes for KM (i.e. creating, capturing, sharing and finding) and the identification of various formal and informal activities (e.g. researching new products, meetings, site visits, newsletters, social activities and CVs). A number of challenges associated with KM were also identified, namely having an absorptive capacity, the alignment of the individual with the organisations objectives, having a knowledge need, loss of context when attempting to capture knowledge, and the relevance and sensitive nature of certain knowledge.

4.1.3 Continuing Professional Development

During the course of the interviews, it was found that CPD is an important part of a construction organisation’s activities, particularly in developing and retaining skilled and knowledgeable staff. The properties to emerge from the interviews included activities, location, provision and purpose, whilst other possible properties might include delivery, frequency, location and structure.

A number of CPD activities were identified, including graduate development, mentoring, post-graduate studies and training. One of the organisations has a 5 year graduate training programme for engineers, which the respondent felt helped to attract and retain staff. Another interviewee discussed the responsibility for CPD, *“every graduate is given a training log book, where the onus is on them to get their supervisors to record their training, but the onus is on the company to manage CPD, but we expect the graduate to be proactive and to come forward as well.”* The graduate training programme, another respondent felt, was important for developing future managers *“we find most engineers when they come in they’re smart, they’re good logical thinkers, but when it comes down to getting their hands dirty, it’s pretty much start again, so the training course that we put them on is really the practical, managerial aspects of building.”* These sentiments were

echoed by others, with statements such as *“ultimately graduate engineers in our organisation become managers.”*

The interviews identified four companies as having a graduate mentoring programme, with a further two having a mentoring programme for all staff up to contracts management level. One respondent indicated that their company is currently looking to implement a mentoring system in the near future: *“I see a mentoring system as being more involved than learning from colleagues on site, it brings the individual into contact with issues that are not particular to the actual project they happen to be on.”* One of the companies ensures that the mentor is a person not involved directly with the protégé on a day to day basis, someone on *“neutral territory.”* The individual in question added *“it took us a while to get it going because people didn’t really understand what mentoring was all about, but we actually did some training of the senior people on mentoring, and that helped, so it’s actually working a lot better now.”*

The interviewees were asked about their employees undertaking third level postgraduate studies, which most saw as something which an individual would undertake based on their own personal motivation, *“it’s a personal thing, it wouldn’t be directed by the company.”* Another stated *“most of our contracts managers have one or two postgraduate diplomas, in project management, contract law, project administration, arbitration, and it’s fully supported by the company.”*

The organisations provide training for staff in a wide variety of areas, *“it’s all part of our training programme, everyone has their name down the left hand side of a big matrix and all these boxes are ticked; what we feel they should have, you’ve done the quality auditing course, the safety management course, a whole raft of them.”* Many of the companies link training to their staff appraisal procedures, *“the appraisal will recommend certain training, say you’re poor on people skills, you’re expected to come back at the end of the year having done that training.”* One respondent also discussed the informal learning that occurs at training courses, *“at these seminars and CPD lectures, you’d be chatting over coffee, and you’d find stuff out informally.”*

The location which CPD activities take place is also an issue that has emerged, with some being run on-site and others, *“run off-site to give the lads a change of location, a change of venue.”*

There is a distinction between CPD which is provided in-house by the company and externally by bodies such as academic institutions, professional bodies and suppliers. In referring to internally provided CPD, one respondent states *“in-house we have a lot of different seminars, safety, environmental, management seminars on an annual basis that everybody goes to.”* Another commented, *“we like particularly technical, we find it’s actually quite hard to get good technical courses, technical building courses, so we do a lot of that in house, with our own senior managers.”* In terms of the external provision of CPD, one respondent referred to bringing in technical specialists, *“only recently we brought in a company to give training on a new scaffolding system, a cup lock system,”* while another hired a management training company to train staff *“on the softer skills as well, dealing with people, management.”* The provision of CPD appears to be an issue which is closely linked to different knowledge domains and the use of external sources (as well as internal), such as those identified in the inter-organisational subcategory within levels of knowledge.

The interviewees surmised a number of reasons as to why CPD was undertaken, including career progression, being encouraged by the organisation, for personal development, for recognition from professional bodies and skills conversion.

Many of the respondents felt that career progression was an important issue for their staff, *“we always keep an eye on our staff regarding promotional possibilities because we like to promote from within,”* commented one respondent, whilst another acknowledged, *“there’s no doubt about it, every graduate is ultimately a manager and a potential director.”*

In this context, another commented on the need to develop their managerial skills, *“most of our people would be technically qualified, engineers and quantity surveyors, so we have more work to do in converting those people...we do some soft skills training and that type of thing, but we need to do more.”*

Personal development is therefore, an important part of CPD; *“the whole purpose of it really is to make sure that someone doesn’t get pigeon-holed out on site, setting out for 5 or 6 years.”* Ultimately, the individual is responsible for this, *“if anybody comes to us that has the enthusiasm and wherewithal, and wants to better themselves, we generally support them.”*

CPD forms an important part of the assessment criteria of professional bodies for chartered membership, with the interviewees identifying Engineers Ireland (EI), the Chartered Institute of Building (CIOB) and the Society of Chartered Surveyors (SCS) as being the main focus for their staff. One respondent, a chartered engineer, stated: *“the engineers really are all on the road to chartered status or some guys will do the CIOB...quantity surveyors have their own, and obviously they are affiliated with the RICS, and they’ve got their own structure.”*

The interviews found that CPD has an important role to play in developing the knowledge of a construction organisations staff. A variety of formal and informal CPD activities were identified which can be provided by the company itself or by an external party. Career progression, personal development and professional body recognition were all identified as drivers for engagement in CPD.

4.1.4 Information Technology

The development of the IT category is based upon both the interviews with the ten senior managers and the earlier survey of IT Managers from the leading twenty Irish construction organisations (which was conducted in early 2005). In addition to the issues identified in the literature, the following properties of IT have emerged; location, level, support, barriers, drivers, applications and users.

The respondent organisation’s hardware and communications infrastructure is displayed in Figure 10, distinguishing between sites and their head office. Access to a computer within the head offices is quite high at 95%, with the level of access on site somewhat lower at

80%. The use of handheld computing devices is quite low in both head office (13%) and on site (6%). Much of the interview participants focus was on the site infrastructure, one example being “on most of our sites, there’s several computers, a good few of the engineers, project managers, and even foremen are computer literate in terms of what they can address on laptops, they all have the facility to dial in and connect to the office, some of the bigger sites are online to the office all the time.”

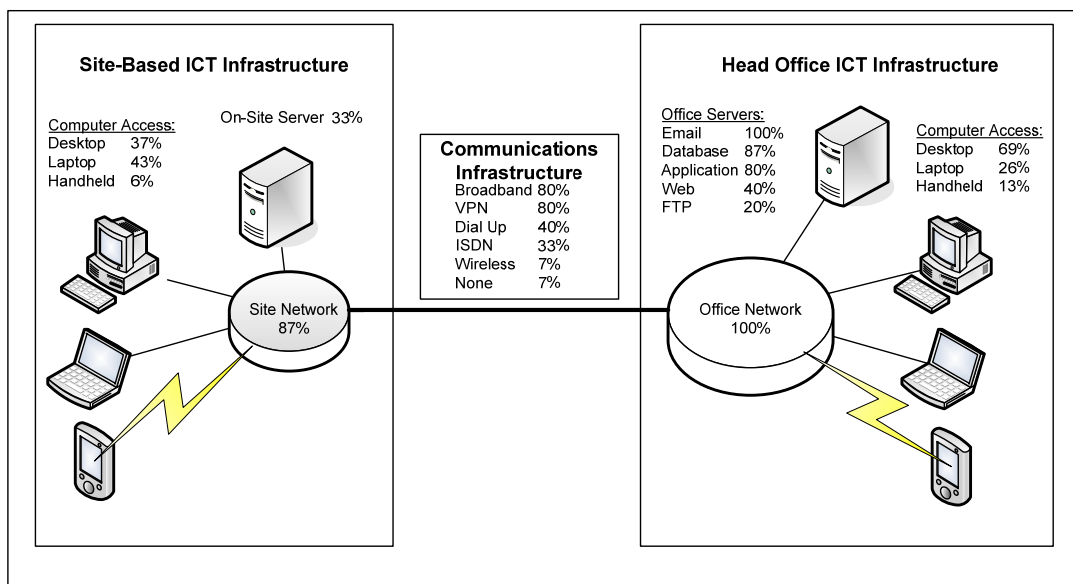


Figure 10: Respondents Hardware Infrastructure (IT Manager Survey 2005)

It was found that all respondent’s head offices are fully networked, with 87% indicating that their sites are also fully networked. The presence of servers in the head office was also quite high, with 100% having an email server, and a high proportion having database (87%) and application (80%) servers. The benefit of having a networked organisation was discussed by one respondent, “every computer on each individual site is linked by a server, we have a server on every job, so I can tap into a central wealth of information there.”

A data communications link between sites and head office was identified by 93% of the IT Managers, as can be seen in Figure 10, the respondents selected more than one option from a pre-determined list which included: broadband, Virtual Private Network (VPN), Dial Up, Integrated Services Digital Network (ISDN) and wireless. One of the interviewees discussed the importance of connectivity to their employees: “one of the reasons I know

that the IT is working for us is that people get very upset if their computer goes down for half a day or if the line goes down.” Some organisations are now looking at the use of remote desktop applications for connectivity from any location, *“we’re looking at going for a complete Citrix system, where everybody, whether you’re working from home, the office or a site, you’re working from a dumb terminal, it’s completely remote.”*

As can be seen in Table 19, all companies reported on using email, with the use of an intranet in just below half (46%) of the respondent’s organisations. The use of other software technologies such as VoIP, video conferencing, groupware, virtual project spaces and instant messaging is quite low. Two of the main applications of IT identified by the senior managers were email and an intranet, with all companies reporting full use of email for all staff, *“the very basics from IT is that you have to have email available to everyone.”* A number of the senior managers discussed the use of an intranet, with one respondent stating, *“we have a company intranet, but it’s not something that I’d visit on a regular basis, how widely its used, I’m not too sure.”*

Software Application	%	No.
Email	100	15
Intranet	47	7
VoIP	33	5
Video Conferencing	27	4
Groupware	20	3
Virtual Project Spaces	20	3
Instant Messaging	0	0

Table 19: Respondents Software Use (IT Manager Survey 2005)

In terms of construction-specific software applications, the interviewees referred to a variety of software systems used by their staff including COINS (for business and financial management), Build Online (for document management) and Primavera (for project scheduling).

A number of drivers for the development of IT were identified as centralised information, external influences, keeping up-to-date, and systems integration. The storage of information in a central location is a major driver in the development of IT, *“pretty much everything we do now is online, I mean I’m logged at the moment to our server in head*

office, I've access to all the files in Dublin, as have all the other guys here. Everything is linked back to our central server, that's made a huge difference."

There are a variety of different IT systems in use within the organisations, with one respondent giving an example: *"we have a number of IT systems that are not fully integrated, for example we have the COINS system for invoicing, a separate system for estimating, we have a separate QS system that we're trying to integrate at the moment."*

Many of the respondents viewed the development of IT in the industry in general as being driven by the client, for example: *"I think it's going to be client or project manager driven, it does need the buy in of the various consultants involved."*

The need to keep up-to-date with technological developments was also seen as a driver: *"I mean we try and keep up, most of our efforts to date have been on the communications side, in other words, people out there on site have been able to get access back to the server, email."*

Barriers to the development of IT were identified as information overload, lack of understanding, need for a paper trail and technological limitations. The ease with which information can be shared has led to a potential overload of information, the prevalence of email was cited by one respondent: *"I suppose now with email, maybe we're being inundated with information."* The following example was given by another interviewee: *"I haven't turned on my machine since 6 o'clock yesterday evening, when I turn on that machine now, I'll have at least 50 to 60 emails, it's crazy, it's just swamping everyone."*

Even with the use of email and other technology, there is a tendency towards hard copies: *"with the paper trail, issuing drawings, it's all digitally transmitted, and most sites, head office, here, they have their own printer, and we can print off the drawings."*

The lack of understanding of site-based activities by the company's IT manager was discussed by one respondent, who referred to *"two levels of IT integration if you want to call it that, head office have reached a higher level because the IT department probably*

have a better understanding of what head office departments need, but there's probably a poor understanding from head office as to what IT sites need."

One respondent spoke about their experiences with regard to the level of IT use, *"our focus all along has been, first of all to get up to speed and to have the infrastructure there, now that we've got it, I don't think anyone realized how overwhelming it would be...the very basics from IT is that you have to have email available to everyone, all your basic stuff in terms of everyone having access to laptops or desktops, that's available to everyone at this stage."* This was a theme that was continued by others, according to one respondent: *"I think we need to be a bit more advanced in our IT,"* whilst another remarked *"we already have a lot of systems in place, we're at the very start of that, the early stages of it and we're already looking to move to the next level."*

In terms of investment in IT, one interviewee stated: *"the infrastructure on the sites even, takes huge investment, but its trying to control that and use it to the best ability, so you're not just putting it in for the sake of having it there...but there's no money spared quite frankly when it comes to that kind of thing."* One interviewee stated that they are currently having their systems reviewed by an external consultant; *"he's looking at our systems, improvements in technology, we just have to try and keep up with it, so on foot of what he says we will be making whatever investment is required."* In addition to external consultants, other individuals to have emerged include the IT department, senior management and multi-disciplinary committees. The main supporting role in the organisations comprises a dedicated IT department, which have typically grown in recent years with increasing computer usage, *"our IT department started off as one guy who dabbled in computers, now we've got 4 or 5 full time, now we have an IT manager."* The survey found that 93% of respondents now have a dedicated IT department to develop and support the use of technology within their organisations.

A number of the organisations have established committees to assist the development of IT in line with business objectives; *"there would be an IT sub-committee that would meet 4 times a year and would review software and business problems, and technology and where*

we're going, and the whole lot, and they'd look at it from a global point of view. You'd have the MD and the IT manager and pretty much all department heads involved in that."

The support of senior management is also crucial, *"we would have a very proactive MD when it comes to IT, in that for a man of his era, he's driven the whole IT agenda."*

The people who use the organisation's IT systems were talked about in terms of their level of IT literacy, role and getting buy-in. The concept of IT literacy varies from good to poor, with one respondent stating: *"a good few of the engineers, project managers, and even foremen are computer literate in terms of what they can address on laptops."* At the other end of the continuum, age and poor IT literacy were discussed: *"some of the older foremen who mightn't be IT literate."* One of the respondents spoke of people developing their IT literacy: *"they type with two fingers, they might do it with one, they're clicking into things, they're generally working off Excel spreadsheets in a simple format, some of them are able to do an MS Project programme, the more developed project managers and programmers can do all these things."*

The role of the individual can influence their use of IT, for example *"site clerks would mainly use them to input dockets, and do administration,"* while engineers use *"computers and data loggers to do setting out by means of a total station, logging points, so they can record the information, get the printouts, give it to the surveyors, do the quantities, rather than writing it down, doing calculations."* One respondent questioned the need for foremen to actually use computers, *"the foreman wouldn't really be into using computers on site...it's something they wouldn't have time to do."*

Getting people to buy-in to using IT systems was also identified as an issue, *"I think when you have a system, you need to get people using that system before you move on...that's something I've really, really learned, when I started this mission several years ago, I never thought it would take so long to get people buying into it."*

In terms of IT, the key themes include a perceived disparity in IT between head office and individual construction sites, data exchange between both being inhibited by an

underdeveloped communications infrastructure. This, in addition to problems such as the disparity in terms of software infrastructure and end-user requirements points to further challenges for IT in supporting a KM initiative.

4.1.5 Human Resource Management

The HRM function has a role to play in managing knowledge within an organisation, with four areas emerging from the interviews, inducting new staff, managing CVs, organising CPD and appraising and rewarding performance.

From a KM perspective, the induction process is important for ensuring that new recruits have adequate knowledge of the people they will be working with and an understanding of how the organisation operates, *“when they join the company, they have a day long induction where they are brought along to head office and the whole running of the company is explained to them and their role in general is explained to them, and the whole way the company is structured, right through, the safety management system, the quality management system, environmental policy, the whole thing is explained to them.”*

As already discussed, CVs appear to be a useful source of knowledge of peoples skills, their training record and previous experience, particularly when a specific expertise is required. There are issues however with keeping them up to date, *“if we’re putting in a submission, and I say give me a CV for Joe Murphy, a senior engineer, who I’m going to propose in the tender, and you get a CV and it’s out of date.”* Furthermore, there are issues regarding the accessibility of the CVs, *“they aren’t something we share freely for obvious reasons, but it’s open to senior people.”*

The HRM function organises and records the CPD and training activities of staff, *“we have a HR manager, with an assistant and training person, so it’s reasonably well logged and documented.”*

The performance of staff is also managed by the HR function, which comprises staff appraisals and reward systems. Appraisals are considered in terms of the appraiser, frequency, structure and topics covered, which are closely related to the individual's

knowledge, their training needs and career progression issues. The appraisals are typically conducted by an employee's immediate supervisor on an annual basis, which for site-based staff is the contracts manager: *"it's managed and co-ordinated by our HR department, but it would be done by the individual's direct superior."*

One respondent commented that the appraisal is *"a review of recent training, experience and performance over the last 12 months, it's more of a career plan really and where they see themselves going in line with the company's plans going forward, and based on that a training plan is developed, which is implemented throughout the following 12 months."*

A very comprehensive agenda for the appraisal is set by one company, *"the first section is job knowledge, problem solving, quantity and quality of work, task management, skills set and training, team building and communication, customer service, flexibility and adaptability, business knowledge, achievement of goals set previously, section B then is a look at strengths and areas for improvement, section C is additional comments, section D is an action plan and goals for the coming year."*

Rewarding staff appears to be a contentious issue, with much more focus upon financial rather than non-financial reward: *"the main thing that's going to talk with the lads is money...at the end of the day the biggest motivator for anyone is bringing home money in his pay packet to his family, that's the biggest thing."*

A review of staff salaries and bonuses is also conducted on an annual basis in all companies, although linking financial reward to an individual's performance can be problematic. *"We give out bonuses every year, but it's very difficult to be completely objective when evaluating performance."* Most respondents indicated their reluctance to discuss financial reward at the appraisals: *"we try to keep the appraisal separate; the appraisal is training needs and a development type thing. Obviously performance is part of the appraisal and performance is part of the financial review, but we will not discuss money at the appraisal..."*

It is apparent that there is substantial overlap between HRM and KM practices. Ensuring that new recruits have sufficient knowledge to perform their work, identifying staff with specific expertise and appraising the knowledge of staff on a regular basis, all indicate the important role of HRM in terms of managing the organisations staff and their knowledge.

4.1.6 Supportive Learning Environment

The analysis found that an organisation with a supportive learning environment recognizes the need to learn from experience and continuously improve, provides opportunity for reflection, and has committed employees and visible senior management support.

The need to learn from experience was acknowledged by all respondents, with one stating: *“if you come across on the basis ‘look we need to learn from this and everybody makes mistake, let’s try and not make the same one again.’”*

Closely linked to this, is the concept of continuous improvement, which is discussed in terms of reinventing organisational procedures and the use of quality management systems to try *“to instil that it’s for the common good and the improvement of the company overall.”*

Within such a pressurised environment as construction, there must be opportunity for reflection, for example one company encourages it *“when people are in between projects, we send them off to building exhibitions, I had an opportunity recently over in the States and so on, we do it that way.”* Other means of providing such opportunity can occur at post-project reviews and individual staff appraisals, *“everybody gets a chance to sit down and look at themselves, appraise themselves.”*

Employee commitment is an umbrella term which encapsulates a number of properties which may indicate a contribution towards a supportive learning environment. Loyalty, a no blame culture, being given responsibility, a sense of ownership and teamwork are all properties which may contribute to employee commitment. With regard to such issues, the

level of commitment could potentially range dimensionally from committed to uncommitted.

A number of respondents made reference to their Managing Director being visibly supportive of staff and taking an interest in staff. One respondent stated that *“positive encouragement from a director can be very effective.”* Furthermore, others added that personal contact with directors is very important for motivating and encouraging staff: *“that’s one of the things we’ve said, that each person should have access to a director.”* Another stated: *“I think it’s important that your director visits site and knows who you are, and I believe the MD should be visiting site on occasion.”*

The presence of a supportive learning environment which recognises the need to learn from experience and continually improve is viewed as important to KM by the interviewees, as are employee commitment and senior management support.

4.1.7 Other Organisational Initiatives

This particular category emerged from the interviewees discussing other initiatives that they have implemented or attempted to implement previously. The properties of this category include implementation, outcome, resources and strategy. Based on such experiences, it would seem reasonable to suggest that there are lessons to be learned when attempting to implement KM. Many of the companies identified augmenting existing tools and systems which are in place that could become part of a KM initiative, with one respondent commenting *“I think to augment what’s there already; I’d like to see a structure there.”*

A number of interviewees identified instances where new initiatives became part of company policy to improve implementation. The improvement of health and safety practices in recent years was given as an example where policies have been developed and implemented, with a similar approach being used for improving waste management practices: *“we’ve got a health and safety policy for the whole company, we don’t have a waste management policy, but that will come in.”*

Referring to the development of IT within his company, one interviewee explained: *“I think when you have a system, you need to get people using that system before you move on, so I think that’s where we’re at right now, we have a system but it’s not perfect.”* Others have reinforced this view, citing the development of management control systems on an incremental basis: *“it started as bits and pieces, in the last 18 months it has come together into a company management system,”* one interviewee commented, whilst another said, *“in the last couple of years we got ISO 9002, then we got 140001, which is an environment award, so we have gradually got an environmental standard, safety standard and the ISO standard.”* The use of pilot projects was another method of implementation identified, one company were in the process of piloting a new software system, *“so we’re running that on this particular project, to see how it works, and if it works, we can expand it out into the company.”*

Another respondent highlighted the resources required to setup a new initiative including time, staff and money, and questioned whether the benefit of such an initiative actually outweighed the costs. To illustrate the point being made, he gave the following example: *“we wanted to keep track of all our dockets on the sites, and we were doing it in a way that was OK, but it wasn’t great, but now we have two people, and that’s all they do. You can see where it mushrooms, you can mushroom in a lot of places and if you go too far, you can have a perfect organisation that’s not making much money, you’re doing everything dead right, absolutely brilliantly, it’s first class, and it helps the company. But there are two people there and it’s probably costing the company 80 grand.”*

The level of formality in a variety of initiatives was discussed, for example one respondent referred to a mentoring scheme, *“it needs to be formalized more and the mentor needs to take more leadership. There’s probably a bit of slippage there in that the approach and the policy is there, it’s the implementation of the mentoring that isn’t where it should be at the moment.”* Another spoke about post-project reviews, *“it varies really, some contracts managers would be very good, they’d have a wrap up meeting and bring all and sundry back, others wouldn’t be as good and they’d have a less formal...a lot of it is down to individuals.”*

Failure of initiatives was a recurring theme, with newsletters, client feedback procedures, an intranet and mentoring all used as examples. One company had organised regular meetings for their quantity surveyors to discuss current issues and problems, which had worked well initially, *“but then it needs to get a kick start again, after another while because the interest is waning, we need to give it an injection of something, just to get it going again.”* Measurement of the outcome of some initiatives seems to be lacking, *“we have a company intranet, but it’s not something that I’d visit on a regular basis, how widely it is used, I’m not too sure.”*

With regards to KM, the interviewees identified lessons to be learned from the implementation of other organisational initiatives, including augmenting existing practices, becoming part of company policy, incremental development, resources required, the level of formality and maintaining momentum.

4.1.8 Reality of the Business

The term "Reality of the Business" is an in vivo term which was used by one of the interviewees, and refers to the wider context of the construction industry and its inherently problematic nature.

The single most important issue to emerge is the “Bottom Line” (i.e. making money). In discussing post-project reviews, all companies stated that the main focus at the end of the project is on financial performance; *“at the end of each job, we would sit down and see how it went, what was the margin at the start, what’s the margin at the end.”* The competitive nature of the industry was referred to in terms of how work is won, *“anything we bid for in whatever format, it’s highly competitive, there’s a very fine line between success and failure of any of these projects.”*

In terms of resistance to change, one respondent commented *“typically it’s not a hugely innovative industry, and yet there have been a number of changes in recent times, but generally speaking I would say it’s an industry that’s slow to change.”* However, the

competitive nature of the industry forces companies to be innovative: *“we recognized quite a number of years ago that really given the changing strategy of tendering for jobs; you have to be innovative in your thinking.”*

As alluded to in the project knowledge subcategory, there appear to be differences between the culture of construction sites and the head offices within companies. This is further compounded by the various organisational locations, departments and functions and levels of management and professional staff, leading to the presence of what has been termed ‘intra-organisational fragmentation.’ This is evidenced in an example given by one respondent who discussed IT integration within the company: *“we have a way to go in integrating all the aspects of our business...so while you have a separate invoicing and delivery system versus estimating system, versus QS system, versus project management system, there is always scope for improvement.”* This implies that not only are people fragmented, but that the technology to support them in their work is similarly fragmented.

The project-based nature of the industry was also discussed: *“each week on each project, is different and individual to another week on another project.”* Due to the geographical dispersion of people *“the cross fertilization of knowledge doesn’t happen.”* This dispersion of knowledge is closely related to the location category in organisational knowledge, with many companies operating on a regional and sometimes international basis: *“well London is completely separate, it’s like a different company, and while we talk to them, we wouldn’t have any great communication at grassroots level, at board level, there’d be interaction there. But for the guy on the site there’s no interaction. Certainly within Ireland, you’ve got offices in Dublin, Cork, Limerick, and Galway and then there are sub-offices in Sligo and Waterford, where there’s some interaction at senior management level, but otherwise it’s not huge.”*

Opportunities for sharing experiences are inhibited by the pressurised environment of construction where *“the difficulty is in finding the time to pass that on, because everybody is busy trying to get their job done.”* Another interviewee commented *“most of our lads are pretty much tight to the bone, and the next thing is we need someone to do this, we need someone to do that, we could do so many things...”* Staff turnover was also identified: *“the*

construction industry, by its nature...there's always people coming in and going out." The economic boom has also added to this "we've had quite a number of people come and go, but I suppose that's reflective of the nature of what's out there at the moment, people get sucked away by attractive packages."

It is evident that the reality of the business must be borne in mind when considering KM, specifically the nature of the industry, which is highly competitive, adverse to change, fragmented, project-based and highly pressurised.

4.2 Discussion

This section discusses the eight emerging categories in the context of the literature review to identify similarities and differences, supporting the further refinement and development of a KM framework. Based on the developing categories and emerging theories, potential areas for theoretical sampling will be considered for subsequent phases of the research.

4.2.1 Knowledge

Knowledge is conceptually complex, and subsequently difficult to define, yet Robinson et al. (2005) suggest that a working definition of knowledge is required if construction organisations are to embrace KM. The emphasis on ‘face-to-face’ knowledge implies the tacit dimension of knowledge, which Kazi et al. (2005) identifies as being most valuable to construction organisations. However, as Quintas (2005) discusses, tacit knowledge is difficult to share with others who haven’t been through similar learning experiences; it is also context specific; and has a social dimension, echoing the constructivist philosophy. With Walker (2005) suggesting that explicit knowledge is no more than information, the interviewees viewed ‘documented’ knowledge as useful for supplementing tacit.

The initial properties of ‘knowledge domains’ have been grouped under organisational, people and technological knowledge, based on the categorisations proposed by Egbu and Robinson (2005) and Siemieniuch and Sinclair (2005). Whilst the ‘people’ property may appear to lack detail, many of its related aspects are considered within the ‘levels of knowledge’ category and will require further integration. This includes those identified by Egbu and Robinson (2005) as external relationships such as suppliers, subcontractors, clients, universities etc.

Individual knowledge refers to the experience, role, personal issues and workload of staff within the organisation; something which Grisham and Walker (2005) discuss in the context of experience, education, skills, attitudes and learning. Storey (2005) states that knowledge workers, who are at the core of KM, must continuously build upon their educational qualifications and experience. The latter was found to have two properties;

level and range, whilst educational background, as identified by Storey (2005), merits further investigation. Motivating individuals to share knowledge in a pressurised work environment is discussed by Jashapara (2004) and was confirmed by the interviewees. The role of middle managers in managing knowledge appears to be quite important, and is an area requiring further consideration. A number of authors discuss the role of CPD in developing a construction professional's knowledge through both formal and informal learning. In this regard, Roscoe (2002) identifies a number of areas that overlap with 'knowledge domains,' such as technical knowledge and management skills that will require further integration.

The need to transfer project knowledge is well recognised in the literature, however there are significant challenges in attempting to capture and retain the lessons learned (KLICON, 1999, Kamara et al., 2002b). The context in which a project is undertaken was a particularly important challenge discussed by Orange et al. (2003), and a theme continued by the interviewees, who identified a number of variables which change from project-to-project, such as consultants, location, design features, project type, site team and size. From the senior manager's perspectives, financial, programme, project team, quality, safety, subcontractor and supplier performance are the main issues which require consideration both during and at the end of a project. These are quite similar to issues within the three categories identified in 'knowledge domains.'

The interviews and coding focus on the location of knowledge within the organisation, and the characteristics 'size' and 'type.' In terms of 'location,' departments, head office, international, local, regional and site, all contribute to organisational knowledge. Individuals are central to all of these and it is possible that this category will become an umbrella category for different subcategories as the research progresses. Further to this, the 'type' and 'size' of organisation may be important factors in relation to how knowledge is managed. It is at the organisational level where Jashapara (2004) suggests that learning needs to become embedded in organisational routines, implying further integration of this category is required with the 'organisational' property in 'knowledge domains.'

4.2.2 *Managing Knowledge*

The interviews conducted and subsequent analysis of them identified four key processes and a number of challenges associated with managing knowledge. Whilst these processes are confirmed by the literature (as evidenced in Table 20), there is variation in the terms used by different authors. In order to ensure consistency, creating, capturing, sharing and finding have been adopted for the present study.

Present Study	Wiig (1997)	BSI (2003)	Kazi and Hannus (2002)	Egbu et al (2005)	Jashapara (2004)
Creating		Creating	Creating	Creating	Generating
Capturing	Transforming		Collecting	Capturing	
Sharing		Sharing	Sharing	Disseminating	Sharing
Finding			Identifying	Identifying	Discovering

Table 20: Comparison of Knowledge Processes with Literature

However, additional processes found in the literature did not emerge from the interviews; these include processes associated with renewing, organising, leveraging and using knowledge, as can be seen in Table 21.

	Wiig (1997)	BSI (2003)	Kazi and Hannus (2002)	Egbu et al (2005)	Jashapara (2004)
Learning		Learning			
Renewing	Renewing				
Organising	Organising	Organising	Organising	Mapping	Evaluating
Leveraging	Leveraging	Enhancing	Adapting		Leveraging
Using		Utilising	Using		

Table 21: Additional Knowledge Processes from the Literature

The process of learning is evident in the CPD category, and will require additional consideration in terms of its role within managing knowledge. The other processes identified in Table 21 above, also require investigation as the research continues.

- Creating: the main focus for creating knowledge was related to researching new ideas and products from external sources. In terms of creating knowledge, it may be created in a purposeful manner such as through R&D or much more serendipitously through the problem-solving process on a construction project as noted by Kazi et al. (2005)

- Capturing: the capture of knowledge for future use by others in central database or repository was viewed as being important by the interviewees. Walker (2005: 27) argues that in attempts to reduce knowledge to information strip it of “*any meaningful context.*” Despite this, it would appear that the senior managers interviewed believe there is merit in doing so, with one organisation having set up a lessons learned database to “capture” project knowledge
- Sharing: appears to be one of the most oft-recurring processes identified in the literature, with a multitude of activities identified by Kamara et al. (2002b) and Dainty et al. (2005), and also by the research participants. A variety of formal and informal social processes or activities emerged from the interviews, which merit further investigation, including meetings, conferences, site visits, safety bulletins, libraries, databases, informal meetings and social activities
- Finding: Grisham and Walker (2005) highlight the potential breadth and depth of knowledge possessed by individual construction professionals. The challenge posed by this for construction organisations, is the difficulty in identifying what people know, particularly their previous experience. The use of CVs was identified as being an indicator of people’s knowledge and experience, proving useful when seeking specific expertise. Given that the most valuable form of knowledge to construction organisations is tacit (Kazi et al., 2005), and that such knowledge is not easily visible or expressible (Nonaka and Takeuchi, 1995), finding people based on their experience may be a viable avenue to explore.

A variety of challenges to the effective implementation of KM have been identified in the literature review and confirmed in the interviews relating to the nature of the industry and organisational issues. Many of these issues have emerged under other categories including ‘reality of the business,’ ‘other organisational initiatives’ and ‘supportive learning environment,’ and will be discussed within these categories. The challenges identified through the senior management interviews are more focused on knowledge and include absorptive capacity, alignment of the individual with the organisation, and loss of context

through time lapse and documentation or codification. Further challenges relate to an individual, group or organisation having a need for knowledge, and the relevance of it to them. In some instances, knowledge may be highly sensitive and confidential, whilst other knowledge may be in the public domain.

4.2.3 Continuing Professional Development

Through the literature review and subsequent discussion on ‘managing knowledge,’ it has become clear that ‘learning’ is a process which requires further consideration in this study. Storey (2005) refers to the need for knowledge workers to build on their educational qualifications and experience repertoire through training, empowering and rewarding them. In this regard, CPD emerged as an important issue from the interviews; something which Olomolaiye and Egbu (2004) also consider an important aspect of KM. The interviewees identified a number of activities which comprise CPD, including graduate development, mentoring, post-graduate studies and training. Grisham and Walker (2005) propose that such activities provide the opportunity for learning between work colleagues through informal discussions.

The purpose of CPD from a construction professional’s perspective was also an issue that figured highly, with ‘career progression,’ development, ‘skills conversion’ and the need to meet the requirements of a professional body being of great importance. The ‘location’ where CPD takes place was discussed by the respondents, again highlighting the problematic nature of geographically dispersed projects. The ‘provision’ of CPD activities can be accommodated both within and outside the organisation, further emphasising the importance of both intra and inter-organisational knowledge. There is a need to examine literature relating to CPD in order to determine the potential role of CPD within KM, and explore issues such as delivery, frequency and structure of CPD activities. Given that CPD is concerned with the development of knowledge in a specialist subject area, the role of professional bodies such as the CIOB, SCS and EI also merit further investigation.

4.2.4 *Information Technology*

It is recognised that IT has an important role to play in supporting processes for managing knowledge (Payne and Sheehan, 2004), yet it must be recognised that technology is limited to managing data and information (Prusak, 2006). While the literature review focused mainly on the infrastructure required to facilitate and support KM, other issues emerged through the interviews and subsequent analytical process.

The hardware infrastructure according to Al-Ghassani et al. (2005) forms the basis for implementing the software required to support KM activities. The research has shown that the IT hardware infrastructure in the respondent organisation's head offices is well developed, with full network capabilities and a high level of computer access. The site-based infrastructure is not so well developed, with a lower level of computer access and network infrastructure than in the head offices. Maintaining connectivity between sites and offices is a critical issue in ensuring that site-based staff are connected to information centrally stored on head office servers. From this perspective, Walker (2004) highlights the importance of the availability, accessibility and security of hardware and networks. Security is an issue recognised by many of the survey respondents, with 80% indicating the use of a VPN.

Apart from email, which is used by all of the respondent organisations, the use of KM software technologies appears to be limited at present. The intranet, which is seen as a key KM tool for geographically dispersed construction organisations, is used by just less than half (46.7%) of the organisations (Payne and Sheehan, 2004). The low use of technologies such as video conferencing, groupware, virtual project spaces and VoIP may be due to the fact that high speed communications infrastructure were not fully available in Ireland at the time of the research (Forfás, 2005).

The interviewees identified a number of drivers of, and barriers to, the development of IT within their organisations. The need for 'centralised information' and 'systems integration' again highlights the fragmentation within these organisations. 'External influences' demonstrates the importance of outside sources, highlighted in the 'inter-organisational'

property of 'knowledge,' whilst the need to 'keep up-to-date' was also viewed as important. Conversely, a number of barriers were also identified, with both 'information overload' and 'need for paper trail' which appear to conflict with 'centralised information.' Furthermore, a 'lack of understanding' on the part of the IT function of existing business processes and potential 'technological limitations' also appear to pose challenges.

The issue of 'location' in differentiating between the IT infrastructure on sites and in offices, has been considered in other categories such as the 'organisational' property of knowledge and in 'CPD.' Because it is such a prevalent theme, the issue of location appears to be conceptually important and therefore requires consideration at a more abstracted level as the research proceeds.

The senior managers viewed investment and the support of people, such as those employed in the IT department, external consultants, senior management, and multi-discipline committees as being important. This concurs with Tiwana's (2000) assertion that management support and funding are crucial in ensuring the success of KM, which raises the need to consider these in the broader context of KM within these organisations.

The interviewees discussed the users of IT within the organisation, in terms of their 'age', 'IT literacy', 'role' and getting them to 'buy-in' to using technology. It is apparent that 'age' and 'role' are closely linked to the 'individual' level of knowledge, while 'IT literacy' may be related to these and 'educational background.' The engagement of staff with IT systems may provide ideas on how to ensure that they 'buy-in' to potential KM systems and/or activities.

4.2.5 Human Resource Management

Storey (2005) highlights the important role of the HRM function in training, empowering and rewarding knowledge workers, and also in facilitating learning and sharing knowledge. The interviews and subsequent coding process identified the importance of the HRM function in appraising and rewarding the performance of staff. Annual staff appraisals provide the individual with an opportunity to reflect upon their experience of the past year,

and to identify areas for improvement in the year ahead. In line with the discussion around measuring KM performance by Robinson et al. (2005), performance appraisals are an existing practice which attempt to measure the knowledge stocks of staff. The appraisal process typically results in the development of a training and development plan, which Olomolaiye and Egbu (2004) cite as being essential in developing skills to manage learning in the context of KM.

Egbu and Robinson (2005) identify people (or know-who) as one of the key categories of knowledge which construction organisations are concerned with, this comprises the knowledge of people both within and outside of the organisation. Internally, the identification of individuals skills and characteristics is important, something which is identified and captured during the appraisal process and also contained within staff CVs. The CVs were identified by the interviewees as being a good source of knowledge of people's skills, their training record and previous experience; they also prove to be invaluable when preparing submissions for projects. A number of activities were identified for knowledge sharing by Dainty et al. (2005) which also fall within the remit of the HRM function. Many of these were identified within the 'Managing Knowledge' category by the senior managers and require further examination from a HRM perspective.

4.2.6 Supportive Learning Environment

This category mirrors the culture section of the initial literature review most closely; something that is viewed as essential for KM. There are a number of similarities between these findings, and the characteristics of a knowledge-sharing culture as identified by Sheehan et al. (2005), for example, the need for 'continuous improvement,' 'learning from experience' and 'opportunity for reflection.' While both 'continuous improvement' and 'learning from experience' appear similar, there may be subtle differences in terms of their purpose; the former being concerned with creating new knowledge, the latter in the capturing valuable knowledge gained from experience. The 'reality of the business' and challenges of managing knowledge demand 'opportunity for reflection' at individual, project and organisational levels.

Both 'senior management support' and 'employee commitment' echo some of the issues raised by Egbu and Robinson (2005). The interviewees, who themselves are senior managers believe that 'senior management support' is important in promoting a good culture, specifically in recognising the efforts of and communicating with staff. Whether or not staff reciprocate this view, is something that requires additional exploration. 'Employee commitment,' which may vary from committed to uncommitted, could potentially impact upon their willingness to engage with KM activities. Additional properties which may determine commitment include 'loyalty,' 'no blame culture,' being given 'responsibility,' a 'sense of ownership' and 'teamwork.' Egbu and Robinson (2005) identify other aspects required to create and sustain such a culture as shared language and meaning of KM, flexible communications, job security, motivation and organisational and technical infrastructures. All of these are evidenced in other categories, and indicate the all-encompassing nature of culture; the position of culture and a supportive learning environment, therefore, requires careful consideration as the framework develops.

4.2.7 Other Organisational Initiatives

The development of a well-defined KM strategy is seen as being essential by Carrillo et al. (2003) and Egbu (2004); however, the interviewees indicated that the implementation of other organisational initiatives does not always follow such an approach, with varying levels of formality. The need to look at existing tools and systems prior to developing a more formal approach to KM was raised by Sheehan et al. (2005) and confirmed by the interviewees, who felt that augmenting existing systems was a potentially useful starting point. Other approaches included the initiative becoming part of the company's policy, incremental development, integrating different systems and the use of pilot projects. Many of the barriers to successful implementation of KM, identified in Table 8, require careful consideration when attempting to implement other organisational initiatives. In this regard, reference was made by the interviewees to resource requirements, such as time, money and staff, and also the measurement of the outcome of such initiatives.

4.2.8 Reality of the Business

The reality of most businesses is that they exist to make money; in this regard the construction industry is no different. As previously discussed, there appears to be significant overlap between ‘challenges of managing knowledge’ and this category. The project-based nature of the industry identified within ‘challenges of managing knowledge’ is again evident in ‘reality of the business’ in terms of temporary nature and geographical dispersion. Further issues identified by the interviewees such as ‘pressurised environment,’ ‘harsh site environment,’ and ‘staff turnover’ echo what Craig et al. (2004) term as hostile to the promotion of KM and learning. The need to share information, experience and knowledge across project teams and the organisation, as highlighted by Egbu and Robinson (2005), is hindered by what has been termed ‘intra-organisational fragmentation.’ It is apparent that the present category should be integrated with the ‘challenges of managing knowledge,’ as the ‘reality of the business’ presents significant challenges to KM.

4.3 Framework Development and Theoretical Sampling

Having reviewed literature, presented the findings and discussed them, the emerging framework can be refined further to ensure that these multiple perspectives are incorporated into its construction. It is evident from the discussion that there is considerable overlap between the various categories and there is scope for improvements to be made. From this perspective, a number of alterations have been made to the eight categories, which have been reduced to six; an overview of these can be seen in Figure 11.

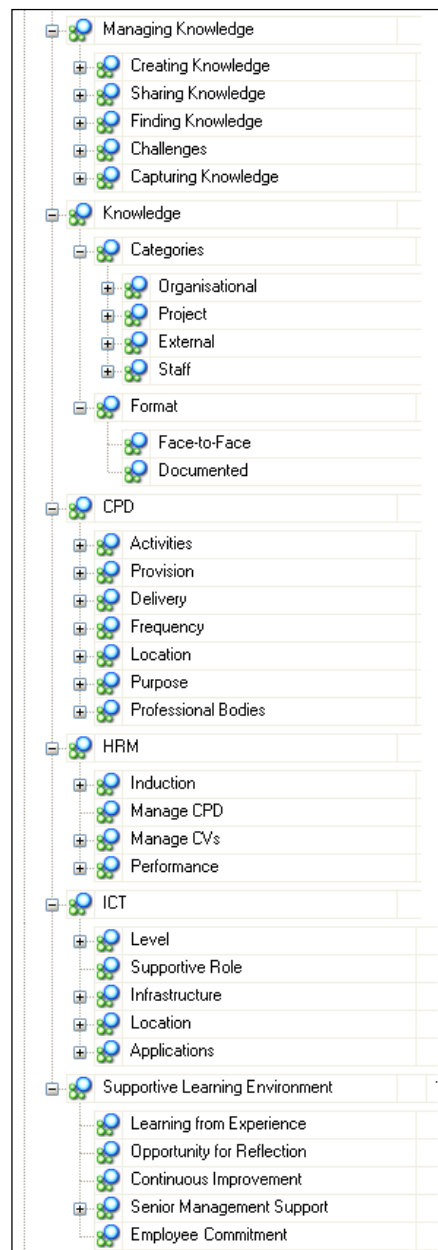


Figure 11: Emerging Categories

The 'format' of knowledge remains unchanged suggesting that both 'face-to-face' or tacit and 'documented' or explicit knowledge are considered to be of value. The knowledge 'domains' and 'level' properties have been combined to reflect the focus of categorisations offered by Egbu and Robinson (2005); however the 'people' category has been separated into the characteristics of 'staff' (previously 'individual') and 'external' sources of knowledge such as suppliers, subcontractors, clients, consultants etc. encompasses what was the 'inter-organisational' level of knowledge. 'Project' knowledge remains a property in its own right within 'domains' and has been merged with 'technological' which is concerned with characteristics of the services or goods to be produced, i.e. the project in the case of construction. Organisational remains unchanged, reflecting the process knowledge of the organisation and its management systems.

The processes associated with 'managing knowledge,' i.e. 'creating,' 'sharing,' 'capturing' and 'finding,' remain unchanged and require additional investigation in subsequent phases of the research. The 'challenges' property now comprise three levels: 'industry,' 'organisational,' and 'specific.' 'Industry' refers to the more global challenges posed by the nature of the construction industry, whilst 'organisational' includes implementation issues identified in 'other organisational initiatives,' problems posed by 'intra-organisational fragmentation,' and 'barriers' and 'drivers' from IT which appear to have more global connotations. 'Specific' challenges refer to those which may be directly related to attempting to manage knowledge.

On a broader level, both Mohamed et al. (2004) and Egbu and Robinson (2005) discuss various issues relating to managing knowledge, including leadership and senior management support, organisational structure, technological infrastructure, a culture of knowledge sharing and learning and staff motivation. In addressing these issues, Davenport (2003) contends that KM must be integrated into existing business processes including HRM, organisational management and information management. Based on the literature reviewed it is evident that the categories IT, HRM and CPD have a supportive role to play in managing knowledge. Through further investigation, it is anticipated that the role of these processes will be explored in the context of the processes associated with

‘managing knowledge.’ In this regard, it is worth recalling the advice of Egbu and Botterill (2002), who contend that existing work practices should be augmented when incorporating technologies to support KM. Perhaps the most challenging category to position within the developing framework is the ‘supportive learning environment,’ which as discussed encompasses some of the required characteristics for a knowledge-sharing culture. As this is such a pervasive category it may pose difficult to refine and incorporate into the emerging framework.

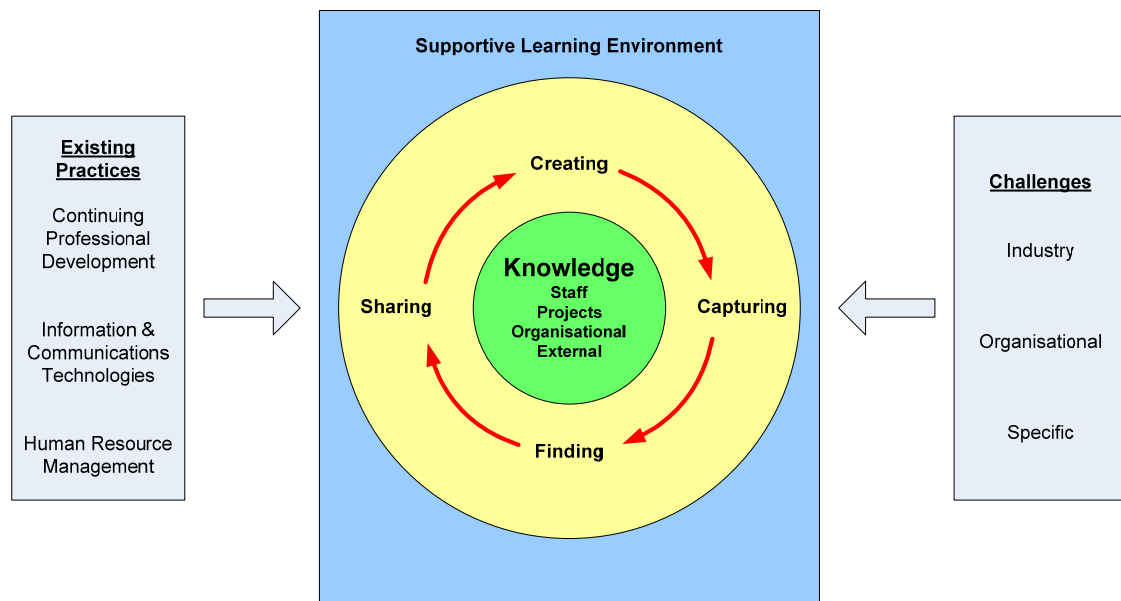


Figure 12: Framework Emerging from Phase 1

A diagram has been developed to summarise the main issues to have emerged thus far and aid the development of categories and potential relationships as the research progresses. Figure 12 attempts to encapsulate all aspects of the framework, with ‘knowledge’ at its centre, surrounded by processes associated with ‘managing knowledge,’ which should take place in a ‘supportive learning environment.’ The ‘challenges’ associated with ‘managing knowledge’ have been isolated and their effect requires further investigation, as does the potential role of existing practices such as CPD, HRM and IT. In order to facilitate the development of the grounded theory, theoretical sampling must be based on the data analysis already undertaken. By writing operational notes during the analytical process, a

record of ideas, questions and sites for further data collection can be maintained (Strauss and Corbin, 1998). These authors also recommend that the researcher writes theoretical notes which allow for reflection and consideration of other possible properties and dimensions of the categories. Based on a combination of these theoretical and operational notes, a number of areas can be identified for further data collection:

- Construction Professionals: there are a variety of disciplines and professions employed by construction organisations; therefore it is important to collect data from the different disciplines in terms of their roles, experience, educational background, career progression, use of IT, and engagement with CPD. The role of middle-managers in gathering and disseminating knowledge is an area to have emerged which merits specific investigation
- HR Managers: there is considerable overlap between HRM and CPD, with learning and skills acquisition an important part of KM. The views of HR Managers on the provision of CPD activities, staff roles and responsibilities, knowledge and its management, and the presence of a supportive learning environment should be investigated
- Professional Bodies: with CPD emerging as an important category, the role of professional bodies may also be explored in terms of their definition of CPD and recognition of individuals and organisations for their participation in CPD activities
- Other Industries: given that the nature of the construction industry is viewed by many as being unique, it is important to ensure that the research is not overly myopic. Similarities and differences with other industries should be explored to aid the further development of properties and dimensions, and provide a basis for comparison
- Further Literature Review: according to Strauss and Corbin (1998), the use of literature can enhance the development of categories through comparison, stimulate analysis and direct the researcher to areas for theoretical sampling. Specific areas requiring further investigation in this regard include CPD and HRM

Whilst it would be difficult to consider all of these issues at once, of most significance at this stage are the construction professionals or ‘staff’ and a review of further literature relating to CPD.

4.4 Summary

This chapter has sought to present and discuss the findings and literature of initial research, the aim of which has been to identify the main issues associated with KM in Irish construction and to construct an emergent framework upon which to base subsequent research. Returning to the research questions posed in Chapter 1, the following is a summary of the main findings of the first phase of the research:

1. How effectively are the leading Irish construction organisations currently managing knowledge?

Based on the evidence provided, it can be argued that these organisations currently manage knowledge on an ad-hoc, informal basis, although there is evidence of practices which can contribute towards KM. These include: researching new products and systems, meetings, site visits, conferences, post-project reviews, intranets and databases and informal communications.

2. What are the main strategic, cultural and technological issues that must be addressed for the adoption of KM in construction?

The main issues to be addressed include the following:

- Understanding the nature of knowledge, which can range from tacit to explicit (or documented). There is a recognised difference between tacit and explicit knowledge which is reduced to information, with more value placed upon the former in construction organisations
- Recognising the categories of knowledge which are of most concern to construction organisations. These include people (both internal and external to the organisation); the context, performance and features of projects, and the myriad organisational knowledge, procedures and norms which dictates how the organisation functions
- Acknowledging that significant challenges are posed to KM by the inherent nature of the industry, its implementation at organisational level and the specific challenges of managing knowledge
- Fostering a supportive learning environment where KM can operate, although this is something that is difficult to define and articulate

- Building upon CPD, which is an important part of the leading construction company's activities and facilitates the ongoing development of staff's knowledge through a variety of activities
- Facilitating KM through the HRM function, including organising CPD, facilitating learning and sharing of knowledge, and appraising and rewarding staff
- Supporting KM through the use of IT which is dependent upon the level of infrastructure in place within the organisation and the role and IT literacy of staff
- Building upon and augmenting existing work practices appears to be the most appropriate approach to developing and implementing KM

3. Can construction professionals be encouraged to engage in KM activities through its alignment with existing organisational processes and activities?

The interviews suggest that CPD is an important part of the leading construction organisation's activities in terms of developing their staff's knowledge. The alignment of KM with CPD activities may provide a 'win-win' scenario for both the construction professional and their employers. Additionally, there appears to be a number of issues which influence a construction professional's engagement in KM activities, such as their level of experience, role, workload, personal issues.

Through the analytical process and writing memos a number of areas for further data collection and analysis have emerged. In the pursuit of theoretical sampling, it is proposed to examine the role of construction professionals within KM, which will be supplemented by a further review of relevant literature. Whilst open coding has been the predominant analytical tool used in this phase of the research, it is anticipated that axial coding will come to dominate as the research progresses. This will particularly be the case in attempting to uncover relationships between managing knowledge and IT, HRM and CPD.

Chapter 5

Case Study A

5 CASE STUDY A

During one of the ten senior manager interviews, the opportunity arose to conduct further research within a leading Irish construction organisation. Through the interview, it emerged that the organisation in question had attempted to address the KM requirements of Engineers Ireland's CPD scheme by implementing a lessons learned database (LLDB), subsequently becoming the first construction company to be accredited for their CPD practices. The company's director was particularly interested in ascertaining whether the LLDB was having an impact; *"the theory is that before you start a particular package you log onto the database and have a look, in the hope that you don't make the same mistake again."* In order to ascertain the effectiveness of this approach to KM (and address Research Question 1), a case study of this organisation was undertaken during 2006, comprising a survey of professional staff and semi-structured interviews with staff on a construction project (see Appendix D and Appendix E respectively).

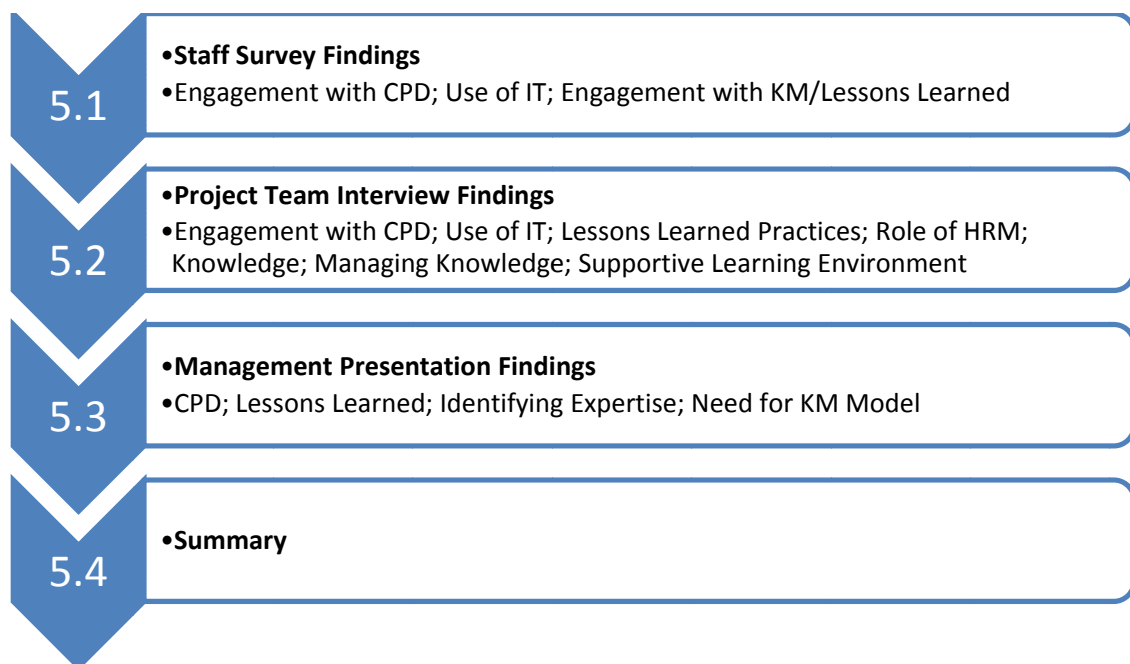


Figure 13: Chapter 5 Overview

Following this, the findings were presented to members of the company's CPD management team. Building on the emerging issues from Chapter 4, this case study also sought to identify the main issues associated with adopting KM (Research Question 2) and

encouraging construction professionals to engage with KM through alignment with existing organisational practices (Research Question 3). In seeking to develop the emerging issues further, this chapter presents the findings of the case study (see Figure 13 for overview of key themes), which will also be discussed in relation to relevant literature and a second case study in Chapter 7.

5.1 Staff Survey Findings

The questionnaire was sent to 180 professional staff based in Case Study A's Dublin region, with 65 staff responding (see Appendix D for a copy of the questionnaire). The following is a profile of the survey respondents' age, experience, work location, role, education, professional body membership and motivational factors.

5.1.1 Age

The findings suggest a relatively young workforce with a total of 63% of respondents age 35 and below. Figure 14 shows the overall age profile of the sample.

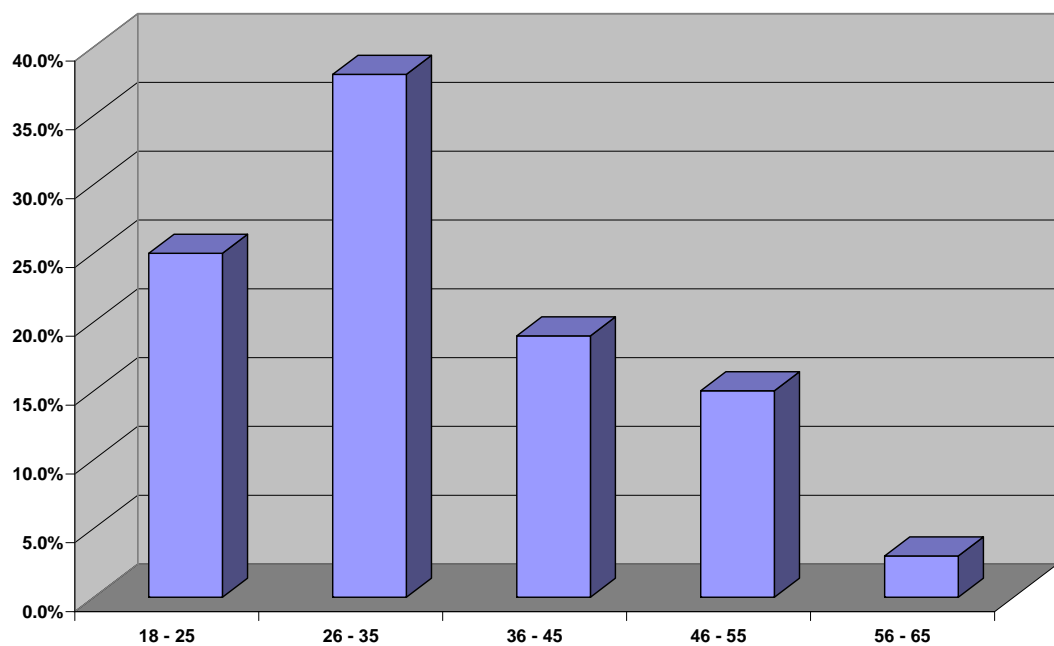


Figure 14: Age Range of Survey Respondents

5.1.2 Experience

As can be seen in Table 22, the survey respondents have a broad range of experience within construction (with over a third having less than 5 years experience). 69% of the respondents have been working with Case Study A for less than 5 years. Notwithstanding the 37% with less than 5 years industry experience (mostly recent graduates), this supports earlier arguments which acknowledged the migrant nature of the industry.

	< 5 years	5-10 years	11- 20 years	>20 years	Total
Working in Construction	37%	25%	14%	24%	100%
Working for Case Study A	69%	21%	8%	2%	100%

Table 22: Survey respondents' industry experience

5.1.3 Education

In terms of an educational qualification, almost half (49.2%) of the respondents hold a degree and a further 16.9% possess a post-graduate qualification. The distribution of educational qualifications is shown in Figure 15 and includes secondary level (4.6%) and trade qualifications (9.2%); with a total of 83% of respondents possessing some form of third-level qualification, ranging from a certificate to post-graduate. One respondent cited a professional qualification (other) from the Irish Management Institute (IMI).

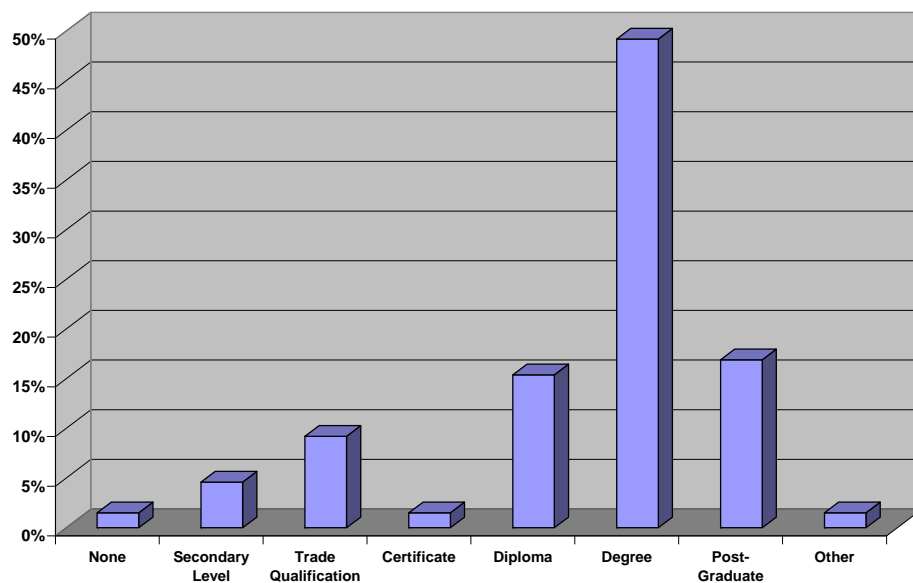


Figure 15: Highest Educational Qualification of Survey Respondents

5.1.4 Role

The highest ranking role to take part in the survey was Quantity Surveyors (26%), closely followed by Engineers (23%), with Project Managers accounting for 15% of respondents. The remainder were drawn from a variety of management and administration roles as illustrated in Figure 16.

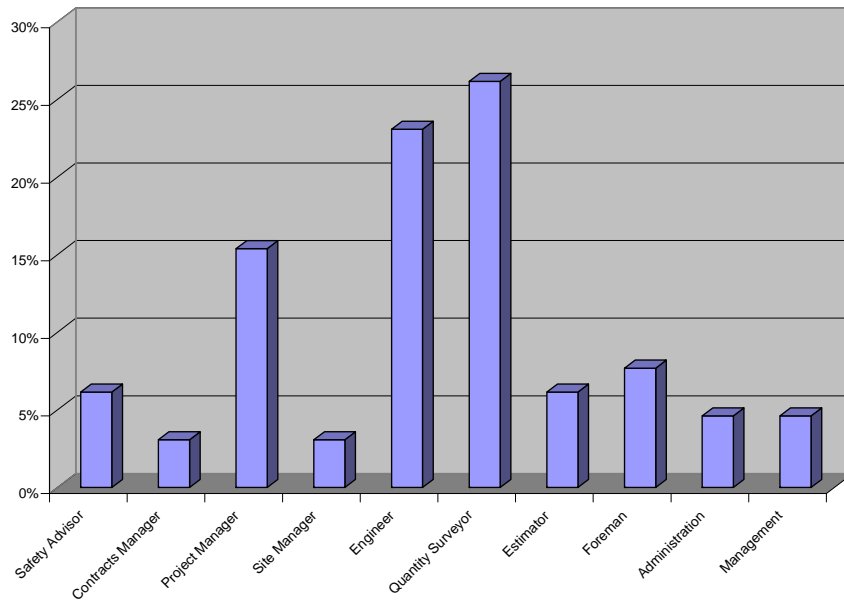


Figure 16: Job Title of Survey Respondents

5.1.5 Professional Bodies

With 63% of respondents holding membership of a professional body, 18.5% of whom hold dual membership, Figure 17 shows the breakdown of professional body membership. In line with the high proportion of professional respondents, there is a high level of membership of Engineers Ireland (28%), the CIOB (23%) and the SCS (15%).

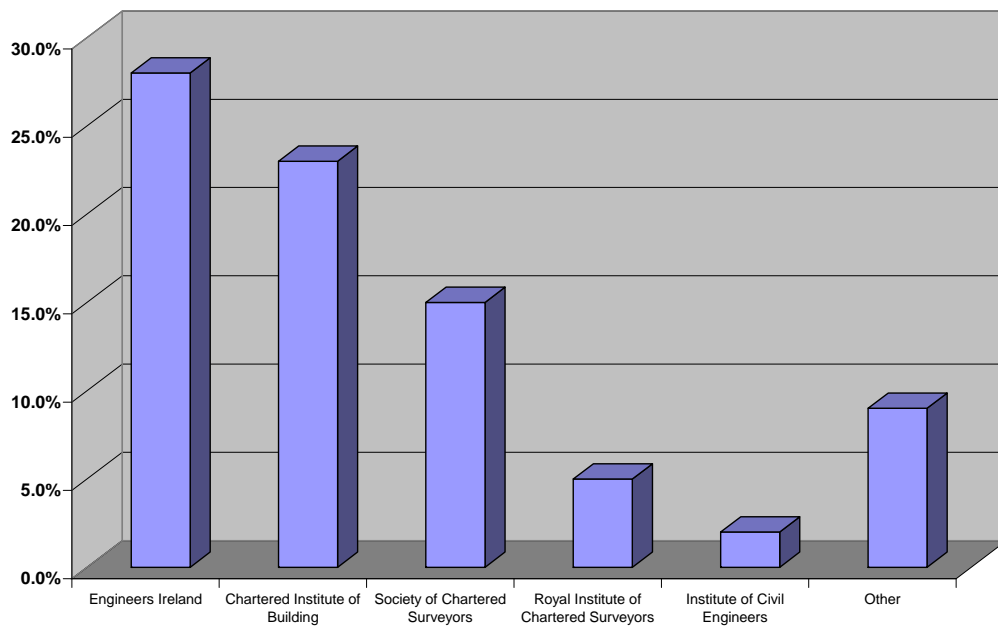


Figure 17: Professional Body Membership

5.1.6 Motivational Factors

As evidenced in Figure 18, apart from financial incentives, being given ‘responsibility to work on own initiative’ was rated the most important motivational factor, followed by ‘recognition of your skills and talents,’ ‘good training and development programme’ and ‘being part of a team.’ Rather interestingly, given what was said in the previous chapter, ‘personal contact with directors’ was rated as the least important factor.

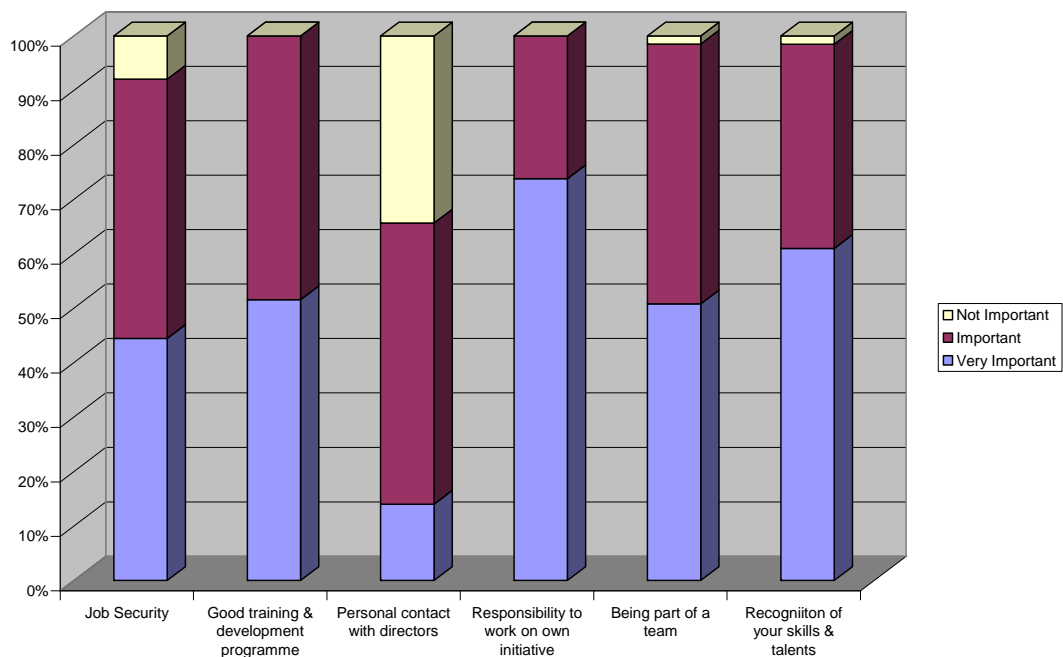


Figure 18: Non-Financial Motivational Factors

Further analysis of these motivational factors, based on age, yielded some interesting results. Those in the 18 to 25 year age range rated a ‘good training and development programme’ most highly, whilst those between 26 and 35 placed equal emphasis on ‘responsibility to work on own initiative’ and ‘recognition of your skills and talents.’ The former was also the highest ranking motivational factor for both the 36 to 45 and 46 to 55 year categories.

5.1.7 Engagement with CPD Activities

The survey sought to explore the level of engagement with a number of identified formal CPD activities, including induction, mentoring, training and site visits.

- **Induction:** 83.1% had completed an induction upon joining the organisation
- **Mentoring:** 60% of respondents are involved in the company's mentoring programme, with 43% being mentees and 17% identifying themselves as mentors
- **Training:** the areas where respondents have received most training include: computer skills (87.7%), health and safety (75.4%), quality management (60.0%) and communication skills (58.5%); other areas where formal training has been received can be seen in Figure 19

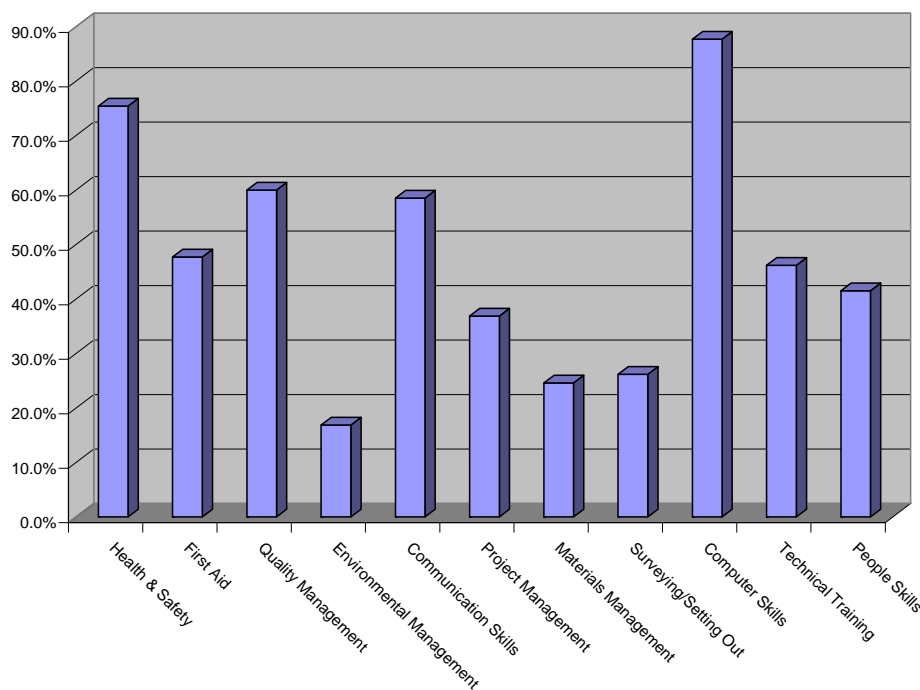


Figure 19: Areas Where Training Has Been Undertaken

- Site Visits: 49.2% indicated that they had visited other sites within the organisation. Table 23 indicates that the longer employees spend working for the organisation, the more likely they are to have visited other sites. Of the 45 respondents who have been with the company for less than 5 years, only 14 have visited other sites within the organisation

	Years working for Case Study A				Total
	< 5 years	5-10 years	11- 20 years	>20 years	
Yes	14	12	5	1	32
No	31	2	0	0	33
Total	45	14	5	1	65

Table 23: Site Visits versus Years Working for Case Study A

5.1.8 Use of IT

As can be seen in Table 24, the majority of those surveyed (93.2%) viewed IT as being an integral part of their job, with 84.6% stating that computers are used effectively within the organisation. Whilst 87.7% of respondents have received training in computers, only 69.2% feel that they are sufficiently trained in this regard. The first phase of the research (i.e. senior manager interviews) indicated that there was too much information being circulated by email; however only 37.5% of respondents, in this particular phase, felt that this was the case.

	Yes	No
Too much information is sent by email	37.5%	62.5%
Computers are used effectively	84.6%	15.4%
Sufficiently trained in use of computers	69.2%	30.8%
IT is an integral part of your job	93.2%	6.2%

Table 24: Respondents Views on the Use of IT within Case Study A

5.1.9 Engagement with KM Activities

A number of KM-related issues were investigated, including knowledge-sharing seminars, the lessons learned database, ability to identify expertise within the organisation and meeting with peers.

The survey found that over half of the respondents (53.1%) attend an average of 1 to 4 seminars per year, with a further 31.3% attending between 5 and 9 over the same period. On a scale of 1 to 5, respondents ranked ‘good way to meet colleagues’ as being the most important reason for attending these seminars; Table 25 presents the other reasons in order of importance

Rank	Reasons for attending seminars	Mean Score
1	Good way to meet colleagues	4.04
2	Interesting content	3.04
3	Good discussion and interaction	2.98
4	See experience of others	2.42
5	Helps improve own work	1.91

Table 25: Reasons for Attending Seminars

The survey found that the LLDB is primarily used when staff have a specific problem or query. Despite nearly three-quarters of the respondents (73.8%) stating that they found it beneficial to them in their work, the use of the database in Table 26 shows that ‘very rarely’ and ‘never’ ranking quite highly in terms of usage (39.8% when combined). Contrary to the Director’s views at the start of this chapter about when the LLDB should be used, it is interesting to note that ‘when a subcontract package commences’ ranked lowest.

Rank	Use of LLDB	%
1	When I Have a Specific Problem/Query	40.9%
2	Very Rarely	27.3%
3	Never	12.5%
4	Quite Often	10.2%
5	When a Subcontract Package Commences	9.1%

Table 26: Use of Lessons Learned Database

Figure 20 illustrates a number of factors related to using the database, which overall, indicate that staff are satisfied with the LLDB, rating relevance and amount of information,

easy to understand, easy to access, well organised, and easy to access quite highly. The question of whether lessons were up-to-date appears to have divided respondents, with 35.4% stating that it is not kept up-to-date, whilst both the identification of key people and ease of search, are also problematic.

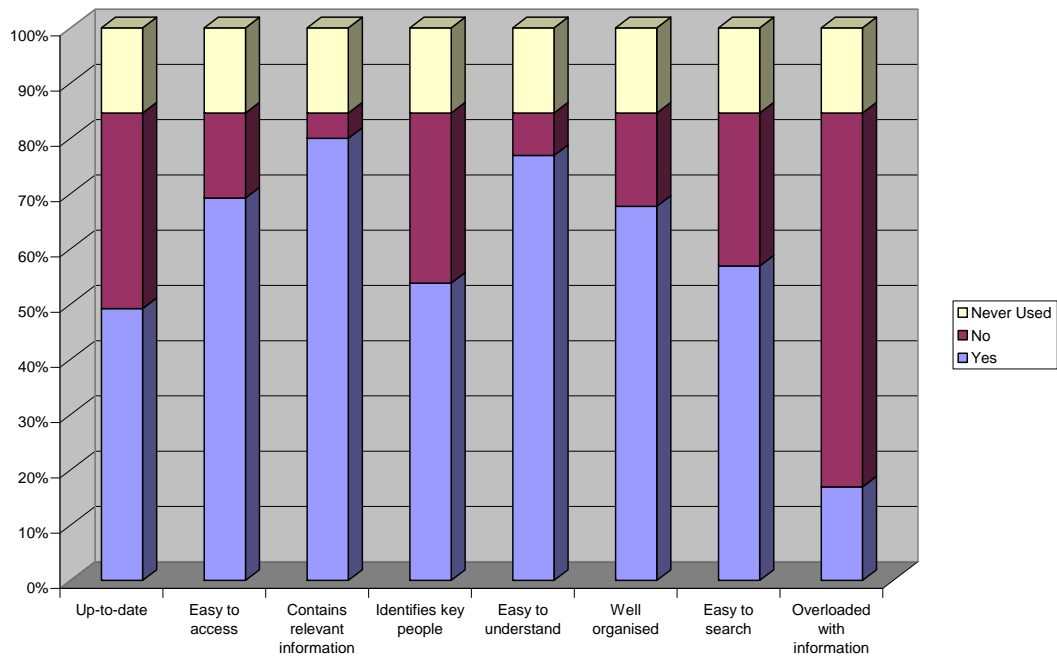


Figure 20: Factors Influencing Use of Lessons Learned Database

The survey asked respondents to identify the ease with which they were able to identify people with certain domain expertise within the organisation. As can be seen in Figure 21, both “*in own workplace*” and “*in head office*” ranked quite highly (87.7% and 64.6% respectively), while 46% of respondents indicated that they could easily identify expertise on other sites within the company. However, only 15.4% felt that they could locate expertise in the company’s regional offices in Cork, Limerick and Galway.

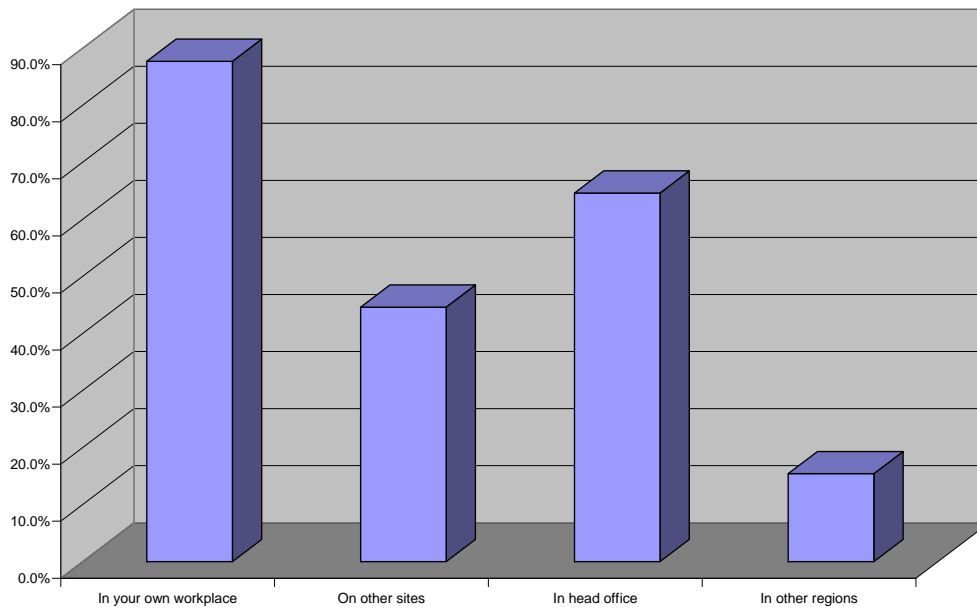


Figure 21: Identifying Organisational Expertise

Further analysis of this issue was conducted, based on the individual's time spent working for the company. Whilst the small sample size and high proportion of staff with the company for less than five years should be acknowledged, the figures outlined in Table 27 give some indication of the effect of company experience on the ability of an individual to identify expertise within the organisation. It can be surmised that the more time one spends with the organisation, the more people they get to know throughout it and their ability to identify expertise increases.

	< 5 years	5-10 years	11- 20 years	>20 years	Total
Frequency	45	14	5	1	65
Workplace	86.7%	92.9%	100.0%	100.0%	87.7%
Other Sites	33.3%	71.4%	80.0%	100.0%	44.6%
Head Office	60.0%	78.6%	80.0%	100.0%	64.6%
Other Regions	8.9%	28.6%	20.0%	100.0%	15.4%

Table 27: Company Experience vs. Ability to Identify Expertise

As can be seen in Figure 22, just under half of the survey respondents (49%) indicated that they never meet with their peers on a regular basis. Of those who do so, 20% meet once a month, with 12% indicating they do so on a more frequent basis (other).

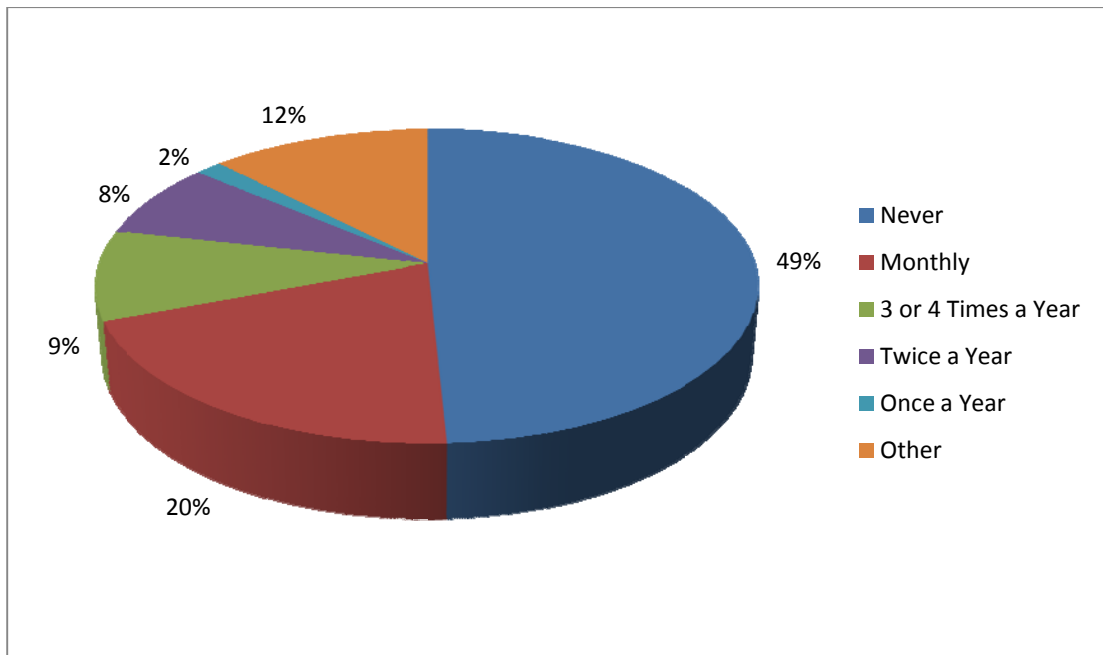


Figure 22: Meeting with Peers

The majority of those who meet with peers on a regular basis (97%) found such interaction of benefit to them in their work, particularly in discussing recurring problems, new construction methods and company news. Of the survey respondents who do not have the opportunity to interact with others outside of their day-to-day roles, 83% indicated that they would like to do so.

It is evident from the survey findings that there is a relatively young, well-educated, professional workforce within Case Study A. One of the more pertinent findings to have emerged is that an individual's experience influences issues such as motivation, engagement with CPD and KM activities and the ability to identify people with specific expertise within the organisation.

5.2 Project Team Interview Findings

An overview of the interviewees' profiles is presented in Table 28, summarising their position, experience, highest qualification and membership of a professional body.

Position	Industry Experience (Years)	Case Study A Experience (Years)	Highest Qualification	Professional Body Membership
Contracts Manager	23	9	Degree	EI
Project Manager	10	10	Degree	EI
Senior Engineer	7	7	Masters	EI
Site Engineer A	9	2	Degree	EI
Site Engineer B	1.5	1.5	Degree	EI
Senior Quantity Surveyor	9	2	Degree	CIOB & SCS
Quantity Surveyor A	7	1.5	Degree	SCS
Quantity Surveyor B	6	1	Degree	CIOB
Foreman A	48	8	Trade	None
Foreman B	40	18	Trade	None
Safety Officer	21	8	Certificate	None

Table 28: Project Team Profile

Based on this information, it is evident that the project team is composed of individual's from a variety of different backgrounds, with differing levels of experience and education. The consideration of these multiple perspectives, will contribute to the identification of issues and subsequent construction of a KM framework that reflects the diversity of construction organisations.

5.2.1 Engagement with CPD

The previous phase of research identified the potential role of CPD within KM, necessitating an exploration of engagement with CPD from a construction professional's perspective. In this regard, Quantity Surveyor B discussed CPD in the context of career progression, *"there's great opportunity to grow in the company. They offer a lot of*

training, in-house seminars, everything with them is a programme of training...it is set, you get your appraisals, you move up a grade, you can see yourself progressing.”

The Contracts Manager echoed that view, *“they have a good attitude to staff, they support training and career development, so I think they’re overall a good company to work with.”*

The Senior Engineer praised the Contracts Manager as being *“proactive on our CPD, if you ask for something you’ve no problem getting time off,”* she continued, *“I think all senior people in the company are proactive in CPD.”*

The Contracts Manager stated: *“at my level, training is really driven by me, and I on an annual basis review my training requirements for the following year.”* A similar theme was followed by the Project Manager, *“it’s up to yourself really...I suppose at this stage there are seminars and different things that come up and you’re on a list for them, but then you go off and do courses where I select the ones that I want.”*

On becoming a chartered engineer, Site Engineer B stated that while the company encouraged CPD, *“it would be me deciding that I become chartered, I think I need another couple of years experience and a certain amount of CPD.”* The Senior Quantity Surveyor believes that motivation is an important factor in becoming chartered, *“once you get chartered, you’re going to be career inclined and make sure that you keep sharpening the saw.”*

The Contracts Manager discussed the need for skills conversion of engineers, *“one of our biggest challenges is converting them from engineers to managers, giving them the proper training to switch from a technical work system to a management work system where they are dealing with people...it is something that we need to put more effort into.”* In this regard, the Senior Engineer spoke of her increased involvement in management issues on the project: *“I’m after going into the whole site management role which is very different to being a project engineer. In a site management role you’re dealing with people, managing subcontractors, monitoring quality.”*

The Project Manager recognised the value of on-the-job experience, *“especially for younger people...that they’re not just a site engineer and you forget about them, it’s important that they’re introduced to different parts of the work.”*

The Senior Quantity Surveyor discussed attending both internal and external seminars, the company *“would probably send you on 2 to 3 external courses every year, paid for by them and then they have their in-house courses which would probably be 2 or 3 again in a year. So you’re talking one every 2 months, where you’re gaining knowledge.”*

The Director commented that *“we find it’s actually quite hard to get good technical courses, technical building courses, so we do a lot of that in-house, with our own senior managers, who give seminars on a range of topics.”*

Mentoring was viewed as a worthwhile endeavour by the Contracts Manager; *“I think that it’s a good scheme, it gives them [the mentees] an opportunity to discuss their career with a senior member of staff...I’m a mentor and I find that it works well.”* There appeared to be some differences between the Engineers and Quantity Surveyors in terms of how the mentoring scheme operated, with the engineers being more formalised in terms of frequency of meetings, records and training for mentors. Quantity Surveyor B acknowledged such differences, stating *“I think the engineers do it a bit differently...but I don’t know how regularly they meet to discuss things.”*

The company has a training programme for all graduates, which, according to the Director, *“is a 5 year training plan, because we find, most engineers when they come in they’re smart, they’re good logical thinkers, but when it comes down to getting their hands dirty, it’s pretty much start again, so the training course that we put them on is really the practical, managerial aspects of building.”*

The Contracts Manager discussed the range of training he typically undertakes; it *“will consist of in-house training, specialist external management training and some research and development through looking both at production facilities and new products coming to the market via the exhibitions around the country. I also review technical and construction*

literature on a regular basis to keep up with current developments...it's a multi-faceted thing."

Training in the use of computers was a recurring theme, with the Project Manager having recently completed courses in the use of Outlook and Primavera. The Senior Engineer has more recently moved onto *"more external training...time management, chairing meetings, motivation and delegation and I'm down for another one, conflict."* The need for continuous training was recognised by Foreman A who stated: *"generally speaking a lot of it has been of the management and economics of the site, which is good to keep abreast of because times change."*

Quantity Surveyor B discussed the benefit of meeting with his peers: *"at in-house training seminars, you'd meet with a lot of the younger surveyors in Dublin and you'd get chatting and find out about how things are running on other sites."* The Contracts Manager confirmed this view, *"at seminars and lessons learned talks, inevitably there's some informal chat, and we catch up on what's happening."*

Due to the project being located in Waterford, the team felt that they were somewhat removed from accessing CPD activities taking place in the head office in Dublin. Quantity Surveyor B stated: *"its difficult for us, we're in here for 8 in the morning, head up to the seminar in Dublin, which doesn't start until 6, turn around and come back down, so it's a long day."*

The Project Manager discussed the problems with staff leaving site to attend CPD events, *"it's difficult to get away from sites, and you can't really have more than one or two people from a site going to it."* He suggested that *"there should be more CPD done on the site, particularly on a big site like this where you have a big staff."*

In terms of CPD, the interviews indicate that Case Study A are supportive of their staff's development, providing opportunities for learning both internally and externally, through a range of activities including training and mentoring. Such activities also present an opportunity to meet with peers and discuss various work-related issues.

5.2.2 Use of IT

Arising from the interviews with the project team, it was found that the main IT applications utilised were email, a central server known as the 'K-drive,' and general software applications.

All of the interviewees indicated using email and Office applications and in some cases CAD, project management and quantity surveying software. The Contracts Manager spoke of his use of IT, *"basically I can use the computer for whatever I need...its pretty much email first, Excel second and Word third."* The Project Manager spoke about learning how to use computers through *"picking it up as you go... I have done courses...I suppose with computers, I know enough for what I need, planning software, Primavera, Microsoft Project and those kind of programmes."* The Senior Quantity Surveyor, in his day-to-day work uses *"Buildsoft and Microsoft Project, the basic Microsoft packages, Word, Excel, PowerPoint and Outlook."* The Safety Officer mainly uses *"Word, Excel, Internet Explorer...I wasn't comfortable on it when I started, but I'm grand now...I also use email to get health and safety bulletins, it does what I need,"* admitting that *"I wouldn't be stuck to the computer!"*

Foreman B acknowledges that *"I could do with a bit more training... I can bash my way through it and I get on alright, there are a few aspects that I need to polish up on."* While Foreman A is able to use computers, he questioned the benefit of them to him in his current role, *"I'm more geared to sorting out things outside on site, than punching the keyboard. If you value your time, it's a waste of time for me to use the computer."*

The Senior Engineer estimates that she uses *"computers for 2 hours a day, at least...reading and writing emails, writing letters, checking drawings...you have to keep on top of it."* Site Engineer A, who spends most of his time out on site, checks his email *"every 3 days or so, if I'm lucky, because I'm so busy on site, I'm outside most of the time. I get a lot of stuff that doesn't apply to me, but I get sent it anyway!"* The Contracts Manager agreed, *"there is a tendency to be copied on every email...it can be time*

consuming when you spend time out of the office, but it's probably better than not knowing what's going on."

The coordination of finishes on the project requires Foreman B to use his computer *"every single day, for a few hours, emails, communications with subcontractors, architects, requests for information...it sure beats all those lever arched files all over the place...it does take you off site quite a bit, but bear in mind that finishing is 85% administration."*

Quantity Surveyor B spends a lot of time using email, *"I'd say I use it 40% of the day, sending correspondence...internally, to subcontractors, suppliers,...it's easier to file when you have it all on email, it's cut down on paperwork."*

The Director described the development of the K-drive: *"the system that we use on the server is one that I put together on paper, and then our IT guys made it work. A lot of it is transferring what we used to do in hard copy to computers, so it is a customised system."* The Project Manager finds that the centralised server *"works well, the filing is excellent, there isn't a big paper trail."*

In discussing connectivity to the centralised server, the K-drive, the Project Manager had the following to say: *"being remote from site, the connection isn't as good as it should be, and a lot of it can be problematic."* These problems were discussed in further detail by Quantity Surveyor A, *"we're connected back to head office, and that was giving us problems for a while but once that works, things work smoothly, if it doesn't work, it does create trouble."*

It is apparent that the interviewees use IT to varying degrees, depending on their role, IT literacy and experience. The physical location of their work on the project also seems to influence their IT usage, with some staff spending more time out on site and hence using IT less than those based in the site offices.

5.2.3 Lessons Learned Practices

As a result of their involvement in Engineers Ireland's CPD Accreditation Scheme, Case Study A developed a lessons learned database (LLDB) to capture and share knowledge gained on projects. Their lessons learned practices were described by the Director, *"at the end of every job, a number of things are taken from the job, a number of positives and negatives and they're written up and put into the lessons learned database, which is based on a list of hundreds of trade packages, and the lessons learned is put into the relevant trades package, so say you're starting excavation in the morning, you go into the server, you look up excavation, and you find half a dozen lessons learned, where people screwed up or where they done exceptionally well. The theory is...that before you start that package you log onto the database and have a look and hope you don't make the same mistake again. So the theory is good but you are depending on people to take the time to look at it. We also give seminars based on lessons learned on a fairly regular basis."*

The LLDB is managed by the company's Administration Manager, and LL are collected, analysed and disseminated as follows:

- The company conducts a post-project review for all projects where *"you get your lessons learned, performance of subcontractors, any client complaints, all these things are gone through."* Key members of the project team discuss the best and worst experiences
- Following the review, the key LL are documented by the contracts manager on a standard template which includes *"photographs, contact details of the people involved, technical literature, and details of the project to put it into some sort of context."* According to the LLDB Manager, they are classified based on the trade/subcontract package with which it is associated. He commented that *"often people would tend to focus too much on the problem, so I would have to go back to them and asked them to review the context"*
- The lessons are stored on the LLDB, a central repository which can be accessed from all offices and sites by logging into the company's network, the use of which is not measured and tracked by management. In conjunction with the HR department, the LL

administrator also organises LL seminars which are usually delivered in the Dublin office in the evening time

The Contracts Manager discussed his use of the LLDB: *“at the start of each project and at the start of stages within projects, we’d trawl the lessons learned library.”* The Senior Quantity Surveyor gave an example of where he used the LLDB recently, *“we’ve used very new products in relation to party walls...so I used that when we done pre-award for that package, we made sure we covered whatever issues happened in the previous job and we put a clause into our pre-award for that.”*

The Project Manager questioned whether the LLDB actually worked in practice, *“before you start everything you’re supposed to look it up, I mean it’s a good idea, but in practice I don’t know if it works that well...”* In relation to her own use of the LLDB, the Senior Engineer admitted to not having used it recently, *“there is probably new stuff in it...I haven’t checked it in about a year...you don’t get time to.”*

Despite being aware of the LLDB, both Foremen A & B, Site Engineers A & B and the Safety Officer admitted that they didn’t use it. A number of the interviewees debated who should actually use the LLDB, the Project Manager spoke about foremen in this regard, *“you don’t want them in front of a computer all day, it’s definitely not for the foremen.”* However, the Senior Engineer who was involved in setting up the database had a different view, *“...a lot of the things on the lessons learned are relevant to a foreman, they are the ones who are dealing with these issues on site...but that’s where the breakdown is, the people who really need to know the lessons learned haven’t got access to a computer.”*

In recognising the problems associated with the database, the company deliver seminars to staff, based on lessons learned. In terms of these lessons learned seminars, Site Engineer A commented, *“there are seminars on lessons learned and I find them good.”* The participant’s experience is a crucial factor in the success of these seminars, according to the Contracts Manager, *“they get people at similar levels together, when they wouldn’t normally get together and they give people a chance to learn from others, from the experience of others. It’s difficult to pitch them at the right standard for a cross section of*

abilities, so I think you have to expect to go to them and get a lot out of some and not so much out of others. But that's purely a reflection of where you are on the scale of knowledge."

Foreman B echoed these comments, *"I think people physically getting together and trashing out things, what's the best way to communicate to people? Well face to face is, rather than leaving it on the K drive."* Foreman A has attended a number of LL seminars but has found *"that they talk about them and do illustrations and things like that, but some of them don't come up with answers!"*

One of the main problems with the LLDB, according to the Senior Quantity Surveyor, is that *"people are so focused on the goal of getting the job done, that they don't look at the database."* Another problem was highlighted by the Project Manager while discussing the LLDB; he attempted to look up *"joinery, labour-only joinery...look, it's gone in to the wrong link!"*

Foreman A suggested that lessons learned should be *"printed out and sent around...they should be sent to our Project Manager, he only has to print it out and stick it in them pigeon holes."* The Senior Engineer suggested *"a seminar once a year to jog everybody's memory to tell them what's in it."*

In terms of responsibility for making contributions to the LLDB, the Senior Quantity Surveyor was of the view that *"maybe it should be put down that when you do your monthly reports that you have to do a lessons learned report and it then gets put into the system...maybe it should be, you have to share your knowledge on jobs, its part of your criteria."*

The LLDB developed by Case Study A are not without their challenges, particularly in ensuring that relevant staff review previous lessons throughout the project. To counter this, regular LL seminars, are delivered to staff in the company's head office, presenting further challenges for staff based on geographically-dispersed projects.

5.2.4 Role of HRM

The previous interview with the Director identified a number of areas where the Human Resource Management (HRM) function could potentially support KM, such as inductions, appraisals and managing CPD.

The Director described the company's induction as follows: *"it centres on where to find stuff on our server, because we have a wealth of information, but with somebody starting off, they don't really know where to look for it. Our experience is there's no point in bombarding somebody with tons of information on their first day, because it just goes straight over their heads, so we concentrate on telling them where to find information, so in their own time, they can go back and dig it out."*

Quantity Surveyor B felt that the induction was more beneficial in giving him an opportunity to meet people in head office, *"while the induction itself gave the information about how to use their systems, it really gave me a chance to have a look around the Dublin office, meet a few people, so you know when you're up there who's who."*

The company's appraisal procedures were described by the Director, *"you're appraised by your immediate boss, that appraisal is then passed on to your director, and you come to the director for your annual review, go through the appraisal, who will recommend certain training for the year, and you're expected to come back at the end of the year having done that training."*

Site Engineer B had an appraisal with a director recently, *"it was good...you feel like you're a bit more part of the company...it gives you a bit more confidence to go and keep doing your training, motivate yourself to go a little bit further."*

The Contracts Manager viewed the annual appraisal as *"essential,"* going on to discuss *"a period of self-assessment beforehand to figure out what do I need to do to develop my career over the coming year. That's a useful exercise to do."*

According to the Senior Quantity Surveyor, during the appraisal, *“they try to look at areas that you want to improve upon or areas that you think you’re lacking knowledge and try and send you on a course,”* continuing that they are *“very good for people that want to move up or gain more knowledge.”*

Similar to previous discussion concerning mentoring, there appeared to be some discrepancy about how the appraisals were managed for Engineers and Quantity Surveyors, according to Quantity Surveyor A, *“within different departments, things are a little bit different.”*

Quantity Surveyor B confirmed this view, stating that he hadn’t done an appraisal with a director, *“no, I’ve done an appraisal with the Senior Quantity Surveyor here; that would have been an internal one.”*

In discussing CPD within the organisation, the Director commented, *“the framework is there, we have a HR manager, with an assistant and training person, so it’s reasonably well logged and documented.”* Site Engineer B confirmed that the Training Coordinator *“would normally email me about different courses going on,”* while Quantity Surveyor B stated, *“our training department would let us know, you’d hear it by word of mouth, and you can put in your name for it, and you’d be called if it was going to be of benefit to you.”*

Activities such as inductions, appraisals and CPD, which are overseen by the HRM function, can be viewed as being relevant to KM, particularly in terms of finding, capturing and creating knowledge. The integration of HRM practices with KM is an issue which will be considered further in this research.

5.2.5 Knowledge

Knowledge was discussed from a variety of perspectives during the course of the interviews in terms of relevance, level of experience, workload, and role.

The relevance of knowledge was discussed by a number of the interviewees. In terms of knowing about other projects within the company, the Senior Quantity Surveyor commented, *“you have enough to deal with on your own project, unless you’re expected to have some involvement, really you don’t want to have any knowledge of it, because you’ve so much on your own plate.”* Whilst discussing site visits, Foreman A spoke about the need for them to be relevant, *“if you’ve said that there was a place where you knew something went on and you needed to look at and it was beneficial, they’d encourage you.”* The Senior Engineer felt that if CPD seminars were *“of no relevance to you, you’d be inclined to say that you can’t go to the next one.”* Quantity Surveyor B recently attended *“a seminar on the management of the block layers, and I’ve got their account here and it’s been extremely helpful when dealing with the 6 to 8 block layers that we have on site.”* In relation to the lessons learned, Foreman A stated, *“it’s normally just a little bit of information that you want, if the information is not there and its relevant to you, you’d talk to the people who were involved.”*

During her time working in head office, the Senior Engineer was involved in developing a database of project reports for senior management which involved the following: *“the main details from the project report were put in the database, original price, final price, variations, original and actual programme, any main problems and financial issues,”* she continued, *“it was pretty restricted access.”* In discussing the confidentiality of project reports, Foreman A admitted that he had never seen one as *“it probably stops as far as the contracts manager or possibly the project manager.”* Foreman B confirmed that *“costing is a factor that I’m not involved in.”*

In terms of ‘individual knowledge’ the interviewees discussed their level of experience, the relevance of knowledge to them, their workload and role. Site Engineer B felt that her lack of experience impacted on her CPD activities: *“the different talks and seminars that I would have gone to, say concrete and formwork, there was joinery, block work, they are fairly relevant. Once you’ve seen it being done, I find it’s easier to go to a seminar and talk about it...it’s hard to visualize something when you go in and listen to someone in a room talk about it for an hour, whereas when you experience it on-site...”*

A number of the respondents discussed occupying a middle ground between being a novice and having a lot of experience. Quantity Surveyor A discussed experience in the context of level and position within the organization, *“I would be kind of in the middle, there would be someone more senior, and someone more junior to me.”* Reflecting on his own experiences, the Senior Quantity Surveyor said, *“I suppose, as you change your role, you use different aspects of knowledge that you’ve picked up in different fields, and you stop using other aspects because it’s redundant, you move from being a junior surveyor where you’re dealing with measurement issues on site, now you’re dealing with the management side of things.”* In adapting to a more management-oriented role, the Senior Engineer has struggled in dealing with programming and scheduling of construction activities, *“I suppose it could be down to inexperience, it’s all part of my learning curve.”*

When discussing the problems with committing to training courses, the Project Manager admitted, *“I suppose time is the thing, the best intentions go out the window when you’re handing over apartments!”* Whilst acknowledging the need for KM-related activities, the Contracts Manager admitted, *“that’s just the nature of the business...we’re trying to get more done all the time...but we probably don’t do as much of it as we could.”* Quantity Surveyor A felt that there is a good culture within the organisation and that people are generally willing to share their knowledge *“within reason, sometimes people are just too busy, but I’ve never had anyone say that to me.”*

A number of key themes relating to knowledge have been identified in the interviewees that might influence an individual’s engagement with KM. Relevance, level of experience, workload and role all impact on how an individual views knowledge from their own perspective.

5.2.6 *Managing Knowledge*

Based on the interview with the Director, a number of identified KM-related activities were discussed with the interviewees, relating to creating, capturing, finding and sharing knowledge.

In terms of purposefully creating knowledge, the Contracts Manager discussed his role in researching new systems and products which *“needs to be done at the start, because once you’ve committed the design team to designing something in a particular way, you cannot then change it and look at a whole new system, so it needs to be done early on.”*

The post-project project was described by the Director as a method for capturing project knowledge, *“where you get your lessons learned, performance of subcontractors, any client complaints, all these things are gone through.”* With regards to the level of detail of the project review, he commented, *“I would be happy that most of the major items are picked up on, quite often in the middle of a job, you get hung up on small things, and it’s really at the end of the job that you look back and say “what were the big issues here,” I mean, you can’t log everything, if you catch the big issues, you’re doing well.”*

Much of the discussions surrounding finding knowledge focused on finding people who had a particular expertise. The Director had identified CV’s as being useful in this regard, but continued, *“CVs aren’t something we share freely for obvious reasons, but it’s open to senior people, also on our subcontractor database, you can check all subcontractors and the key person on any particular job, and on the lessons learned also, the key people are identified on that, that’s how you would find out.”* The idea of developing a staff yellow pages which listed their skills and previous projects was discussed with the Contracts Manager, who stated, *“I’ve looked at other companies within Ireland that have that and it can be quite useful. For senior people they have the individual’s profile, but we don’t have it.”* This concept was discussed further with the Senior Quantity Surveyor, who commented, *“we’re building a cinema out there which is very specialised in acoustic details, but I know that the Cork office have done a cinema...if we knew who to contact, we’d be able to identify things to look out for, what to do, what not to do. It would be handy for specialised projects, a database of contracts managers and specialised projects they’ve worked on, whether it be tunnelling or acoustic works, or hospitals or the likes of big pharmaceutical plants, maybe having them categorised.”* Quantity Surveyor A had previously worked with a large project management company who employed such a tool, *“it was like a CV for everybody...there wasn’t too much information, just the jobs they’d*

worked on within the company and outside the company and the value of them...to know who would have experience in other areas.”

A number of formal and informal knowledge sharing activities identified in the interview with the Director were discussed with the project team. The formal activities included departmental meetings, project reports, site meetings, site visits, workshops and seminars; whilst the informal activities comprised informal get-togethers and social activities.

- Departmental Meetings: both the Safety and Surveying departments organise regular meetings for their staff to discuss relevant issues. According to the Safety Officer, *“about once a month, there’s a meeting in head office,”* where the safety officers can raise any issues they have
- Project Reports: at the end of each project, the Contracts Manager compiles a project report which is *“circulated around senior personnel, it would be lessons learned, both the good and the bad, innovative systems of work used, new contractors who were found to perform particularly well, so it’s a useful updating tool for senior management”*
- Site Meetings: the Contracts Manager holds a weekly site meeting for the on-site project team; *“it’s good to let everybody in the team know what’s going on because it’s very easy to go from one meeting to the next without speaking to everybody”*
- Site Visits: according to the Director, *“happen if something comes up and it’s relevant somewhere else, but also if a site manager is between jobs, one of the things we would ask him to do is look around and visit all the other sites, see what he can pick up.”* The Project Manager believes that direct experience of new systems and products is very important, *“you see it first hand, rather than being told it’s a great system, you can talk to the lads on site and they’ll tell you the problems or the issues...”* When working on projects in the Dublin area, the Safety Officer would visit a number of sites on a regular basis, and found them useful where *“something that turns up that’s new to you...you ask the question, see how it’s done, then you know for the next time.”* Site Engineer A described a visit to another project, *“the foreman and engineer brought us around the site on a Saturday, looking at pods, twin-wall, a couple of other new work methods.”* As these systems were going to be used on the current project he learned *“how it worked, we knew how to go about setting out for them...it’s helped lessen the*

problems.” The Contracts Managers felt that there was potential for more interaction between ongoing projects within the company, *“I think what would be of benefit and I’ve done it before, but not recently is site visits on current projects at particular stages, other substantial projects to see how things are actually going, there’s probably not enough of that done...but if it was promoted more it might be of better use to us all.”* He was of the view that all levels of staff have *“got something to learn from site visits, it’s just a case of finding the time”*

- **Workshops and Seminars:** the company organise workshops and seminars on a variety of topics including lessons learned, with the Director adding, *“we’d also take specific topics, somebody would take a specific seminar on cladding or metal stud partitions or DPCs, so we would have a series of these going on throughout the year.”* Site Engineer A described a typical seminar, *“you might get 8 – 10 people at them, around the table, about an hour and a half long and if you want to ask questions you can. You do learn from it.”* The Senior Engineer felt that interaction was somewhat limited at these seminars, particularly for younger staff, *“because they don’t know each other...if you’re a site engineer and you don’t know the person sitting beside you.”* The Project Manager was of the view that problem-solving workshops would also be of benefit, *“if you had an agenda with headings and ‘is this working lads, is that working?’ I think that would be interesting”*
- **Informal Communications:** the Contracts Manager keeps up to date on other projects within the company through *“word of mouth, there’s no newsletter or update report issued on a regular basis.”* Foreman B had a similar view, *“only through word of mouth, I wouldn’t visit them or anything like that.”* He then spoke about knowing people throughout the company: *“I’d like to think that I know quite a few people in the company still, but its constantly changing, yes, there are people I know that I can refer to, I can ring so and so and say ‘listen we’re getting doors from this company, have you ever dealt with them before?’”*
- **Social Activities:** according to the Contracts Manager, *“they have some social outings and do help to get staff together, and inevitably work is discussed.”* In terms of getting to know people, the Project Manager admitted that *“most people I know in the Cork office, I know them through the golf society”*

A recurring challenge to managing knowledge discussed during the interviews was the geographically dispersed nature of construction projects, which the interviewees spoke about in relation to a variety of issues. The project which the team were based on was over 150km from the company's head office in Dublin. In this regard, the Safety Officer discussed the problems of getting to training courses, *"there was a course, but I couldn't get up to Dublin at the time, I was down here."* The Contracts Manager felt that he didn't have as much opportunity to meet with his peers as he would if working nearer to Dublin, on knowing about other projects he commented, *"I'd have a reasonable knowledge, again because we're a little remote there, I wouldn't be coming across other staff members as frequently as I would normally."* Similarly, the Safety Officer stated, *"I'm not in around Dublin so you wouldn't hear any of the gossip, you don't hear what's going on."*

The concept of intra-organisational fragmentation was discussed by the project team in relation to head office departments, and on a regional basis. The Senior Engineer discussed the problem with sharing knowledge between departments and site in relation to subcontractor procurement, *"that initial information gets lost in the commercial department and never filters its way down to the site...they have learnt everything to know about them and where the problems are with them, and that information is never passed from one site team to the next."* Despite these problems, the Contracts Manager felt that there was adequate communications between sites and head office, *"I'd be the hub there really, but yes, there is. We'd have regular visits on various aspects of the head office departments, safety, IT, programming, services...they come down regularly."*

The regional structure of the company was described by the Director, *"we've offices in Dublin, Cork, Limerick and Galway, but there wouldn't be a whole lot of interaction between the regions, but once a year we meet and compare notes...there's probably more similarities than differences, but there are a lot of differences also, Cork have a different way of doing business to Dublin."*

"I don't know anything about Cork, Limerick or Galway. I know where the Cork office is," the Project Manager stated, *"we deal with plant in Cork the odd time, but that's probably because we're in Waterford, when you're in Dublin you wouldn't deal with them at all."*

Foreman A felt that there was potential to learn from other regions, *“I think it would be quite beneficial to go from Dublin to Cork to view places, sooner than going from site to site in Dublin, because they’re channelled into doing things the same in Dublin, where as Cork might have a different slant on things.”*

Building upon the findings and analysis presented in Chapter 4, the interviews confirmed a variety of activities associated with the processes for managing knowledge. Furthermore, the concept of intra-organisational fragmentation was confirmed as a significant barrier to managing knowledge in construction organisations.

5.2.7 Supportive Learning Environment

The requirement for a supportive learning environment was identified Chapter 4 as important in facilitating KM. Although it is difficult to define, the issue emerged throughout the course of the interviews in relation to training and development, quality management, longevity of employment, learning from experience and contact with directors.

In terms of the Supportive Learning Environment within the organisation, the Contracts Manager praised them, *“I think they’re good, they’ve a good attitude to staff, they support training, they support career development.”* Foreman A stated, *“I think they’re not the best payers in the world, but they’re inclined to try and look after their staff.”* Upon finishing college, Site Engineer B was *“offered two jobs and this company seemed to be a bit of a better deal, more involved in CPD with more of an emphasis on it.”*

Whilst Corrective Action Reports were used for reducing defects, the Contracts Manager discussed continuous improvement *“in terms of inefficiencies, we would always be looking for ways to carry out work, and that’s an inherent part of what we do, we look at new systems to see if we can do something more efficiently.”* The Senior Engineer spoke of the company’s quality management system, *“we have a quality audit twice a year, and a few things have come up that we’re doing inefficiently.”* Foreman B continued on a similar theme *“communication is good within the company, supervision and management are*

good, they've got ISO...but you know there will always be unseen problems, and it's not something that you'll eradicate."

On being committed to the company, the Project Manager who has been with them since graduating, made the following comment: *"I suppose I'm with them ten years, that probably answers that question, every year you think about "there's more out there" but when you come down to the brass tacks of it, it generally doesn't work out. So I suppose I'm happy enough at the moment."* Conversely, Site Engineer A spoke about people who joined the company with industry experience, *"they don't seem to stay that long, they come in for a job and they leave at the end of it...the people who stay come in from the start, as graduates."* Quantity Surveyor A who has also worked elsewhere commented, *"if you start out of college, and stay with them for 6 or 7 years, you will move up very quickly because you're in a set programme, but how many people do stay in the first job they go into out of college?"*

Having worked in construction for 40 years, the last 18 of those with Case Study A, Foreman A stated, *"they're quite good, they're quite loyal to their employees as long as you make an honest effort to do your work to the best of your ability and be loyal to them."*

At project level, it was noted by the Contracts Manager believes that *"there's a good team spirit here...however, this varies from project to project and from team to team."*

The ability to learn from experience is also hindered by the project-based nature of the industry. The Senior Quantity Surveyor discussed the importance of learning from experience, *"you'd hope that you're not making the same mistake twice, but every project is different, you might come across a different type or a different brand of problem that might in some way relate to it, but it's a totally different scenario. You shouldn't be making the same mistake twice, but..."* Quantity Surveyor B spoke of learning from the experience of others at seminars, *"they are all very beneficial because you're there and you have some of the directors sitting in on it and a couple of the managing surveyors there, they voice their own experiences with the presenter, you pick up a lot of stuff at them."*

The ability to draw upon the collective experience of staff in the problem-solving process was also viewed as important. The Project Manager felt that there was enough time given to problem-solving and reflection during the course of the project, *“if there is a problem we just get whoever is involved...and we’ve a wide range of people here with different experiences, like we have young people with new ideas, we’ve the foremen there, the old heads on site, there’s a good wealth of knowledge there.”*

The Senior Engineer discussed the potential to learn from experience, given the nature of the construction business, *“sometimes you do have time to reflect, sometimes you just don’t and most likely not. But then that’s the nature of it, if they win a contract, they’re not going to leave you sitting in the office here when you should be getting yourself set up on another site.”*

The company has a policy of giving all staff *“access to a director,”* according to the Director. However, as the company has grown in recent years, it has become more difficult, the Director admitted, continuing *“but we work hard at it.”* Foreman B finds the directors to be very approachable, *“they’re up to speed with what’s going on out there, they’re very approachable, my main person to deal with in the company is the director on this project, we have a good rapport.”* According to the Senior Quantity Surveyor, the annual appraisals with a director *“show that they’re interested in your career development and to be able to even get time from a director, because everyone is flat out, for them to even spare you time does mean an awful lot.”*

Overall, the company was praised by staff for its commitment to their development, with a supportive learning environment evidenced through employee commitment, good communications, learning from the experience of others and senior management support.

5.3 Management Presentation Findings

Following the compilation of the case study findings, a report was compiled and presented to management from the company in their Head Office in Dublin (a copy of the report and presentation are contained in Appendices G and F respectively). Those present at this included the Director, who had been previously interviewed, the HR Manager, who had assisted in administering the research, and the company's Administration Manager, who is also responsible for the Lessons Learned Database (LLDB). The author's supervisor also attended and actively participated in the discussion.

5.3.1 CPD

Given that much of the findings were focused on CPD, this was the first area to be discussed by the participants, with specific reference to the different professions and professional bodies, CPD for graduates and experienced staff, mentoring and seminars. The initial reaction from the Director to the research findings was as follows: *"quite a few of the things you've drawn up as problems are practical difficulties, our business is building and CPD is a side issue, albeit important, but you don't want to take the focus off what you're doing, getting that balance is difficult."*

The HR Manager discussed CPD accreditation, *"with Engineers Ireland it's very structured, there are seven criteria, and for a construction company there is a constant battle between trying to get the job done and the area of continuing professional development."*

In terms of professional bodies, the Director confirmed the survey findings stating, *"Engineers Ireland, the CIOB and the SCS would count for a very large proportion of our staff."*

The company have a training partnership with the CIOB, which according to the HR Manager, *"has worked particularly well for people who have come through the trade side"*

and become supervisors, going on then to general foremen or construction managers...the CIOB gives them a path which correlates with the career path we have here."

According to the HR Manager, *"we outwardly market our CPD to attract graduates in, but it's difficult to decipher who are the ones that really want a career in construction and who wants to use the company's training and then move on."*

"Just on the point of experienced recruits, that is an interesting one, they don't get as much training as the younger recruits but it's very hard to find appropriate training for them," the Director noted.

The HR Manager acknowledged this problem, *"there is a challenge particularly at the project manager level...they're still doing training, very much on the soft skills, they have the technical knowledge. There's probably a fairly well-defined career path for the younger ones, but with the project managers, it's definitely a challenge."*

The different approaches to CPD were considered by the Director, *"the quantity surveyors are appraised twice a year, engineers are appraised once a year, the engineers have mentors, the quantity surveyors don't."*

Differences at regional level were also highlighted by the HR Manager, *"if you research Cork, the quantity surveyors are probably more advanced on the mentoring side than the engineers, initially we trained the quantity surveyors and the engineers on the mentoring but then they went different ways. I suppose you're dealing with two different professions but definitely it is something we should look at."*

The discussion then turned to the timing and location of seminars, particularly as the interviewees found travelling to Dublin tiring. The Director suggested having seminars *"early in the morning."* The response to this suggestion was mixed. The HR Manager replied, *"the morning might be better because people are fresher... I think it would be better"*

“I think bringing the seminars to the sites, particularly on bigger projects would be a good idea,” the Supervisor added. *“But if you go to the site you end up with everyone from the contracts manager to the junior engineer all in one room,”* the Director responded. However, the Administration Manager was of the opinion, *“I think it would be good to have that mix of experience.”*

5.3.2 Induction

The induction generally lasts three hours and covers general company information, safety, quality and the K-drive. The Administration Manager commented, *“the part of the induction that I do is on the k drive, and is shorter than it used to be, now I just try to give people a feel for where they might find information on the network.”*

According to the Director, *“the huge issue we have in that regard is that we have a lot of systems for managing the way the company operates, and it takes quite some time and effort to get the hang of it.”*

5.3.3 Lessons Learned

The Administration Manager described the LLDB: *“they include photographs, contact details of the people involved, technical literature, and details of the project to put it into some sort of context. But often people would tend to focus too much on the problem, so I would have to go back to them and asked them to review the context.”*

The loss of context was something the Administration Manager has struggled with himself, *“I have presented some of the lessons learned, and some of them I’m not very familiar with...the best thing is usually to speak to the person who was involved in lessons learned in order to understand what occurred”*

The Director wasn't surprised by the low levels of LLDB usage, *"we should probably make that a bit more compulsory, we'll need to think about how we do it...but we are getting some good stuff through."*

"The issue of ease of access was a bit surprising," the Administration Manager noted, *"it's something that we could easily improve on, it could easily be converted into a more user-friendly database."*

The Director admitted that *"it's pretty easy to use, but I think we need to up the ante on it;"* he continued, *"they could be included on inspection and test schedule forms and have it as part of an audit, the QA audit..."*

Through the discussion, it was found that the Dublin and Cork offices have a separate LLDB and central server. The Administration Manager stated *"we're supposed to exchange lessons learned between one another but that has fallen by the wayside...we simply send them our files and vice versa... another difficulty is, if it comes from Cork we wouldn't know the context, the job, or the person who came up with it"*

Involving younger staff in lessons learned was discussed by the Director, *"on the Waterford site, we got some of the younger people to put together the lessons learned, rather than getting the contracts manager to do it, that worked extremely well...a surprising amount of detailed suggestions came up..."* He discussed taking this one step further, *"the idea of asking a young engineer to present the lessons to their colleagues, at least you'd be sure that one person would know what the lessons learned were!"*

The HR Manager felt that such an approach could have other benefits *"if they had to produce a lessons learned and present it that would be a challenge...and it would help with their presentation skills, because very quickly some of them will be doing it for clients... presenting themselves in meetings is something that they are measured on in the appraisals now, sometimes the hardest people to talk to are your own peers, so there is merit in that idea."*

5.3.4 Identifying Expertise

In terms of developing a database of staff expertise, the Administration Manager admitted, *“I actually toyed with the idea of having an additional field within our contact list in Outlook which included expertise.”* The Director wondered whether such a facility could be incorporated into the LLDB, *“is there any easy way to put that on the lessons learned? Could you put in some easy search facility to look for people?”* The Administration Manager replied, *“not as it is now, but we could manually extract those names.”*

5.3.5 Need for KM Framework

Towards the end of the session, the discussion focused on the concept of KM, the Director commented, *“it would be nice to see a template for how the whole thing works, the way it tends to happen is ‘lessons learned that is a good idea, we’ll set it up’ then we say ‘we have a project team database’ and they’re all completely independent... it will be nice to see the big picture...”* He continued, *“I’ve never sat down and looked at knowledge management, inductions, lessons learned etc and how all of this knits together.”*

In responding to the findings of the research, the management team highlighted a number of important themes. The company try to provide ample CPD opportunities for staff of all levels and professions, but struggle with the provision of learning opportunities for more experienced staff. The induction provides new recruits with some knowledge of how the company operates. Loss of context, LLDB usage, regional fragmentation and level of experience were all confirmed as determinants in engaging with lessons learned practices. The development of a staff skills database for finding knowledge merits further investigation and there is a need for a KM framework which integrates the various aspects of KM. It is anticipated that such issues will be dealt with during the analytical process in Chapter 7.

5.4 Summary

Based on a survey of professional staff, interviews with a construction project team, and a presentation to management, the main findings from Case Study A can be considered in relation to the stated research questions.

1. How effectively are the leading Irish construction organisations currently managing knowledge?

The company has developed lessons learned practices which include post-project reviews, a lessons learned database and lessons learned seminars. The impetus for the research contained in this chapter arose from the Director's interest in the use of the LLDB which had been developed. Contrary to his belief, referring to the database when a new subcontract package starts ranked lowest in terms of frequency of use. Whilst there are a number of problems with the lessons learned practices adopted by the case study, the research points to an organisation that recognises the importance of KM and is dedicating resources to managing knowledge.

2. What are the main strategic, cultural and technological issues that must be addressed for the adoption of KM in construction?

In terms of managing knowledge, the respondents confirmed the previously identified processes of creating, capturing, finding, and sharing knowledge. The main challenges to managing knowledge included geographical dispersion and intra-organisational fragmentation between project teams, departments and regions. Other issues of note include:

- Regular performance appraisals are a worthwhile and beneficial undertaking for both the individual and the organisation, providing an opportunity to appraise the individual's knowledge and identify areas for further training and development
- The use of IT is viewed as being integral to most people's work, and centres around email, Office applications and the company's central server

- The identification of expertise within the organisation is a challenge, particularly on other sites and in other regions, and appears to be influenced by the time spent working with the company
- The opportunity to meet with peers on a regular basis was found to be extremely beneficial by those who had the opportunity to do so, particularly in discussing recurring problems, new construction methods and company news
- The provision of CPD and learning opportunities, continuous improvement, employee commitment, opportunities for reflection, and access to senior management all contribute to a supportive learning environment within the organisation

3. Can construction professionals be encouraged to engage in KM through its alignment with existing organisational processes and activities?

There is evidence that the alignment of KM with existing organisational practices such as CPD can encourage construction professionals to engage in KM. Despite the recognised challenge of providing CPD opportunities, there is a high level of engagement with CPD activities such as induction, mentoring, training courses, seminars and site visits within the organisation, all of which is visibly supported by senior management. The company employs a relatively young and well-educated workforce, across a range of professions, with both the organisation and the professional staff valuing involvement with professional bodies. In attempting to understand the concept of KM and its implementation in construction organisations, the Director acknowledged the need to understand how KM integrated with existing practices. This is an issue which will be explored further in the thesis.

The findings from this case study shall be discussed in relation to relevant literature (Chapter 3) the emerging issues from Phase 1 (Chapter 4), and Case Study B in Chapter 7.

Chapter 6

Case Study B

6 CASE STUDY B

This chapter presents the findings of an action research case study which sought to improve the sharing of specialist construction knowledge within a leading Irish construction organisation's pharmaceutical division, whilst addressing the stated research questions (see Figure 23 for an overview of the chapter). Prior to considering the findings, some background information is provided, which emerged in an interview with the division's Director in Phase 1 of the research. Conducted during 2007, Case Study B comprised two cycles: the first cycle explores the sharing of knowledge between members of the Pharma Division's management team, discussing the technical aspects of cleanroom construction, the potential for previous knowledge to be exploited under the management contracting route and the need for a more formal approach to KM. The second cycle focuses on capturing lessons learned on a cleanroom project through a combination of interviews and a post-project review with the project team. The findings of both cycles were presented to a number of senior managers from the company; with the ensuing discussion also included in this chapter. At this juncture, it should be acknowledged that the opportunity to conduct this case study arose whilst supervising a minor dissertation on a taught MSc programme. The student completing the minor dissertation was working as a Contracts Manager with Case Study B on a multi-million euro cleanroom project at the time.

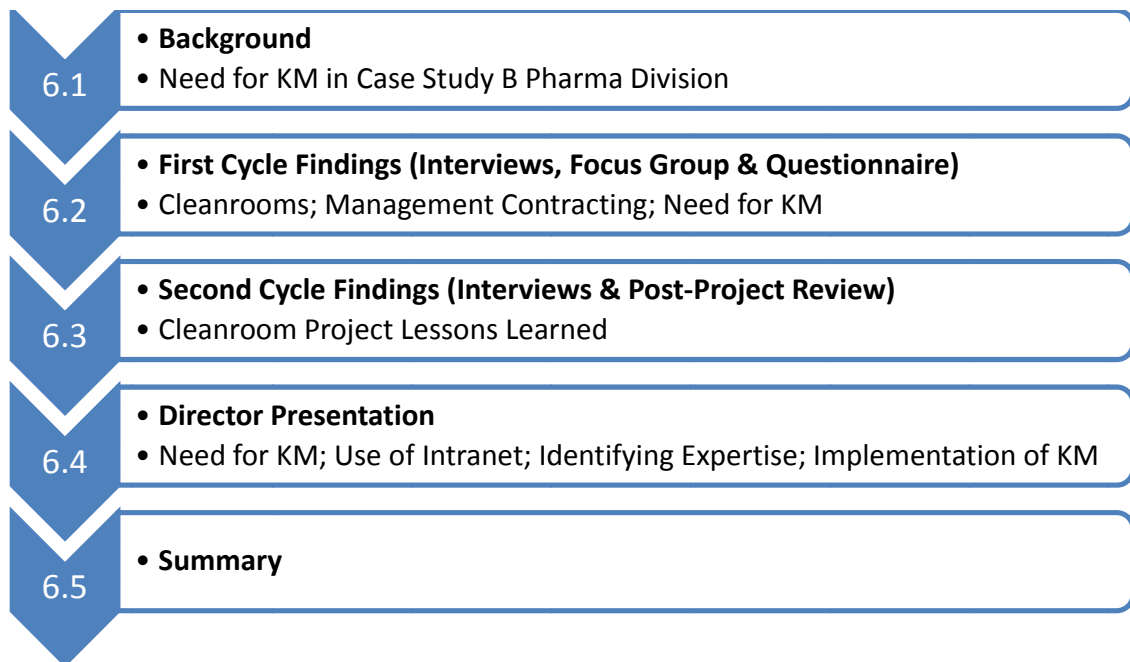


Figure 23: Chapter 6 Overview

6.1 Background

Case Study B have been retained by a number of pharmaceutical clients for cleanroom projects in a management contracting role, and have subsequently established a dedicated Pharma division. As part of the Senior Manager interviews (in Chapter 4), the director of the newly established Pharma division was interviewed regarding a number of issues related to managing and sharing knowledge, the following being a summary of some of the more pertinent points made by him:

- Management contracting *“gives you the opportunity to make a name for yourself, to prove that you have something to bring to the table. Where we find this useful is in repeat business because we get clients, when you offer the service, they like it, they see they’re getting value for money and they come back to you”*
- *“There’s a huge amount of knowledge out there, but a lot of it is staying in individual’s heads or even within the project teams.”* The company recognises the need to manage knowledge; it is *“something that we’re trying to do, but possibly would need more structuring”*
- Despite not having any knowledge sharing platform within the Pharma Division or wider organisation, the director believes that *“getting people together is very good”* for sharing knowledge. Particularly small groups comprising key people, *“if you get the knowledge in to the guy leading a project team, the contracts manager, it then filters down. But we probably have a fair bit to go yet, until we crack that one.”* A lack of time for busy construction managers was cited as one of the biggest impediments to implementing such a measure

It can be surmised that construction organisations such as Case Study B rely on the knowledge, experience and skills of their employees to execute these increasingly complex cleanroom construction projects as efficiently as possible. Fong and Wong (2005: 70) identify the transfer of knowledge across projects as a major challenge for construction organisations, stating that *“it is common for specialist and technical knowledge to become lost from one project to the next.”* Despite such challenges, Case Study B does not have any formal approach to managing their specialist knowledge of cleanrooms. It is clear that if they were to adopt a more formal approach to managing knowledge, their effectiveness as management contractors could be improved.

6.2 First Cycle Findings

An overview of the participant's profiles from the first cycle of action research is presented in Table 29, summarising their position, industry experience, experience with Case Study B, and value of their current cleanroom project.

Position	Industry Experience (Years)	Case Study B Experience (Years)	Current Project Value (€million)
Pharma Director	30	30	180
Senior Contracts Manager A	19	14	180
Senior Contracts Manager B	12	12	110
Contracts Manager A	18	10	55
Contracts Manager B	15	13	180
Contracts Manager C	16	15	100

Table 29: Knowledge Sharing Research Participants (First Cycle)

It is apparent from the evidence in Table 29 that Case Study B's Pharma management team all have substantial experience of the construction industry. Furthermore, all participants have spent 10 years or more working for Case Study B in a variety of roles. It should be noted that the Pharma Director, Senior Contracts Manager A and Contracts Manager B were all based on the same €180 million pharmaceutical project.

6.2.1 Interviews

The practitioner, hereafter referred to as Contracts Manager C, interviewed his colleagues over the course of two days in the company's regional offices in Cork and Waterford. The interviews focused on identifying recurring problems in the procurement and construction of cleanrooms through the management contracting route, and current and potential approaches to managing knowledge within the Pharma division.

Cleanroom Procurement & Construction

The respondents discussed a range of issues relating to cleanrooms including, finishes, services, the appointment of specialist contractors, commissioning and validation. A wide variety of problems have been encountered by the respondents in managing the construction of cleanrooms in areas such as floor, wall and ceiling finishes, the application of silicone, the integration of services into a cleanroom environment, services design and installation, ducting layouts, and setting and maintaining pressures. Much time was spent discussing the most appropriate type of wall and ceiling construction to use in a cleanroom, and all respondents agreed that a modular factory wall panel system and a grid ceiling system were preferable due to the quality of finish, speed of erection and improved services integration. The Pharma Director spoke about his current project where *“the client was insisting on using stick built with plasterboard because an equivalent plant in Europe was built that way. Weeks were spent proving that the modular wall system was cheaper and better, particularly because the quality of plasterboard contractors in this country leaves a lot to be desired.”* The timing of the appointment of the cleanroom contractor was viewed by all as a very important issue, with all agreeing that this should happen as early as possible in the project. Senior Contracts Manager B stated that *“the cleanroom contractor needs to be involved in the early stages of design before the mechanical and electrical contractors are appointed.”* Based on their experience, a number of the respondents felt that the cleanroom contractor should supply and install all fixtures and fittings within the cleanroom. This did not happen on Contracts Manager C’s project and thus required his project team to undertake considerable coordination of all subcontractors and suppliers within the cleanroom project. The commissioning and validation process was also viewed as being highly problematic, with a lack of time within the construction programme for this intensive process being a major issue. Early commencement of commissioning and validation, the issuing of documentation, and the role of the client in the process, were also viewed as areas where improvement was required.

Management Contracting

All respondents indicated that their projects were procured under management contracting, with the exception of Senior Contracts Manager B, who stated that the client was indecisive when it came to the selection of a procurement route. He noted *“because of the delay in*

selecting the procurement path, there was 6 months lost on pre-construction and coordination which was a big mistake.” As a management contractor, it was found that the level of experience of the client with this procurement route, and indeed, in building in general, has an impact on the outcome of the project from Case Study B’s perspective. In most projects, Case Study B have been appointed approximately 6 months before starting on-site, allowing for their experience and knowledge of buildability issues to be used in the design process. There was general agreement that management contracting is the best procurement route for such large scale, fast track projects. The main complaint from all respondents was that the design process was frequently behind schedule, thus impacting on the construction schedule.

Knowledge Management

In commenting on the current approach to sharing knowledge, Contracts Manager A commented, *“it’s not too bad within the Pharma division but within the organisation as a whole I would say that it is poor. The Pharma division with the size it is at the moment, we can talk and visit each other as the division gets bigger and expands; this is going to get more difficult.”*

According to Senior Contracts Manager B, *“the knowledge is there within the people’s heads but sharing it only really happens when you go and ask a question.”* He added, *“there is no forum for sharing knowledge even though there is a valuable pool of information and experience within the organisation.”*

It was acknowledged by all that knowledge sharing within the Pharma division was relatively informal, and there was a consensus that a more formal approach to KM was needed in order to develop and maintain a competitive advantage over rival contractors. The Director felt that *“by standardising the way we do things, we can reduce mistakes and demonstrate our expertise to clients and design teams.”*

Contracts Manager A continued this theme by stating, *“as it [cleanroom construction] is reasonably specialised, it would be particularly useful in situations where we do interviews, to bring someone along that has done a similar project who can demonstrate to*

the client that we know how to manage them.” Senior Contracts Manager A was of the opinion that “you would certainly gain a reputation for managing and coordinating pharma projects better. At some stage you will get the competitive advantage.” This was a theme continued by Senior Contracts Manager B: “it will help us, it will save us money, it will make our job more efficient.”

In making suggestions for sharing knowledge, a number of activities were discussed, including site visits, project reviews, and regular knowledge-sharing sessions. In terms of site visits, Senior Contracts Manager A stated that *“most people learn more by doing a walk and seeing similar issues on other projects. It is important for people when they are at the early stages of a project to visit another job that is nearly finished.”* Having a specific need is highly important when it comes to site visits, according to Contracts Manager A, *“unless I have something specifically to gain I don’t gain as much, if I am in a situation where I am starting a job I know what I need to gain, I can go to that job and get it which is more beneficial”.*

A number of respondents indicated that they have conducted post-project reviews in the past, but very much on an ad-hoc basis. Contracts Manager B spoke of one of the main challenges in this regard, *“you would always hope to do lessons learned at the end of a project but what generally happens is that people kind of move on and the project finishes over a longer period and at the end you are on your own!”* Despite no formal lessons learned procedures, the Director commented that *“there is a realisation that it would have a benefit to others involved in similar type projects.”*

The willingness of people within Case Study B to share their experiences with others was also discussed, and all agreed that there was a culture of openness and willingness to share experiences within the organisation. However it was interesting to note the comments of Senior Contracts Manager B, *“it is always nice to know a little bit more than your peers but you don’t want to see any of your colleagues missing out,”* he continued, *“there may be a reluctance to divulge mistakes even though we have all been involved in projects where mistakes were made!”*

The interviews yielded a number of noteworthy issues, specifically that cleanroom projects present significant challenges in terms of finishes, services, management of specialist subcontractors and the commissioning and validation process. Management contracting provides an opportunity for Case Study B to utilise their previous experiences in the design process. There is a need for a more formal approach to KM within the Pharma Division and the wider Case Study B organisation, with site visits and post-project reviews viewed as areas for potential in this regard.

6.2.2 Focus Group

Based on the interview findings, an agenda was developed for the focus group with particular emphasis on the appointment of the cleanroom contractor, recurring cleanroom design and quality issues, commissioning and validation, Case Study B's role as a management contractor, and the development of KM within the Pharma division (see Appendix H). Moderated by the author, the participants for the focus group included all of the interviewees, with the exception of the Pharma Division Director who was unable to attend. Prior to commencing the focus group, the moderator gave a presentation to the group introducing himself, outlining the purpose of the session, the role of the moderator, and the need for KM. Contracts Manager C also gave some background to his research and the €100 million cleanroom project which he was managing in Clonmel, Co. Tipperary. The participants were advised that the focus group was going to be audio and visually recorded. Finally, some ground rules for the session were stated, including the need for an open discussion, there were no right or wrong answers and not to interrupt others when speaking. Individual introductions were conducted to give the moderator an understanding of the participant's experiences. Through facilitated discussion, the high-grade knowledge identified in the interviews was further refined and consolidated during the course of the focus group.

The following points reflect the consensus of the Pharma division's management team who participated in the focus group:

- Cleanroom contractor appointment: the cleanroom contractor employed by Case Study B should be appointed as early as possible, although the timing may vary; this is dependent upon project-specific issues. It was proposed that the need to do this should be documented and presented to the client, based on previous project experiences
- Design and quality issues: it was originally intended to discuss a range of issues relating to finishes and services, however, after a lengthy and comprehensive discussion on floor finishes, it was realised that a three hour focus group would not suffice to discuss all issues related to finishes and services. In order to reduce problems with these issues, it was agreed that quality alerts be compiled and emailed to all Pharma staff on a regular basis, lessons learned documented and posted on Case Study B's newly established intranet and site visits arranged at various stages of projects to share experiences
- Commissioning and validation: it was agreed that there is a lack of expertise within Case Study B in the commissioning and validation domain, and that the recruitment of specialists and training of existing staff in this area is required. In addressing problems of setting pressures, relative humidity and temperatures during commissioning, it was suggested that a window should be left in the programme to get systems up and running. Commissioning and validation meetings should be started during pre-construction, with the focus group agreeing the following agenda: scope, strategy, schedule and critical path, sequence of critical items and systems, design documents, procedures and personnel involved, approval sequences, documentation contents and test pack formats and system boundaries
- Management contracting: in order to be more proactive with the client and consultants in relation to design changes, it was proposed that Case Study B have an individual working in the design office. Through this approach, buildability issues could be considered earlier, problems pre-empted and information requirements defined

- Knowledge management: the group agreed for the need to develop formal procedures for KM within the Pharma division, and indeed the wider organisation. Based on initial feedback at the focus group, all agreed that such a structure for knowledge sharing was particularly useful and would encourage attendance at future KM activities.

There was also a discussion relating to individuals not sharing knowledge in order to have a competitive advantage, but everyone felt that this is not the case in Case Study B. They concluded that the environment and culture within the organisation meant that everyone is willing to share their experiences.

The focus group provided the participants with the opportunity to consolidate the findings from the interviews, confirming many of the issues relating to cleanrooms and management contracting. By taking a context-specific perspective (i.e. cleanroom projects within Case Study B), the participants recognised the need for a more formal approach to KM.

6.2.3 Questionnaire

Following the focus group a questionnaire was circulated to the participants, the main purpose of which was to evaluate the focus group as a framework for knowledge sharing within the Pharma division. The participants were asked five simple questions relating to the focus group and KM, outlined in Table 30.

Question	Contracts Manager A	Contracts Manager B	Senior Contracts Manager B	Senior Contracts Manager A
1. On a scale of 1 to 5, how would you rate the focus group (5 being the most beneficial)?	5	4	4	5
2. Do you think there is potential for future use of a focus group within Case Study B and the Pharma division?	Yes. Identify key people & agenda	Yes. Need agenda & central location	Yes. Agree strategy & topics	Yes.
2a. If yes, how often should we meet to have a focus group?	Twice a year	Once a year	Twice a year	Three times a year
3. In order of importance, what methods are best for sharing knowledge in the pharma division?	Presentation Site visit Focus group Lessons learned	Site visit Focus group Lessons Learned Presentation	E mail alert Lessons learned Site visit Focus group Presentation	Lessons learned Site visit Presentation Focus group
4. Do you think that such knowledge sharing methods could lead to the improved delivery of Pharma projects?	Yes	Yes. Help with schedule to reduce issues.	Yes	Yes. Conclusions should be taken forward as "policy".
5. Is there a need for our Building Service engineers and senior staff to receive training in commissioning validation?	Definitely	Definitely	Maybe. Also bring in new people.	Definitely

Table 30: Focus Group Evaluation

All participants agreed that the focus group was of benefit to them and that they had learned a lot from such an approach to sharing knowledge. They were unanimous in their view that such an activity should become a regular occurrence within the Pharma division. In order for this to happen, it was suggested that a strategy for KM should be developed and agreed,

and an agenda developed for the focus groups on relevant/specific topics. Contracts Manager A suggested that, depending on the topics, other key people within the division should attend, including building services engineers, foremen etc. Again, all felt that knowledge sharing methods such as the focus group, lessons learned, email alerts and site visits could improve the delivery of Pharma projects, with Senior Contracts Manager A stating that any major conclusions derived from such activities should be “*taken forward as policy.*” In order to improve the knowledge stocks of the Pharma division, training in the area of cleanrooms, and particularly commissioning and validation, should be provided. Senior Contracts Manager B also suggested that the division should explore the possibility of hiring people who specialise in commissioning and validation.

6.3 Second Cycle Findings

For the second cycle, the purpose was two-fold; firstly capturing the lessons learned on a €100 million medical devices project, and secondly on aiding the further identification and confirmation of the emerging issues through the exploration of current and potential KM activities, CPD, use of IT and organisational culture. The project was based in Clonmel Co. Tipperary. It was completed over three phases on an existing medical devices facility, and consisted of the construction of cleanrooms, offices, canteen, laboratories, a central utilities building, civil works and car parks, warehousing, a 38 KV sub station, and modifications to existing buildings. Case Study B were awarded phase 1 of the project in 2004, and negotiated the remainder of the works with the client, comprising a total programme of 3 years. Due to the works being carried out in an existing facility, the work was handed-over on a phased basis, leading to additional complications due to the nature of the work in extending an existing, live production facility.

Following discussions with the collaborating practitioner (Contracts Manager C), participants for the second cycle were identified from the project team, whose experience is evidenced in Table 31. These included the Contracts Manager himself, the Site Agent, Foreman and the Building Services Engineer, all of whom have been involved in the project since it began on-site in August 2004.

Position	Industry Experience (Years)	Case Study B Experience (Years)
Contracts Manager C	16	15
Site Agent	23	19
Foreman	16	11
Building Services Engineer	7	7

Table 31: Lessons Learned Research Participants (Second Cycle)

6.3.1 Interviews

The semi-structured interviews with the four members of the project team sought to identify the main lessons learned on the project relating to a number of technical and management issues, including cleanroom finishes, services integration, commissioning and validation, handover and snagging (see Appendix I for interview questions). In order to aid the identification of emerging issues and the development of the KM framework, current and potential knowledge management activities, engagement with CPD and use of IT, were also discussed.

Lessons Learned

The following is a summary of the main lessons learned identified during the interviews:

- Cleanroom Finishes: there were numerous problems identified relating to floor, wall and ceiling finishes as well as the use of silicone for sealing joints. The protection of such elements was viewed by all as being crucial whilst construction work was ongoing. The Foreman commented, *“it’s inevitable that there’s going to be a certain amount of damage, but the repairs to the wall panels and floors were a big issue.”*
- Cleanroom Services: according to the Site Agent, the integration of services, such as lighting and sprinklers, into the cleanroom proved problematic, *“there was a lot of overhead traffic which caused recessed fittings to fall out, and lights and diffusers to drop.”* The Building Services Engineers highlighted an issue with the sprinkler heads and their compatibility with a walk-on ceiling: *“if you stepped on the ceiling overhead, you were putting the sprinkler below under pressure and over time the sprinkler caps popped off...we ended up having to retrofit a lot of the sprinklers with brackets at our own cost.”*
- Building Management System (BMS): due to the phased nature of the project and close proximity to the client’s live production plant, there were problems with alarms and the BMS; with the Contracts Manager commenting, *“there were problems with spurious alarms...the client ended up getting hundreds of warnings and ignored them...we got a lot of grief with that.”*

- Commissioning and Validation: with the various protocols and high volume of documentation, the commissioning and validation process was challenging for the Building Services Engineer, *“the process is unbelievable...it’s massive and you require up to six signatures from the client side; compliance, quality, facilities, software, QA, and a BMS specialist who all have to review the documentation and approve it before the work can actually start.”*
- Handover of Phased Work: there were a number of cases where people had to work over live cleanrooms in order to make connections to the new phase; this led to problems with leaks and items falling into the existing cleanroom. According to the Foreman, *“it’s awkward because you don’t want to be gowning up and going in doing work in a live cleanroom environment.”*
- Snagging: the Contracts Manager felt that the process of snagging which involved numerous subcontractors, client representatives and themselves could have been improved, *“we need to sit down and develop a strategy for snagging a cleanroom...it needs to be rationalised an awful lot.”*
- Subcontractor Performance: the Site Agent felt that the ordering of specialist cleanroom materials lacked coordination, *“we couldn’t finish and seal the room until we had everything in...there was a three to four week delay on doors.”*

In a similar vein to the first cycle numerous lessons were identified by the interviewees relating to cleanroom finishes and services, commissioning and validation, and managing subcontractors.

Current and Potential Knowledge Management Activities

Having discussed the lessons learned on the cleanroom project, the interview questions focused on the wider issues of existing approaches to managing knowledge and the potential for a more formal approach to KM. The Contracts Manager discussed his frustrations with the company’s current approach to sharing knowledge, in particular, the lack of leadership: *“it’s not great, even with a lot of these big projects that we’re pricing at the moment we’re reinventing the wheel...individuals and groups are doing their own thing, and are not able to converse with anybody else. You’re trying to find out who did similar projects, and they don’t always have the time to give you the information...but say those*

facts are put upon the intranet, who was on the project, the main features, how it was built and maybe just one quick call to confirm something and not take up too much of the guys time...I think we still have a good bit to go in that regard, but I don't know if it will ever get to the stage where they appoint a knowledge manager. There's a long way to go yet... there's definitely merit in it, but it needs a leader."

The Building Services Engineer felt that knowledge sharing was quite poor at present, *"I don't have any interaction with my opposite numbers on the other cleanroom projects, but hopefully if we all use this resource on the intranet that would help alleviate some of the problems."* However, the Foreman was of the opinion that knowledge-sharing between projects *"wasn't great...but then again if something came up I know I could make a call, contact the lads on another project."*

Whilst the Site Agent acknowledged that knowledge-sharing was good on an informal basis, he added *"it might be no harm to have a more formal system or approach. I think it would be good for staff to sit down and discuss recurring problems and look at ways around them."*

In terms of opportunities for sharing knowledge, the Contracts Manager felt that *"it's actually getting time to do it is the problem, I would have liked to have gone to another project to look at the cleanrooms there, I think there is merit in doing it, but unless you have a specific reason for doing it, you're not inclined to...it's something probably in hindsight I should have done with the key staff, it would have been a good idea and it's definitely something I would do in the future. But when you're getting out of the ground doing foundations, rebar, concrete, etc., it's the last thing you think of...but you should be able to make the time."*

Reflecting on the need to capture lessons learned, the Contracts Manager commented, *"I suppose if I was back on a job of that scale and complexity again I would probably set up a file for lessons learned as they happened, rather than going back through e-mails and reports, and then to be able to disseminate that throughout the company on the intranet or by other means."* He continued, *"you can't write everything down, as long as you catch*

the major issues and share them with everyone else. With all the QA documentation we have, such as non-conformance reports, it would be good to have a log of all the lessons learned. But I suppose it is a challenge...we have a lot of documentation, quality, health and safety, environmental, all of which has to be kept up to date as part of our ISO accreditation."

The Foreman was of the view that post-project reviews should be conducted on all projects, *"if people come up against a problem on a project and the same problems happen 50 miles down the road in another project, six months later, it's ridiculous...for the sake of a get together like that, just to eliminate those problems."* However, he acknowledged the problems of conducting such as review at the end of a project, *"when it gets to the stage at the end of a project, things start to dwindle, fellows move on to new projects and you're handing over to the client, so it's hard."*

Post-project reviews were viewed as being potentially useful by the Building Services Engineer, *"but it depends on where the information goes after the review. If we all have a discussion about it, that's fine...I think it's more about where the outcomes of that review go, how readily accessible it is and how well it is utilised elsewhere."*

Based on their experiences, it is apparent that the participants recognise the benefits of a more formal approach to managing knowledge. Further discussion in this regard focused on the use of site visits, problems due to regional fragmentation and the importance of meeting with peers to share knowledge and experiences.

Site Visits

The Site Agent felt that site visits were useful *"if it's something that you haven't seen before and you're going to be getting into it. Just to meet someone who has gone through all of that before, and they fill you in on the pitfalls and you get a good idea of what's coming up."*

The Building Services Engineer felt that site visits needed to be relevant in order to be effective, *“if you knew that things were going to be very similar between the two projects, then that would be very applicable...I think relevance is a big issue.”*

The Foreman has not visited other sites, *“but I think it would be good to see how things are done elsewhere. He continued, “you can’t beat seeing it there hands on, one visit for an hour, just to see it and have a chat with the guy involved. If I was back at the start again I would ask to go see another cleanroom project.”*

Site visits were viewed as being a useful learning experience as long as they presented the individual with new and relevant experiences. The opportunity to discuss specific aspects of a project with a counterpart, whilst on-site, was seen as invaluable by the Foreman.

Regional Aspect

“I don't know what is going on outside of the southern region,” the Contracts Manager commented, *“you have the southern region, Cork and Waterford, you're employed in that region and that's it, but sometimes if there is a big job on somewhere, some staff might be moved between regions. Apart from that, the regions all have their own setup with their own boards.”*

In terms of knowing what projects are ongoing within the organisation, the Site Agent commented, *“I mostly know what's going on within our own region because you would hear things from other people on an informal basis... I would not know what is going on with regards to the road projects or in other regions. Particularly when it's not relevant to you, you are less interested in it.”*

The Foreman admitted that *“because I worked in Dublin I would know some of the people up there; I wouldn't know people in the other regions because I haven't worked there.”*

As in Case Study A, the regional divides within the organisation were highlighted as inhibiting knowledge sharing across the organisation.

Meet with Others in Similar Positions

The identification of expertise is an issue that the Building Services Engineer discussed: *“I would have liked to have spoken to other people before starting this project. Any queries I have had, I have directed them to my immediate boss within the building services department...you might not always get the right person with the knowledge that you're looking for, but he would be able to put you in touch with other people within the company who would have particular expertise.”*

The Contracts Manager spoke about meeting with others in similar positions, *“the only time it really happens is at the annual safety conference, where everyone gets together for half a day...these events also provide an opportunity to talk with people that you might not see on a regular basis, over lunch and then all of a sudden you find out that someone you haven't seen in years is working on a project that is of interest to you.”*

The Site Agent also identified the safety conference in this category, though not as useful as above, where *“you might meet guys who are in the same position as you, but in general no, that doesn't happen.”* However, he added that recently there have been *“a few seminars on things like purchasing... all our purchasing is done through the Cork office now, so we had a seminar on that with the girl who does all the purchasing and that was good.”*

The Foreman spoke of a similar seminar he had attended in Dublin, *“about purchasing and it was great, for the sake of an hour there I learned a lot, with everyone having their input. It was specifically about purchasing and the COINS system, different lads on different sites have their own habits and the purpose was to try and standardise our approach...I found it very good, it was an open discussion and we were able to get our point of view across also.”*

The Building Services Department *“meet once a year for a building services seminar, where guest speakers are brought in, it's a good opportunity to learn...its useful information. It is very structured, we usually have a Q&A session with the guest speakers and workshop sessions around particular topics, for example looking at how to improve temporary electric installations on site and we would discuss that in groups.”*

The opportunity to meet with others in a similar position was viewed as invaluable by all of the interviewees, particularly where there was an opportunity provided to discuss recurring problems.

Continuing Professional Development

In relation to training the Foreman noted, *“the training department keeps you well informed in that regard...I've done a lot of safety training, scaffolding that kind of thing, they're very good on it.”*

The Contracts Manager discussed CPD within the organisation, *“we have a training manager in head office and every member of staff has a training programme, which is particularly good for the younger staff. Some of the more senior staff would be mentors to the younger guys and they have a training manual, with different levels of progress. So I would be mentoring two or three of those guys, and biannually we would meet up to review progress and look ahead to the next six months and I would report back to the training department on that. So that's a good system for young staff to progress through.”* He continued by discussing the different approaches to training and CPD depending on experience, *“generally there are different types of training depending on the level you are at within the company, but it does depend on whether you're a surveyor, an engineer... there are some differences.”*

In this regard, the Building Services Engineer spoke about career progression, *“we have our own career path within the building services department, there is junior building services engineer, building services engineer, and I would be at the first level of senior building services engineer. We have annual appraisals where there are different tasks which would have to have completed over a period of time, which dovetails with our professional development with CIBSE (the Chartered Institute of Building Services Engineers).”*

Case Study B has a well-structured approach to CPD, with training and mentoring, performance appraisals all feeding into staff development. The individuals role, experience

and management level within the company appear to dictate the type of CPD that is engaged with.

Use of IT

In discussing his use of IT, the Contracts Manager commented, *“day-to-day it would primarily be e-mail, using Word from time to time to do up a letter, mainly e-mail, but sometimes using TeamPlan to develop programs and progress reports.”*

The Site Agent admitted that he doesn't use computers much, *“to be honest I mainly just use the e-mail...I spend most of my time out on site, not in the office.”* Similarly, the Foreman does not use a computer in his day-to-day work, *“I'd be more of a hands-on man and I'd rather keep it that way! Any e-mails that I need to see, the lads in the office just print it off for me. I don't want to spend a day in the office on the computer.”*

The Building Services Engineer uses computers *“fairly extensively, we have our own site server, we have a network... so that has become the norm over the years because of external pressures from clients, design teams etc. where e-mail communication dominates.”* In terms of software applications, he continued, *“I'd use all the basic packages Word, Outlook, Excel, as well as some of the project management systems such as PowerProject.”*

As with Case Study A, email and office applications dominate in terms of IT, however Case Study B have also recently developed an intranet for staff. The Contracts Manager expressed some reservations about the intranet, *“there is still a bit of a way to go before it is suitable for people to use... there is some information on it, but it's sparse enough at the moment, there are standard templates on it for letters, presentations and things like that. They need to put more on it and make it more user-friendly.”*

In relation to the intranet, the Building Services Engineer commented, *“the building services department is setting up a lessons learned section on the intranet, but that will only be as successful as the amount of information posted by people...it's all about the input really.”*

Despite its recent introduction, it appears that Case Study B intend to utilise the intranet for KM, with a lessons learned section currently under development.

Organisational Culture

A recurring theme throughout the interviews was the supportive culture in place within Case Study B. In discussing his experiences, the Contracts Manager commented: *“I find them very good, obviously I’m with them a long time so I have a good experience of the organisation and how it works. I find them very good to deal with, there’s great backup there... I’ve no problems, they’ve always been good to me, granted you do have to travel a bit, but that’s the nature of construction.”*

The Site Agent spoke of his experience of working with Case Study B, *“I find them very good to work for... I’ve had a lot of offers from other companies... what I find with them is that you get plenty of backup, they’re good that way and they look after their staff.”* This was a theme continued by the Foreman, *“there is good support there, and on this site there is a good team working here.”*

In terms of the presence of a knowledge-sharing culture, the Contracts Manager stated, *“I think we have a good culture...people are generally willing to share their knowledge with you if you have a question.”*

Whilst some people may view ‘knowledge as power,’ the Site Agent admitted, *“I wouldn’t find that here, they are very good for sharing knowledge. Anyone I have ever dealt with has been really good and told me exactly what I wanted to know.”* The Foreman was of a similar opinion, *“I find the company good throughout, with regards to sharing information and knowledge.”*

As can be seen in the above comments, it is clear that a good organisational culture is important for supporting knowledge sharing within the company.

6.3.2 *Post-Project Review*

With a wide variety of issues identified during the interviews, these were consolidated and refined into an agenda for a post-project review meeting, in the form of a focus group. The participants in the focus group included all four individuals who were previously interviewed. The aim of the session, which lasted for approximately two hours, was to consolidate the individual team members learning, and identify the main lessons learned on the project. Prior to commencing the review, the author (acting as moderator) explained the purpose of the focus group and the importance of lessons learned, discussed his role in the process, and highlighted issues surrounding recording and confidentiality. The main findings of the review included:

- Cleanroom wall panels need to be properly protected
- A template should be made for cut-outs in the walls as considerable time and money was spent on repairs
- A 1200mm x 600mm grid system is the preferred option for a walk-on ceiling
- The company need to consider the extent of silicone sealing required when pricing a job
- A recommended list of light fittings, filters and sprinkler heads needs to be identified, as a number of these were found to be incompatible with the ceiling system
- The HVAC system's capacity and efficiency should be checked during design
- A clear protocol should be agreed with the client for commissioning and testing of alarms and the building management system
- The commissioning contractor needs to appointed as early as possible and a window left in the programme for getting the system up and running, and for testing it
- Procedures should be developed for people working in areas that have been handed over to the client
- A strategy for snagging needs to be agreed with all subcontractors, the client and design team

At the end of the focus group, all participants agreed that they had learned a lot from one another and that a post-project review should be undertaken after every project. Based on the post-project review, a LL report was composed which included a title, project details, contact details for the project team (see Appendix K). The actual lessons were categorized

under a number of key headings including flooring, walls, ceilings, use of silicone, lighting, sprinkler heads, HVAC, alarms, services integration, commissioning & validation, handover of phased work and snagging.

6.4 Director Presentation

Upon completion of the research, the findings, along with some recommendations for improving KM, were presented to a number of senior managers from Case Study B. This involved a presentation by the author and the collaborating practitioner (Contracts Manager C) to the Director of the Pharma Division, a Regional Director from the Cork office and a Regional Director from the Waterford office (who was also involved in Contract Manager C's €100 million cleanroom project). A lengthy discussion followed the presentation involving the above people from Case Study B, the author's supervisor and two other academics with an interest in the research; Academic A, who leads a part-time MSc in Construction Project Management and Academic B, who leads a BSc (Hons) in Quantity Surveying and is heavily involved in the CIOB and SCS. This unstructured discussion was recorded and used to guide further research, and contribute to the emerging issues. The discussion focused on a number of areas, including the need for a more formal approach to KM, identifying expertise within the organisation, learning from experience, the use of the company's intranet and the implementation of KM practices.

The Need for a Formal Approach to KM

Initial discussion centred on the use of a bi-annual knowledge-sharing session in the form of a focus group, with the Cork Director commenting, *“that's definitely a good idea, because we certainly have a lot of experience and we very seldom get time to actually share it...there is knowledge gained and sharing it is the difficulty.”*

All of the senior managers agreed that a more formal approach to managing knowledge was needed, with the Pharma Director noting, *“we've talked about this over the years, where we have ceramic tiles coming off a wall down in a hotel project in Waterford and then hearing that the same problem happened in Galway, and then we all say that we need to share this kind of experience, but it's haphazard, you might send the odd e-mail around, and the only*

place that has happened is in the safety department, where it is very focused. It was suggested before that the guy in the QA department would lead up something like this...but when you have a problem on a job the last thing you think about is sharing it, because you are so focused on solving it!"

Contracts Manager C also spoke of how the safety department shares knowledge, *"the safety guys are quite good at that kind of thing, I remember at the annual safety conference one or two of the guys got up and spoke about their experiences...this is what we did wrong, learn from it, I found that very good."*

With regards to sharing mistakes, the Pharma Director commented, *"if you want to share something that was done incorrectly and you found a solution, there is a certain reluctance to stand up and say that!"* To which Contracts Manager C responded, *"yes, we discussed that, even with the safety guys, they keep it very anonymous, so for example if they are talking about a project where the jib fell off the crane, they keep it anonymous and don't mention the actual project."*

Organising regular knowledge-sharing sessions was viewed as potentially useful by all involved, however the Pharma Director noted, *"of all the people I have come across, Arups are big into sharing knowledge, they have these lunchtime briefings, where all the guys in the office discuss particular issues...to a certain extent that's easier for a company where all the guys in one office, but we've got people scattered around all over the country."*

Based on his experience of delivering a part-time MSc programme, Academic A stated, *"if you could flag dates for particular sessions, so people knew well in advance that the knowledge sharing session was coming up, they can plan around it...and if you're a member of a professional body these things can count towards CPD...these things can work reasonably well, once they can see the benefit from one or two of the sessions they will be more inclined to attend the next one."*

In terms of structuring such sessions, the Pharma Director felt that the approach adopted in the first cycle of research was most appropriate, *"maybe the way to do it is target*

particular sectors, rather than trying to share knowledge throughout the whole organisation, you look at specific issues such as cleanrooms,” he continued, “I think it’s relatively easy to manage knowledge in a specific area because it’s quite focused and there’s only certain types of industries that use it, but you try and share knowledge on steel fixing, that’s some challenge!”

Utilising experience from previous projects when tendering for work was a recurring theme during the discussion, with Contracts Manager C stating, *“at the moment the company is tendering for shopping centre developments in Kilkenny, Wexford, Carlow and Waterford, all of which include large basements, and in a way we are reinventing the wheel with regard to basement construction...”* The Waterford Director added, *“we’re trying to come up with the best solution for basement construction and there are four different groups looking at these four projects, but there are a lot of common themes...but we’re working together now and collating all of the information... so you have all of that next time a similar project comes up.”*

Further discussion centred on the changing role of the main contractor in the Irish construction industry, moving from the traditional procurement route towards design and build and management contracting. The Waterford Director cited a preference for such procurement routes, because *“we have more input and control with the design team and we get them to produce the information to suit the construction.”* Referring to the development in Kilkenny, he commented, *“they want to appoint a contractor as early as possible and get them on board and involved in the design process. Now it’s not a design and build, but they wanted the contractors input, which is great.”*

The participants recognised the need for a more formal approach to KM, citing the possibility of regular focus group sessions as a mechanism for sharing valuable knowledge and experience across similar projects.

Use of Intranet

The use of the company’s intranet for KM was considered during the discussion. Contracts Manager C spoke about its potential use in this regard, *“if I go back to other projects I’ve*

been involved in, I have a fairly good idea of the standards required for fair-faced concrete, but unless I give that to someone else or put it up on the intranet it's lost...even if you had specific headings up on the intranet, with contact details for those type of projects, who to ring if you have a problem..."

There was some resistance to posting information on the intranet, with the Waterford Director stating, *"you end up with loads of information but no one ever reads it."* The Cork Director added, *"certainly from my age level, putting that information and knowledge upon the intranet is pointless because it will just get lost and won't be used... it gets left there!"* However, Academic B felt that such use of the intranet would appeal to younger professionals, *"if you had all of that in a repository, that could act as CPD for younger staff...all of the disciplines, the SCS, CIOB and EI have requirements for professionals to do a certain amount of CPD, the intranet would be an excellent and easy way of fulfilling that."*

The intranet was seen as a useful repository for storing documented knowledge, and although reservations were expressed about information overload, the stored knowledge was seen as offering a means of CPD for younger professionals.

Identifying Expertise

The identification of staff with particular expertise was discussed by Contracts Manager C, with the potential of using an online people finder tool on the company's intranet, *"it doesn't even have to be that much information, just that I was involved in such and such a project with fair faced concrete and my contact details, and the next guy can give me a ring, come down and meet me, have a look at things..."*

The Cork Director noted that *"we have experienced that with Arup on projects where they have brought in staff with particular expertise from the UK, they have that experience, a wealth of experience behind them."* He saw merit in such a tool, particularly in identifying people in other regions, *"where it falls down is that I would know the experiences of the Cork people or the southern region, but I could have a problem and someone up in Sligo could have the solution and I wouldn't know that... that's where it definitely breaks down."*

The development of a staff skills database for identifying knowledge across the organisation appears to merit further investigation, particularly in over-coming intra-organisational fragmentation.

Implementation of KM

On the potential for a more formal approach to KM, the Waterford Director commented, *“there's nothing formal, it is far from ideal... but there's a huge breadth of knowledge within the company and we need to tap into that.”*

“Time quite frankly is the biggest obstacle of all,” the Pharma Director stated, discussing the potential for KM-related activities, *“the most interesting technical job that we've done recently in the southern region is the school of music and I saw that job for the first time the day it was opened! I mean my desk is about a mile and a half from that site! I never got to it and I fully intended to see it...it's mainly my own fault in terms of organisation but I think you'll find the same thing with other people.”*

In terms of resourcing KM however, there was reluctance amongst the senior managers to create a dedicated KM function, with the Cork Director stating, *“I suppose we would be very slow to create another section or department within the organisation.”*

The Pharma Director continued on this theme *“there are so many guys out there who have a wealth of knowledge on stuff that we don't even know about, but the secret to making this work is that it becomes the norm...so it would be best if you could make a part of the everyday activities.”* He continued, *“I think that with knowledge it's what all of us have, we all have to take ownership of sharing it, but at the end of the day you do need someone to champion it.”*

In terms of implementing KM, the Pharma Director felt that a pilot basis was preferable, *“well I think you have to test drive it, and the group within the pharmaceutical division is relatively easy to control because it's small and focused. I spoke to Senior Contracts Manager A and Contracts Manager B when they came back [from the focus group] and*

they liked the idea of getting together because they don't get the opportunity to do that very often...just to try it and test drive it for 12 months would be good idea, see if that works and then spread out gradually.”

“The other way to deal with it,” the Cork Director noted, “is to take it to the Managing Director, if it gets backing from the top it tends to work better...if he falls in line and agrees with the recommendations there's a good chance it'll work.”

While KM was viewed as a positive development for Case Study B, challenges in implementing it were identified as a lack of time, the need for additional resources and the requirement for senior management support in ensuring success.

6.5 Summary

Based on an action research approach comprising interviews, focus groups and questionnaires with staff within the Pharma Division, Case Study B recognised the need to be more effective in managing their knowledge with a number of strategic, cultural and technological issues identified as follows:

1. How effectively are the leading Irish construction organisations currently managing knowledge?

Given the complexity of cleanroom projects, and the opportunities presented by management contracting, there is a need for a more formal approach to managing specialist knowledge within the Pharma division. The participants in the first cycle of the action research were specifically chosen because of their experience of cleanroom projects and management level within the Pharma division. Through the research process, a number of recurring issues were identified relating to the construction of cleanrooms. The participants recognised the need for improved knowledge sharing within the division, with a focus group proving useful in facilitating the sharing of high-grade, specialist knowledge. Feedback indicated that such knowledge-sharing sessions should occur on a regular basis, supplemented by site visits and post-project reviews, the lessons learned becoming policy where relevant. The second cycle of the action research sought to capture lessons learned from the practitioner's cleanroom project. A number of lessons were identified relating to cleanroom finishes, services, the building management system, commissioning and validation, handover of phased works, snagging and subcontractor performance. The participants recognised the need for improved KM practices and indicated a preference for site visits and meeting with peers.

2. What are the main strategic, cultural and technological issues that must be addressed for the adoption of KM in construction?

All participants acknowledged a good organizational culture, where there was a supportive environment and a willingness on the part of staff to share knowledge. However, while the Senior Managers recognised the importance of adopting a more formal approach to KM,

the main issue in terms of implementation was identified as the need for backing from the Managing Director.

3. Can construction professionals be encouraged to engage in KM through its alignment with existing organisational processes and activities?

In order to encourage staff to engage with KM, the Senior Managers recognised the need for the integration of KM with existing practices (including CPD and the company intranet), as opposed to the development of a dedicated KM function. In terms of engagement with KM, the individual's role and level were identified as influencing factors, particularly in relation to engagement with CPD and use of IT.

Taking the issues identified in this chapter into consideration, the following chapter discusses these issues and develops the emerging issues further through axial coding. This shall be achieved by discussing the findings in conjunction with relevant literature from Chapter 3, the emerging framework from Phase 1 (Chapter 4), and the findings from Case Study A (Chapter 5).

Chapter 7

Case Studies Discussion

7 CASE STUDIES DISCUSSION

Previous analysis (in Chapter 4) identified knowledge of people, projects and the organisation as significant categories, which require managing through a variety of processes including creating, capturing, finding and sharing. Existing organisational practices in the areas of IT, HRM and CPD were identified in the discussion as having a potential role to play in KM. The presence of a supportive learning environment was also viewed as essential in addressing some of the identified challenges. Furthermore, the perspective of the construction professional was viewed as being important, particularly in relation to their discipline, role, experience and education. With these issues in mind, Case Study A sought to evaluate existing practices relating to KM, lessons learned and CPD, whilst Case Study B explored the potential for knowledge sharing between middle managers and the development of lessons learned practices.

This chapter seeks to develop and refine further the categories which emerged in Chapter 4, framing the findings from the two case studies in the context of the literature review and the analytical process. Following the development of a skeleton theoretical structure, the data needs to be reassembled to uncover relationships among categories. In this regard Strauss and Corbin (1998) recommend the use of a paradigm, whereby data can be gathered and ordered through axial coding. By distinguishing between conditions, actions/interactions and consequences, the paradigm is used as a framework around which to systematically gather and order data relating to categories (see section on Data Analysis in Chapter 2 for further details).

Incorporating the findings from the cases studies, and in an attempt to consolidate the emerging issues, five paradigms have been developed. They are as follows: management of organisational knowledge, management of project knowledge, management of professional knowledge, the role of IT and the role of HRM. The supportive learning environment category, due to its previously identified pervasiveness has been incorporated into a number of the developing categories, including the management of organisational knowledge and the management of professional knowledge.

As can be seen in Figure 24, each paradigm is discussed individually, after which further consideration is given to the merging issues and the development of the emergent framework. The chapter concludes by summarising the main themes identified in Chapter 7.



Figure 24: Chapter 7 Overview

7.1 Managing Organisational Knowledge

Identifying and discerning the different KM processes has proven to be a challenging undertaking, particularly as there is considerable overlap between processes. Given the fluid nature of knowledge, as identified by Davenport and Prusak (1998) and the constructivist perspective discussed by Schwandt (1994) where knowledge is continually being shaped and refined through interaction with others in a variety of social processes, it further compounds the ability to distinguish between these apparently discrete, yet complex interrelated processes. From an organisational perspective, much of the literature refers to a wide variety of activities which feed into these processes, such 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 (Kamara et al., 2002b). Whilst a number of these activities are evident elsewhere within this chapter; in this section it is intended to discuss the various processes further in relation to the identified activities.

7.1.1 *Creating Knowledge*

The process of creating has proven to be one of the most challenging processes to identify within the case study findings. The constructivist perspective indicates that knowledge is 'created' or constructed through a variety of social processes (Schwandt, 1994). With regard to the focus of this phase of the research, it could be argued that CPD allows professionals to 'create' new knowledge; particularly as Egbu et al. (2005) argue that it is concerned with adding value to previous knowledge, such as developing new skills and competencies of employees. Roscoe (2002) talks about CPD in the context of 'developing' technical and managerial knowledge, a theme which was discussed by the Contracts Manager from Case Study A, in terms of the range of CPD he undertakes including management training, researching new products and reading technical literature; "*it's a multi-faceted thing.*"

From a project perspective, Kazi et al. (2005) and Orange et al. (2003) contend that, through the daily problem-solving process on construction sites, specialist and technical knowledge is created which is socially constructed. According to Nonaka and Takeuchi, (1995), creating knowledge in a purposeful manner is typically concerned with innovation; some evidence of this was provided by the Senior Engineer, *“when I was in head office, things were a bit quiet and they were wondering about new materials and new systems, and I had to do a bit of investigation of them, visiting other sites and factories, ring people about it.”*

7.1.2 Finding Knowledge

From an outcome perspective, Offsey (1997) states that KM should improve awareness of where to find knowledge within the organisation. The main focus with regard to identifying knowledge in both Case Study A and B centred on ‘people knowledge,’ which, according to Egbu and Robinson (2005), comprises knowledge which deals with the skills, problem-solving and the characteristics of staff and the inherent alliances and relationships with suppliers, subcontractors, clients, consultants, universities etc. In this regard, Bolisani and Scarso (1999) discuss the importance of know-who; information about who knows what and who knows how.

Based on the survey in Case Study A, staff find it relatively easy to identify people knowledge within their own workplace and head office, yet a breakdown occurs when identifying expertise on other sites and regions within the organisation. Another determining factor in this regard, was the time that an individual had spent with the organisation, the longer the time, the more people they get to know; thus their ability to identify expertise increases. The senior managers in Case Study B, admitted that they were able to identify such knowledge in many cases, particularly as they had access to staff CVs, yet the Cork Director admitted that this broke down at a regional level. Whilst many of the participants in both case studies admitted to contacting senior managers to find people knowledge, many felt that an online people finder would be potentially useful. However, there was some discussion about the amount of information which could be posted, particularly from a confidentiality perspective.

There was consensus among a number of the participants that a brief profile of all staff and their experience was required, which could include their name, contact details, previous projects and expertise. Egbu et al. (2005) confirm that skills databases can prove useful in identifying people with specific skills, particularly knowing who to contact when there is a problem. One element that could potentially feed into such a tool is the annual performance appraisals, which both organisations conduct with all staff. These are useful, particularly as they allow an organisation to measure an employee's accomplishments over a period of time (Wiese and Buckley, 1998). While the main focus is on 'between person' and 'within person' evaluation, they can also be used to maintain HR systems and document and update personnel records (Wiese and Buckley, 1998, Walsh and Fisher, 2005).

7.1.3 *Capturing Knowledge*

Capturing knowledge is concerned with transforming tacit knowledge into explicit forms, through documentation (Egbu et al., 2005). While Hussain and Lucas (2004) focus on capturing best practices, the area of lessons learned practices is focused on capturing project experiences, successful or otherwise, in order to avoid the repetition of previous mistakes (Carrillo, 2005b, Kartam, 1996).

In relation to the LL process, the challenge of both identifying and capturing lessons can be extremely difficult, with tools such as post-project reviews and debriefing used in this regard (Disterer, 2002, Kartam, 1996). Case Study A utilise post-project reviews to identify and capture lessons learned on their projects, with the Director commenting "*it's really at the end of the job that you look back and say "what were the big issues here," I mean, you can't log everything, if you catch the big issues, you're doing well.*" The concept of 'loss of context' due to time lapse and through documentation, which was identified in the senior manager interviews and arose again in the case studies, is particularly relevant in relation to capturing knowledge.

The Pharma Director in Case Study B acknowledged the challenges associated with capturing knowledge, *“there’s a huge amount of knowledge out there, but a lot of it is staying in individual’s heads or even within the project teams.”* While Smith and Rupp (2004) confirm that it is difficult to develop metrics of knowledge, the appraisal process is an area that both the literature and findings identify for capturing staff’s ‘knowledge’ in relation to their experience, training, previous projects etc. A further area where synergy could be achieved in this regard is the recording of CPD which is required by professional bodies. Guest (2007) discusses the trend towards web-based recording of CPD activity, which he posits can be combined with online CVs and personal websites.

7.1.4 Storing Knowledge

For Egbu et al. (2005), storing knowledge involves recording valuable experience in electronic form. One of the most important organisational resources in this regard is the intranet, which, according to Payne and Sheehan (2004) is *“widely used as the single point of access to an organisation’s knowledge.”*

Case Study A uses a central server known as the ‘K-Drive’ to support the storing and filing of organisational resources and information, which the Project Manager views as *“excellent, there isn’t a big paper trail.”* At the time of the research, Case Study B had launched an intranet and was in the process of developing resources on it. Much discussion focused on how the intranet could be used to support KM, particularly in facilitating an organisational people finder/skills database and a lessons learned database, although there were some reservations expressed about the intranet becoming overloaded with information.

The explicit knowledge stored on the intranet was viewed as a potential source of CPD material for staff, according to Academic B *“all of the disciplines, the SCS, CIOB and EI have requirements for professionals to do a certain amount of CPD; the intranet would be an excellent and easy way of fulfilling that.”* Previous discussion has also highlighted the potential use of intranet for inducting new staff (Egbu et al., 2005).

7.1.5 Sharing Knowledge

The sharing of knowledge is arguably one of the principal processes associated with KM, with a multitude of activities in this area identified in the literature and discussed by the research participants. The previous phase of the research identified a wide variety of such activities, which were categorised as either formal or informal. A number of these activities including site visits, workshops and seminars, meeting with peers, mentoring, email, meetings, conferences, informal communications and social activities were discussed by the case study participants.

- Site Visits: both case studies reported visiting other sites as a useful method of sharing knowledge, although in both instances these visits were undertaken on an ad-hoc basis. The evidence suggested that more experienced employees used their contacts within the organisation to arrange such visits; however, a number of respondents felt that all employees could benefit from such experience. Site visits proved to be particularly useful in the early stages of a project, when there was a need to find out about a specific aspect of a project, such as bathroom pods and twin wall systems in Case Study A, and cleanroom construction in Case Study B
- Workshops and Seminars: a variety of workshops and seminars are organised by both organisations. Case Study A run seminars on lessons learned and Case Study B have organised workshops for foremen to review and discuss purchasing procedures, which allows for interactive discussion. The Building Services department in Case Study B have an annual seminar for their staff. Whilst the challenges of getting geographically dispersed staff together were acknowledged by the participants, many felt that there was benefit in organising such events. The survey in Case Study A found that almost a third (31.3%) attended between 5 and 9 seminars annually and found them useful. The role and level of experience of participants was a recurring issue, with the Contracts Manager in Case Study A commenting, *“they get people at similar levels together, when they wouldn’t normally get together and they give people a chance to learn from others, from the experience of others”*

- Meetings: the Pharma Director was of the view that “*getting people together is very good*” for sharing knowledge. Both case studies reported a variety of regular meetings at different levels throughout the organisation, including board of directors, regional directors, departments, and sites. In Case Study A, the Contracts Manager had initiated weekly meetings for the site team as an opportunity to share knowledge on all aspects of the project. Sharing knowledge with peers forms an important part of KM, particularly in geographically dispersed construction organisations, where opportunities for such interaction can be limited. The survey in Case Study A found that, of those respondents who met with their peers on a regular basis (51%), the majority reported such interaction as beneficial to their work, particularly in terms of discussing recurring problems, new construction methods and company news. Those who did not have an opportunity for meeting with peers indicated a desire to do so. The focus group in Case Study B was organised to facilitate an opportunity for knowledge-sharing between staff of a similar level (i.e. middle managers), and was found to be beneficial to all participants
- Mentoring: transferring knowledge from experienced staff to the less experienced through mentoring is important for developing the organisation’s future leaders (Mondy and Noe, 1996; Scandura et al., 1996). Both organisations reported using mentoring for graduates, which was linked into their graduate development programmes. The HR Manager in Case Study A suggested that such an arrangement can be beneficial to the mentor as well
- Email: the use of simple applications such as email to aid KM was discussed by Egbu et al. (2005). Email is now one of the most widely used forms of communication within both organisations, and indeed the other leading Irish construction organisations. On construction sites, email appears to be predominantly used by project staff based in the site office, with foremen and site engineers generally reporting a low level of use. Some of the participants felt that there was an over-reliance on the use of email, with a tendency for them to get copied on all emails, whether it was relevant to them or not. Such issues would need to be addressed if email was to be used as part of KM

- Conferences: Case Study B organises an annual safety conference for all staff, which is held over two days; half of the employees attend on the first day, and the other half on the second. In discussing the conference, Contracts Manager C stated, *“the safety guys are quite good at that kind of thing, I remember at the annual safety conference one or two of the guys got up and spoke about their experiences...this is what we did wrong, learn from it, I found that very good.”*
- Informal Communications: many of the participants spoke about finding out about something through word of mouth, based on a network of contacts that they have built up over a period of time. Again, time spent working with the organisation would seem to influence the ability of an employee to use informal channels of communication, such as telephone or email to contact colleagues
- Social Activities: both companies organise social activities, such as nights out and golf outings which invariably lead to staff discussing work-related issues. In Case Study A, the Contracts Manager spoke of *“catching up”* with colleagues and finding out about their projects, while the Project Manager admitted that *“most people I know in the Cork office, I know them through the golf society”*

In terms of organisational knowledge, it is apparent that the findings from Case Study A & B echo those findings outlined in Chapter 4, particularly the processes for managing knowledge and their associated activities. Incorporating the preceding discussion with previously developed categories, ‘The Management of Organisational Knowledge within the leading Irish Construction Organisations’ has been developed. As can be seen in Figure 25, axial coding has led to a paradigm model which attempts to reflect the organisational aspects of KM.

Causal Conditions

- Knowledge is now recognised as a critical organisational resource which, if effectively managed, can improve innovation, business performance and client satisfaction
- Involvement in Engineers Ireland's CPD Accreditation Scheme is compelling many of the leading Irish construction organisations to consider the development of a formal approach to KM

Phenomenon**The management of organisational knowledge within the leading Irish construction organisations****Context**

- Construction organisations operate in an industry which is characterised as being competitive, project-based, geographically dispersed and highly pressurised
- The large size of construction organisations and intra-organisational fragmentation at a variety of levels within organisations including, regions, departments, sites, head office, and internationally, make managing knowledge difficult
- Construction organisations provide the best place for learning, allowing for consideration of issues that are relevant to the business
- Knowledge of people (their skills and expertise), projects (performance and lessons learned) and the organisation (processes and systems) and the external business environment (clients, competitors, professional bodies etc.), are all important in the context of managing a construction organisation's knowledge

Intervening Conditions

- The organisational resources, including time, staff and costs required to operate a KM initiative must be given consideration
- The presence of a supportive learning environment where senior management recognise the need for continuous improvement and provide opportunities for reflection and learning from experience
- Organisational knowledge forms through a unique mix of people, techniques and technologies which are shaped by the organisation's unique history and culture
- A central problem of promoting learning across an organisation is that, despite people acting collectively, they learn individually
- Successful KM requires: visible senior management support, assessing organisational culture, eliminating barriers, setting goals, getting departmental buy-in, designating a champion, empowering workers, allocating resources and tracking results

Actions/Interactions (Strategic or Routine)

- Much knowledge is 'managed' in an unplanned manner, being created, captured, found and shared on an informal basis through word of mouth and informal communications
- The main strategic action for purposively creating knowledge is research and development of new building materials and systems
- Whilst much knowledge is tacit and socially constructed, many organisations 'capture' knowledge in documented form. Much experience and knowledge that has been gained by the organisation is captured in company policies and procedures
- Increasingly, 'captured' knowledge such as lessons learned, policies and procedures and other documentation, is being stored by construction organisations on an intranet
- Finding knowledge involves identifying people who have a specific expertise or knowledge of a certain area. Typically staff use informal channels of communication to identify this knowledge, although in certain instances, staff CVs are used by senior managers
- A number of activities are employed to encourage knowledge sharing, including site visits, workshops and seminars, meeting with peers, mentoring, email, meetings, conferences and social activities
- The development of relationships, reflective conversations, probing questions and in-depth interactions are the backbone of knowledge sharing

Consequences

- Potential benefits of managing an organisation's knowledge include: cost and time reduction, process and product improvement, innovation, success and market leadership, client orientation & satisfaction, improved decision support and problem solving, less repeated mistakes and duplication of work, improved staff quality, satisfaction, motivation and retention, increased awareness, accessibility and availability of knowledge and more effective teamwork
- The development of a formal approach to KM within the leading Irish construction organisations can lead to accreditation under Engineer Ireland's CPD scheme

Figure 25: Managing Organisational Knowledge

7.2 Managing Project Knowledge

Lessons learned practices have emerged as an appropriate method for managing project knowledge. Within this section, both case study organisations are initially discussed separately, focussing on evaluating existing LL practices in Case Study A and developing LL practices in Case Study B. The two case studies are then discussed together in relation to improving the implementation of LL practices and the development of a paradigm model.

7.2.1 *Evaluating Existing LL Practices*

The staff survey in Case Study A reported a low level of use of the LLDB, while the interviews and management presentation confirmed a number of challenges in adopting LL practices in construction previously identified in the literature review including:

- Loss of Context: the Administration Manager in Case Study A admitted that in attempting to document LL it was difficult to capture the context, which presented a challenge when delivering LL seminars that he was not familiar with
- Out-Of-Date: one of the main problems identified in the Case Study A survey, was the currency of the LL on the database; it is suggested by Davidson (2006) that existing LL should be regularly reviewed to ensure accuracy, reliability and relevance. This would also help to limit the potential for missing links, which the Project Manager found frustrating
- Difficulty in Using the LLDB: some of the site-based staff, including the Site Engineers, Foremen and Safety Officer, admitted that they did not have the time to sit at a computer searching the LLDB, while both the Senior Engineer and Project Manager also admitted that they did not have the time to use it. Such ‘pull’ methods leave the burden on the individual to search the LLDB, whereas Weber and Aha (2002) contend that ‘push’ methods could deliver LL to relevant staff based on their role, interests, training and experience

- Information Usefulness: the perceived usefulness of the LL in relation to an individual's current job responsibilities, as identified by Voit and Drury (2006), was a recurring theme during the Case Study A interviews. For example, the Senior Engineer who had been involved in setting up the database, stated that many of the lessons were relevant to the foremen, whilst the Contracts Manager, Senior Quantity Surveyor and Quantity Surveyor B all reported using the LLDB at various stages during the project
- Experience: with regards to the LL seminars, the Contracts Manager viewed them as useful, if people with similar experiences participated. During the management presentation in Case Study A, the involvement of younger, less experienced staff in the LL process was discussed, which, according to the Director, led to "*a surprising amount of detailed suggestions came up.*" Getting such staff members to present lessons to their peers was viewed by the HR Manager as having the added benefit of helping "*with their presentation skills, because very quickly some of them will be doing it for clients... presenting themselves in meetings is something that they are measured on in the appraisals now, sometimes the hardest people to talk to are your own peers, so there is merit in that idea*"
- Fragmentation: Fisher et al. (1998) contend that overcoming departmental silos and fragmentation in large construction organisations is one of the main reasons for implementing LL practices; it was found that LL are not shared within Case Study A on a regional basis (Case Study B also identified this as a problem in relation to managing knowledge)

In general, the use of both an LLDB (codification) and LL seminars (personalisation) appears to work well; however, as Dixon (2004) notes, further integration of technology and social processes is required to help the organisation to overcome some of the above problems.

7.2.2 Developing LL Practices

Prior to the action research in Case Study B, there had been attempts to conduct project reviews and document the lessons learned, with little success. There was a realisation that such activities, according to the Pharma Director, “*would have a benefit to others involved in similar type projects.*” As a result of the research, all participants in Case Study B saw the potential for LL practices within the Pharma Division and indeed the wider organisation. There is evidence of existing KM-related practices within the organisation, particularly within the Safety and Building Services departments, who both have annual conferences for staff; such practices should be built upon and developed throughout the organisation.

Through the post-project review in Case Study B, a significant amount of high-grade, context specific knowledge was captured in the lessons learned, relating to cleanroom finishes and services, building management systems, commissioning and validation, handover of phased work, snagging, and subcontractor performance.

In discussing the subsequent use of LL, the Building Services Engineer hinted at a distribution gap, similar to that identified by Weber and Aha (2002), “*it depends on where the information goes after the review. If we all have a discussion about it, that's fine...I think it's more about where the outcomes of that review go, how readily accessible it is and how well it is utilised elsewhere.*” He went onto discuss an LL section on the company’s intranet, where there is a requirement for individuals to submit LL themselves (Kartam, 1996), which he believes “*will only be as successful as the amount of information posted by people...it's all about the input really.*”

Contracts Manager C spoke of the need to apply lessons when tendering for new projects, giving examples of his current involvement in a shopping centre development with a large basement. The concept of information usefulness, as discussed by Voit and Drury (2006), is particularly pertinent here, because if lessons from previous basement projects were available, it would reduce the need to “*reinvent the wheel.*” The Waterford Director viewed LL as being important in that they could be utilised and applied in procurement

routes, such as management contracting and design and build where the contractor's previous experience should be exploited.

In order for LL and KM to be successful on a wider scale, the Pharma Director was of the opinion that a champion was required, and that implementation should be undertaken on a pilot basis. Essentially, if the company wishes to develop LL practices further, they will need to appoint human intermediaries to 'champion' the process, get senior management support, set goals, get buy-in, empower staff, allocate resources and track results (Voit and Drury, 2006, Robinson et al., 2005, Fisher et al. 1998). The Cork Director viewed the support of the Managing Director as being the most important element in developing LL practices further stating that, "*if it gets backing from the top it tends to work better.*"

7.2.3 *The Lessons Learned Process*

Having evaluated the LL practices of Case Study A and conducted LL on a cleanroom project within Case Study B, the following are some of the main issues relating to the LL process:

- Collection: it is acknowledged by Disterer (2002) that the identification and capture of LL is an extremely difficult process: the Director from Case Study A felt that only the main lessons will be captured at the end of a project. The post-project review is one of the most popular methods of collecting LL, hence its use with Case Study B, albeit in the form of a focus group. The sought input type collection process as identified by Fisher et al. (1998) seems to be the best method for collecting LL; the Senior Quantity Surveyor from Case Study A spoke about a previous employer who required staff to submit LL as part of their reporting duties. In order for the collection of LL to be effective, the support of senior management in providing time and resources for the project team to review the project is vital. Getting the key members of the project team to participate is highly important, as it provides a multi-faceted, in-depth view of the project upon completion. The collective knowledge of the participants in the second cycle of Case Study B allowed for their different perspectives to enhance the validity of the LL

- Analysis: once captured, the LL must be analysed to ensure that they are factually correct, as unsound LL may be rejected by construction professionals. Furthermore, the documentation of LL requires consideration of the following: title; information on its source and context, and its classification for easy retrieval (Kartam, 1996). In Case Study A, all LL are entered into a standard template and checked by the LL manager to ensure sufficient contextual information. A LL report was developed for Case Study B which included a description of the project, the project team contact details, a list of consultants and subcontractors and a brief description of the main LL. It was the view of the research participants that such a structure was worthwhile, particularly as most people would be more inclined to contact the relevant person to follow-up on specific queries
- Dissemination: one of the biggest challenges in disseminating LL through pull methods such as a database is the distribution gap, as identified by Weber and Aha (2002). As already mentioned, this was evident within Case Study A who had implemented a LLDB, where the Director acknowledged this problem. Almost half of the survey respondents (49%) stated that they use the LLDB very rarely or never, highlighting the need for human intermediaries (i.e. managers) to monitor and review their staff's use of the LLDB. The interviews revealed that staff did not have time to search the LLDB, felt that the lessons were not relevant to them, and there was no requirement on them to use it. The survey and interviews with staff also found that there are problems in searching and retrieving information from the database. The need to retrieve the lesson quickly, and by multiple parameters, is something that Kartam (1996) identifies as a key component of LL practices. Case Study A recognised that there were problems with dissemination, and developed training seminars based on LL, which were delivered to staff in the evening time. Again, there were a number of problems with the seminars, including the timing and location, delivery, relevance and experience of those in attendance. As well as using LL for training, Davidson (2006) suggests that they should be incorporated into business processes, and be used to develop checklists. The findings from the first cycle of Case Study B identified a number of potentially useful methods for

disseminating LL including, site visits, regular knowledge-sharing focus groups between projects, documented LL on the company intranet and regular email alerts. Both cycles of Case Study B viewed the need for certain LL to be integrated into business processes, such as best practice guidelines, standard agendas, recommended lists and working protocols and strategies

7.2.4 *Improving the Implementation of LL Practices*

Many of the challenges discussed in Case Study A and B contribute to what is known as the distribution gap, which can occur because LL practices are not linked to company policy, users may not know or forget about the database, and users may not have the time or skill to retrieve and interpret textual lessons, and subsequently apply them. In order to address some of these issues, a number of suggestions are offered including:

- Integrate LL into existing work practices: make LL practices part of people's work and organisational procedures, including tendering and contract procedures, health and safety, quality, reporting, and performance appraisals
- Incorporate major lessons into company policy: the Senior Contracts Manager A in Case Study B suggested that any major conclusions derived from such activities should be "*taken forward as policy*"
- 'Push' lessons to relevant people: while a number of interviewees acknowledged that they do not use the LLDB, there is potential to 'push' relevant LL to them via email or print format, based on their role, interests, training and experience
- Provide training: deliver regular refresher training on the use and benefit of LL practices
- Incorporate LL into CPD: both Case Study A and the literature reviewed have shown that there is potential to align CPD with LL practices. In order to redress the distribution gap, the use of focus groups to capture knowledge in the form of LL could potentially be used to form the basis of work-based learning activities within an organisation. By linking LL to CPD, professionals could meet the requirements

of their professional body, whilst organisations could benefit from a more knowledgeable and effective workforce

Having given consideration to project knowledge and lessons learned practices, issues such as the challenges of adopting LL practices, the LL process and improving the implementation of LL practices have been incorporated into a paradigm model as outlined in Figure 26.



Figure 26: Managing Project Knowledge

7.3 Managing Professional Knowledge

The first phase of the research identified the need for further exploration of a variety of topics from the individual construction professional's perspective. Specific issues identified included their role, educational qualification, experience, personal issues and workload. Given the close alignment of CPD practices with the individual, this has also been considered from the perspective of the construction professional, with elements of the CPD category from Chapter 4 incorporated. Within this section, the role and level of experience of the individual will be given due consideration, particularly the potentially important role of middle managers.

The participants in both case studies represent a variety of different roles which commonly occur in construction organisations, including: Directors, Contracts Managers, Project Managers, Engineers (both Civil and Building Services), Quantity Surveyors, Safety Officers, Site Agents and Foremen. The individual's role dictates their responsibilities and level of involvement within construction projects.

The survey in Case Study A found a relatively high level of respondents with a third level qualification, including 15% with a diploma, 49% with a bachelor's degree and 17% with a post-graduate award as their highest qualification. Of the eleven project team interviewees, eight have a third level qualification, whilst the remaining three (who work in supervisory roles) have trade certificates. Those with third level qualifications also reported holding membership of relevant professional bodies.

The first phase of the research identified the subcategory 'experience' which ranges dimensionally from 'novice' to 'veteran,' confirmed by Leonard and Swap (2005) in their discussion of 'deep smarts.' In developing these deep smarts, they contend that experience plays a central role and may be difficult to transfer to less experienced people, as they may lack the required frameworks, domain knowledge or prior experience.

With regards to Case Study A, the project team interviewees had a range of experience, with both Foreman A and B having 48 and 40 years industry experience respectively. Site

Engineer B, who has spent her 1.5 years in the industry with the company and could be categorised as a ‘novice,’ cited her lack of experience as an impediment to understanding construction techniques which were discussed at CPD events. There appeared to be some staff who were neither ‘novices’ or ‘veterans,’ such as the Senior Engineer, who was in a transitional period in her career, moving from an engineering role towards a more management oriented role. The Contracts Manager and Foremen could be considered to be veterans of the industry, having an extensive range of experiences in a variety of roles. It is worth noting that significant experience does not preclude further learning; with 48 years experience Foreman A admitted that he continues to learn about construction.

The complexity of experience and its pervasiveness is something which, according to Grisham and Walker (2005), spans locations, cultures, languages, technical expertise, education and political experiences, and encompasses people skills and attitudes. Leonard and Swap (2005) posit that the sharing of knowledge between individuals is dependent upon experience, and individuals possessing similar frameworks, domain knowledge and prior experience. Discussion elsewhere has identified a number of different areas where experience holds influence, including engagement in CPD, performance appraisals, site visits, mentoring, use of IT, engagement in LL practices and identifying expertise within the organisation. Overall this indicates that experience has an important role to play in managing knowledge.

7.3.1 Engagement with Continuing Professional Development

According to Shipton and Shackleton (1998), in terms of CPD, the support and encouragement of the individual’s line manager is very important, a view confirmed by the Senior Engineer in Case Study A, who praised the Contracts Manager as being “*proactive on our CPD, if you ask for something you’ve no problem getting time off.*” Roscoe (2002) identifies professional body recognition, credibility with employers and colleagues, improving job performance, and developing capacity for career progression as the main reasons for individuals to undertake CPD.

A relatively high level of professional body membership was identified in Case Study A, with 63% of respondents holding membership of such an organisation. The Director confirmed the survey findings: *“Engineers Ireland, the CIOB and the SCS would count for a very large proportion of our staff,”* with 28%, 23% and 15% of the survey respondents having membership of these bodies respectively. Whilst professional body membership was not the focus of Case Study B, it is interesting to note that they have a dedicated Building Services department, with many of these staff holding membership of CIBSE.

A lack of time, geographical dispersion, reluctance to change and lack of interest were cited as the main barriers to the uptake of CPD by Thomas et al. (2006). The impact of time pressures featured prominently in the management presentation in Case Study A, with the HR Manager stating, *“for a construction company there is a constant battle between trying to get the job done and the area of continuing professional development.”*

One of the main inhibitors of engagement with CPD identified in Case Study A was the location of CPD activities. With the project based in Waterford, and CPD activities taking place in the company’s Dublin and Cork offices, it proved challenging for staff to commit to travelling to CPD events in the evening time. To overcome these issues, the Project Manager suggested that *“there should be more CPD done on the site, particularly on a big site like this where you have a big staff...it’s not a thing where it has to happen in head office.”*

The potential use of the company’s intranet in overcoming geographical dispersion was discussed during the presentation to senior management in Case Study B. Academic B stated that the intranet would appeal to younger professionals, *“that could act as CPD for younger staff...all of the disciplines, the SCS, CIOB and EI have requirements for professionals to do a certain amount of CPD, the intranet would be an excellent and easy way of fulfilling that.”* In this regard, Best et al. (2005) found that e-learning solutions had been used to improve CPD engagement for geographically-dispersed dental practitioners.

In transferring knowledge from experienced to less experienced staff, both Mondy and Noe (1996) and Scandura et al. (1996) contend that mentoring is particularly useful in

developing the future leaders of an organisation. With 60% of the Case Study A survey respondents indicating involvement in the company's mentoring scheme (43% are mentees; 17% are mentors), the HR Manager feels *"besides developing mentees, it's actually good for the mentors."* However, the interviews revealed that there was some differences in how mentoring operated for Engineers and Quantity Surveyors. This may be due to the fact that Engineers Ireland CPD Accreditation Scheme has specific requirements for mentoring. In Case Study B, Contracts Manager C spoke of how the mentoring programme is linked to identifying training and development needs.

Training is viewed as one of the main CPD activities, with Case Study B having *"a training manager in head office and every member of staff has a training programme, which is particularly good for the younger staff,"* according to Contracts Manager C.

While it can be problematic, Case Study A pride themselves on their provision of CPD and training, according to the HR Manager, *"we outwardly market our CPD to attract graduates in, but it's difficult to decipher who are the ones that really want a career in construction and who wants to use the company's training and then move on."* The Director spoke about the training programme they have for all graduates which lasts for approximately 4 to 5 years, and deals with the *"practical, managerial aspects of building."*

Again, the areas of training seem to change as the individual becomes more experienced, with the Senior Engineer who has moved into more of a management role, moving onto *"more external training...time management, chairing meetings, motivation and delegation and I'm down for another one, conflict."* These soft skills, according to Smith and Rupp (2004), form an important part of the development of future leaders.

Of the twelve key areas for management development in construction organisations identified by Maxwell-Hart and Marsh (2001), the Case Study A survey found that information technology, health, safety and welfare, quality and environment, and communications and presentations ranked among the highest. The interviewees of both case studies identified IT as an area where they had received significant training.

The first cycle of research with Case Study B identified a lack of expertise in the area of commissioning and validation, with the participants agreeing that further training in the area of cleanrooms and particularly commissioning and validation should be provided in order to improve the knowledge stocks of the Pharma division.

Regardless of the level of experience, Foreman A (from Case Study A) was of the view that training is important for keeping up-to-date with new developments, stating it *“is good to keep abreast of, because times change.”*

According to Grisham and Walker (2005) participation in CPD activities can provide the benefit of informal learning through discussions with colleagues. This was a view confirmed by a number of interviewees from both case studies, particularly for staff who had been with the company for some time. For example the Contracts Manager in Case Study A, who has been with the company for 9 years commented, *“at seminars and lessons learned talks, inevitably there’s some informal chat, because I might meet somebody that I haven’t seen for 6 months or a year, or more and we catch up on what’s happening.”* Both the Site Agent and Contracts Manager C in Case Study B highlighted the company’s annual safety conference as a good opportunity for this type of discussion.

7.3.2 *The Effects of Experience on Engagement with CPD*

Both Buck and Newton (2002), and Rothwell and Arnold (2005) identify age and experience as having an influence on engagement with CPD. This was a theme discussed in Case Study B by Contracts Manager C, who spoke about the different approaches to training and CPD depending on experience, *“generally there are different types of training depending on the level you are at within the company.”* He also identified the individual’s role/discipline as having an effect, *“but it does depend on whether you’re a surveyor, an engineer... there are some differences.”* Again, this is a view confirmed by Maxwell-Hart and Marsh (2001) who suggest that different approaches to CPD are required depending upon the individuals experience and management level.

For younger staff, CPD appears to be driven by professional body recognition and career progression. The Building Services Engineer in Case Study B, spoke about the professional development requirements of CIBSE “*dovetailing*” with the career path within the organisation. Similarly, both Quantity Surveyor B and Site Engineer B discussed career progression and becoming a chartered professional. The survey respondents from Case Study A in the 18 – 25 age bracket rated a ‘good training and development programme’ as their most important non-financial motivational factor. Such programmes can typically be categorised as mode 1 knowledge production, which are concerned with discipline-specific, scientific knowledge.

Once younger staff gain experience and become chartered, the main focus of CPD appears to be upon skills conversion, which the Contracts Manager in Case Study A discussed in detail, “*one of our biggest challenges is converting them from engineers into managers, giving them proper training to switch from a technical work system to a management work system.*”

The more experienced professionals spoke of their CPD as being more self-directed, with both the Contracts Manager and Project Manager in Case Study A confirming this view. Whilst Rothwell and Arnold (2005) contend that less experienced practitioners have a higher uptake of CPD, both the HR Manager and Director of Case Study A were of the view that as staff become more experienced, it is difficult to get suitable training for them. It appears that as an individual gains experience and progresses through the management levels, their training and development needs change, requiring different approaches to both CPD and KM. Junior staff are more concerned with ‘gaining experience’ and are typically involved in mode 1 knowledge production, with mode 2 becoming increasingly relevant with progression (Gibbons et al., 1994).

7.3.3 *The Important Role of Middle Managers in KM*

Contrary to the negative sentiment towards middle managers espoused by a literature review conducted by Styhre and Josephson (2006), a number of authors view the middle level of management as being crucial to KM-related activities (Nonaka and Takeuchi,

1995; Mohamed et al., 2004; Davenport and Volpel, 2001). This correlates with the earlier findings from the senior manager interviews, where middle managers were found to have a ‘filter up-down effect’ within the organisation. In this regard, the Contracts Manager from Case Study A viewed himself as “*the hub*” in terms of communications and knowledge-sharing between his project team and head office. He also holds a central role in a number of KM-related activities, including conducting performance appraisals with site-based staff, capturing lessons learned, reviewing the LLDB when commencing projects, mentoring less experienced staff, delivering seminars to other staff, and researching new building systems and products.

The participants in the first cycle of research within Case Study B were purposely selected based on the potentially important role of middle managers in KM. The following comment from the Pharma Director during the senior manager interviews reflected this, “*if you get the knowledge in to the guy leading a project team, the contracts manager, it then filters down.*” Apart from the Pharma Director, the other five participants were all deemed to be ‘middle managers,’ based on the management levels proposed by Maxwell-Hart and Marsh (2001). With all participants having 10 years or more experience of working with Case Study B, and significant industry experience, from a constructivist perspective, it was perceived that these individuals would have similar concepts, models and schemes relating to the management of cleanroom projects. Such similar experiences, it was anticipated, would lead to a shared understanding of the main issues in procuring and constructing cleanroom projects through management contracting. During the knowledge-sharing focus group, it became apparent that mode 2 knowledge, which is socially generated and is anchored in practical, context-specific here-and-now problems was being produced (Gibbons et al., 1994).

Having taken a variety of issues relating to the construction professional into consideration, the phenomenon ‘The Development of a Construction Professional’s Knowledge through CPD is closely linked to their Role and Level of Experience’ has been developed. The paradigm model, as illustrated in Figure 27 considers the management of professional knowledge through CPD as having potential benefits for not only the individual, but also for their employer.

Causal Conditions

- Construction professionals, who are at the core of KM, should be self-starters, continually striving for creative solutions and building on their educational qualifications and experience repertoire
- Younger construction professionals (novices) tend to engage in CPD in order to become chartered members of their respective professional bodies and progress their career
- CPD is used to by construction professionals for skills conversion as they progress from technical into management roles
- More experienced construction professionals tend to be more selective in their engagement with CPD, viewing it as an opportunity for both personal and professional development
- Increased profitability, improved project delivery and client satisfaction can be achieved by construction organisations that employ highly skilled staff

Phenomenon

The development of a construction professional's knowledge through CPD is closely linked to their role and level of experience

Context

- Construction professionals work in an industry which is characterised as being competitive, project-based, geographically-dispersed and highly pressurised
- Many Irish construction professionals are members of professional bodies including EI, SCS, CIOB and CIBSE, all of whom have differing CPD requirements, including a mandatory or obligatory requirement, the amount of CPD activity per annum, monitoring, and recording of CPD activity
- Construction organisations provide the best place for learning, allowing for consideration of issues that are relevant to the business
- CPD opportunities can also be externally provided by professional bodies, academic institutions, and suppliers
- A more subtle context is the physical location of the CPD activities; that is, whether they are conducted on-site or at a remote location such as the company's office or an external venue
- There are twelve key areas for management development in construction organisations: corporate management, business management, financial and management systems, promotion and business development, communications and presentations, the client and relationships, respect for people, project management, professional, commercial and contractual practice, information and communication technology, health, safety and welfare, quality and environment, and the construction profession in society

Intervening Conditions

- The individual's age, educational background, experience, role and workload all have an impact on their ability to engage in CPD and acquire knowledge/learn
- Issues such as motivation, absorptive capacity, having a knowledge need and the relevance of the knowledge can influence the level of engagement
- The individual must be capable of learning and making sense of large amounts of complex information and must be sufficiently motivated to seek out opportunities and design their own work, often with little direction
- Motivating individuals to learn and share knowledge can be particularly difficult in a pressurised environment, such as construction where professionals are busy and time for reflection is limited
- Organisations have an increasing role in supporting staff's CPD activity; this requires a supportive learning environment, where senior management support the provision of CPD and recognise the need for continuous improvement

Actions/Interactions (Strategic or Routine)

- Performance appraisals are used to identify, capture and appraise the construction professionals experience over the previous year and identify areas for further improvement in the coming year
- There are a variety of recognised 'formal' activities which can contribute towards CPD, including: graduate development programmes, mentoring, post-graduate studies, training courses, site visits, conferences, workshops and lectures, research publications and presentations, teaching, and involvement with professional bodies
- A lack of appropriate CPD activities for more experienced professionals would indicate the need for an action learning approach (mode 2 knowledge production), where learners educational needs are assessed and supported by multifaceted techniques such as small group or one-on-one sessions
- Professionals who seek to engage with CPD will arrange these activities around their work location and schedule
- Participation in CPD activities allows employees the opportunity to reflect upon their work, trade stories and ideas with co-workers, and catch up on professional theory and practice
- Participation/engagement in a variety of KM-related activities at project and organisational levels
- Middle managers act as a hub for managing knowledge within construction organisations, their involvement with construction projects and senior management meaning that they act as a key interface for organisational knowledge through involvement in a number of activities: site visits, lessons learned, performance appraisals, delivering seminars and researching new products and construction methods

Consequences

- For the individual, CPD ensures that professionals acquire the knowledge required to execute their professional and technical duties, are up to date in their field, are improving their current and future capacity for promotion and career progression, satisfy their professional body's requirements, and maintain credibility with their colleagues and employers
- For the organisation, CPD can improve recruitment and retention of staff, enhance innovation, raise the organisation's profile, align business goals with personal development, and support career planning and promotion
- Engagement with CPD activities also provides the opportunity for informal learning, whereby professionals can 'talk shop' and network with their peers
- Awareness of KM can be improved by using training as a vehicle to focus on achieving quality, creativity, leadership and problem solving
- CPD has a role to play in facilitating the integration of mode 2 knowledge production that is relevant to employees, their role and the company's objectives

Figure 27: Managing Professional Knowledge

7.4 Use of Information Technology

Tiwana (2000) suggests that KM will only be successful if it builds upon existing systems. In terms of IT systems, previous discussion has identified that the leading Irish construction organisations have a relatively well-developed hardware and network infrastructure. Whilst Case Study A confirmed some issues regarding connectivity between remote sites and the head office IT infrastructure, in general the platform for implementation of KM technologies such as email, an intranet and people finder, is in place (Al-Ghassani et al., 2005). In addition to the widespread use of Office applications, the findings from both case studies confirm the prevailing use of email as a communication tool, both within the organisation and externally.

Whilst a lower level of computer access on sites was identified in the earlier part of the research, this appears to be due to the fact that not all site-based staff use computers on a regular basis. Apart from Foreman B in Case Study A, who was heavily involved in coordinating finishes, the Site Engineers and Foreman A (also in Case Study A) and the Foreman and Site Agent in Case Study B, reported spending most of their time 'out on site' as opposed to in the site office on a computer. Those who used IT on a more frequent basis, identified email and Office as their main applications.

An intranet is viewed as an important KM technology, providing a single point of access to an organisation's knowledge across geographically dispersed construction organisations (Payne and Sheehan, 2004, Al-Ghassani et al., 2005). Case Study A have implemented an intranet, known as the K-drive, which acts as a central source for correspondence, project documentation and lessons learned. Case Study B have also recognised the potential of a centralised information source and have recently implemented an intranet, which includes standard templates and a lessons learned section for the Building Services department; this requires further development. The Directors from Case Study B felt that there were potential problems with the intranet, particularly if it was overloaded with information. However, it was suggested that the intranet could act as a repository for the CPD activities of younger professionals, who might be more inclined to use it.

In discussing the use of a people finder/skills database to identify expertise within the organisation, many of the participants expressed an interest in the adoption of such a tool. In discussing the use of such technology, the Directors from Case Study B felt there was merit in it, particularly in identifying expertise in other regions, a view echoed by the Senior Quantity Surveyor in Case Study A. The participants in the management presentation in Case Study A also recognised the potential of such a tool, particularly if it was linked to the LLDB. Rather than connecting people with information, such an approach could encourage the sharing of tacit knowledge as discussed by Payne and Sheehan (2004).

The preceding discussion and that relating to IT in Chapter 4, have been combined through the analytical process to develop the paradigm model presented in Figure 28.

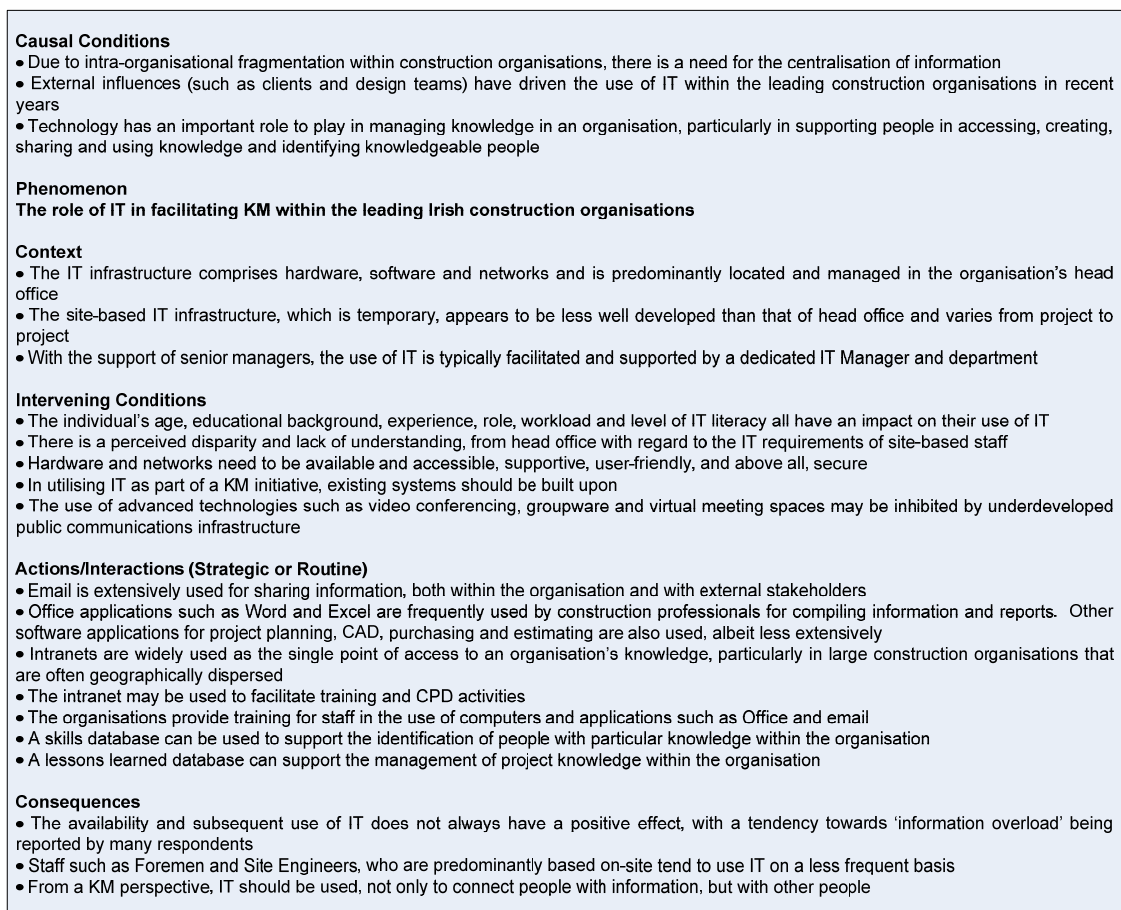


Figure 28: The Role of IT

7.5 Role of Human Resource Management

Both Gourlay (2001) and McDougall and Beattie (1998) suggest that HRM specialists have an important role to play in KM initiatives with regards to both formal training (mode 1 knowledge production) and informal learning (mode 2 knowledge production) strategies. The findings from Case Study A suggest that the HR Manager is actively involved in managing CPD activities, liaising with professional bodies, organising inductions, and overseeing the performance appraisal process.

Mondy and Noe (1996) and Fowler (1990) agree that induction is an important process for ensuring that new employees adjust to the company, their job and work group, settle in effectively, and become productive as quickly as possible. Topics covered should include general company information, policy and procedures, introduction to other employees, safety and job requirements, and should involve both the HR function and the employee's supervisor or senior manager (Mondy and Noe, 1996). Case Study A have an induction for new employees which typically lasts three hours and covers general company information, safety, quality and the K-drive, which 83.1% of survey respondents have completed. It was suggested that induction information could be posted on the company's central server for staff to refer to after the induction. Quantity Surveyor B felt that the main benefit from the induction was that *"it really gave me a chance to have a look around the Dublin office, meet a few people, so you know when you're up there who's who."*

The main focus of performance appraisals relates to performance planning and goal setting, pay increases, promotion and transfers, training and employee development, and feedback and counselling (Cleveland et al., 1989, Longenecker, 1997). Whilst both Case Studies A and B have annual performance appraisals for staff, it was primarily the project team interviews in Case Study A which focused on this. The Director of Case Study A cited the link between training and development and pay increases through the appraisal process, *"we find with having that structured approach once a year, it's written down, and people are slow to come back the next looking for a raise, if they haven't done their training."* This is a view shared by Shipton and Shackleton (1998), who state that a performance

management system should promote a culture of learning and development, and recognise and reward those who actively participate in such activities.

The Contracts Manager from Case Study A uses the appraisal to review his staff's progression, "*where they are going and whether they are staying on the technical side of things or drifting to the management side of things.*" This, according to Wiese and Buckley (1998) is a trait of an effective manager who will try to motivate, direct and develop their subordinates.

Both the Contracts Manager and Senior Quantity Surveyor spoke about the value of reflection and self-evaluation as part of the appraisal process. The latter described appraising an individual's knowledge as "*very good for people that want to move up or gain more knowledge.*" While it is reasonable to suggest that appraisals could have a potential role in KM, developing metrics of knowledge is a difficult task, particularly as much professional knowledge is substantially tacit, making it impossible for workers to articulate (Smith and Rupp, 2004). There is evidence to suggest, however, that criteria such as communication skills, product knowledge, attitude, initiative and aggressiveness, enthusiasm, knowledge of competition, time management and motivation should be in the appraisal process (Pettijohn et al., 2001). Indeed, evidence from Chapter 4 indicates that criteria such as job knowledge, problem-solving, team-building and communications are already being used in the performance appraisal process.

The interviews yielded both positive and negative feedback on performance appraisals. The Contracts Manager viewed the annual appraisal as "*essential,*" with Site Engineer B indicating improved motivation, commitment and satisfaction. On the negative side, Site Engineer A felt that the follow up on training was lacking. Similar to mentoring, there appeared to be differences with regards to the running of performance appraisals, with both Quantity Surveyors A and B citing differences between the professions.

Having conducted axial coding around the 'the supportive role which HRM plays in facilitating the use of available knowledge and encouraging people to learn' it is evident

from Figure 29, that this category requires further development, particularly in terms of the context and intervening conditions associated with it.

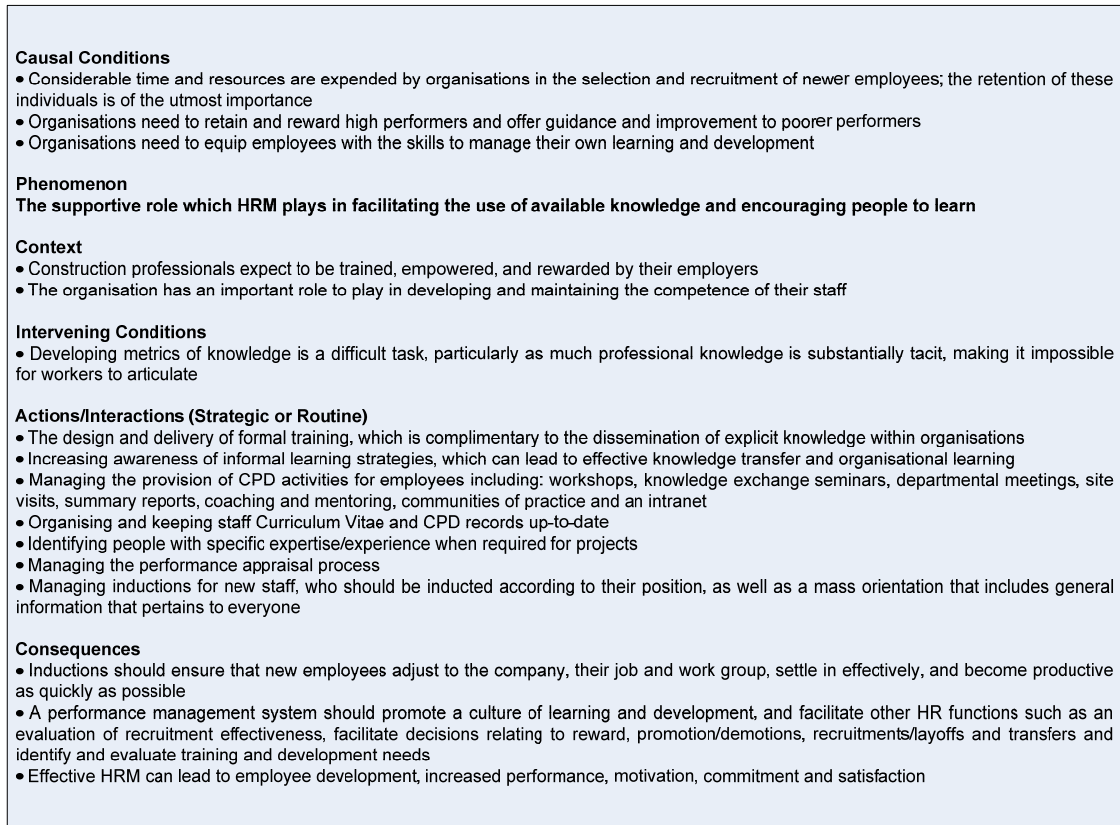


Figure 29: The Role of HRM

7.6 Framework Development and Theoretical Sampling

The preceding discussion has led to the development of five paradigm models through the process of axial coding, as described by Strauss and Corbin (1998); Managing Organisational Knowledge; Managing Project Knowledge; Managing Professional Knowledge, the Role of IT and the Role of HRM.

The phenomenon of the management of organisational knowledge within the leading Irish construction organisations encompasses a wide variety of issues, many of which are evident in the other paradigms and will require further integration as the research proceeds. There are potential linkages between creating knowledge and CPD, which is concerned with creating professional knowledge. In terms of finding knowledge, IT has a role to play in facilitating a people finder/skills database and HRM a role in maintaining such records.

At project level, lessons learned practices facilitate the capture of knowledge, whilst HRM has a role to play in capturing professional knowledge through appraisals and recording of CPD activity. The role of IT in storing knowledge is evidenced in an intranet which could potentially encompass lessons learned, a people finder/skills database; and a learning management system for CPD and inductions.

A number of knowledge-sharing activities can contribute towards CPD: site visits, workshops and seminars, meeting with peers (between professionals of similar management levels/experience), mentoring (between more experienced and less experienced staff) and conferences. IT can also facilitate knowledge sharing with email allowing the sharing of knowledge/useful information; however, it must be noted that such technologies are not used by all staff.

The management of project knowledge through lessons learned practices highlights a number of KM-related processes including capture, store, share, record, analyse, disseminate, record and collect. It is clear that many of these mirror the processes identified in the management of organisational knowledge, with more consistency in the use of such terms required. There are also a number of challenges identified in adopting

LL practices which may have connotations in a wider sense when discussing KM, including loss of context, usefulness, relevance, fragmentation, and a distribution gap. Other implementation issues, such as the need for a champion and senior management support, implementation on a pilot basis, lack of time and resources, monitoring of staff engagement, and integration into existing work practices, also appear to be applicable to the wider aspects of managing knowledge.

There are also obvious links between this paradigm, and others including, the role of IT in storing lessons on a database or intranet; linking project team members details on lessons to a people finder/skills database, and using emails to disseminate lessons to relevant people. It is also evident that CPD activities such as seminars, site visits and focus groups should be aligned with LL practices, whilst training on the use of an LLDB and the actual lessons themselves could be incorporated into CPD. The HRM function has a role to play in facilitating activities such as training, seminars, site visits and focus groups. An individual's professional knowledge, role and experience will also have an influence on their level of involvement in LL practices.

The phenomenon, the development of a construction professional's knowledge through CPD, is closely linked to their role and experience, and suggests that as professionals gain experience their CPD needs change. In this context, it is evident that as novices gain more experience, they move from mode 1 knowledge production (such as formal training) towards being veterans, where mode 2 knowledge production may be more appropriate and relevant.

There is significant overlap between CPD and KM activities such as lessons learned, mentoring, site visits, training, workshops and seminars, the alignment of which could potentially improve the involvement of professionals, although the role of the professional body requires further consideration in this regard. From a KM perspective, the concept of action learning for experienced professionals is an area that requires further consideration. There are also obvious links between this phenomenon and the other four which require further investigation and integration, such as using an intranet for CPD, the role of HRM in promoting learning opportunities, and the potential for project and organisational

knowledge to form the basis of CPD activities. This will need to be considered in the context of the professional's role and level of experience, both of which will dictate their ability to engage in some of the aforementioned activities. One such area which has been identified in this regard is the role of middle managers acting as a 'hub' for KM within construction organisations. They have been identified as being involved across a range of KM-related activities such as performance appraisals, mentoring, LL practices, delivering CPD, conducting research on new products and building methods and acting as an interface for sharing knowledge across projects.

The role of IT in facilitating KM within the leading Irish construction organisations is dictated by a number of intervening conditions, including the individual's perspective and the existing infrastructure. With the main applications of IT comprising email, Office and an intranet, there is potential for these to be used to facilitate a number of the identified KM processes including capturing, storing and sharing knowledge. The use of an intranet to facilitate a lessons learned database, a people finder/skills database and as an online CPD resource, also require further consideration in the context of the other phenomena.

Perhaps the least well-developed of the paradigms, the supportive role which HRM plays in facilitating the use of available knowledge and encouraging people to learn, requires further development through the incorporation of additional literature and further research. What is evident, is that HRM has an important role to play in facilitating both mode 1 and mode 2 knowledge production, through a variety of CPD-related activities. The induction process is seen as being an important tool in showing new employees where knowledge exists within the organisation, in the form of policies and procedures and other employees, and it has been suggested that an intranet could facilitate some of the induction process. Managing staff CVs and CPD records, managing the performance appraisal process, identifying expertise within the organisation, and liaising with professional bodies also fall under the remit of the HRM function.

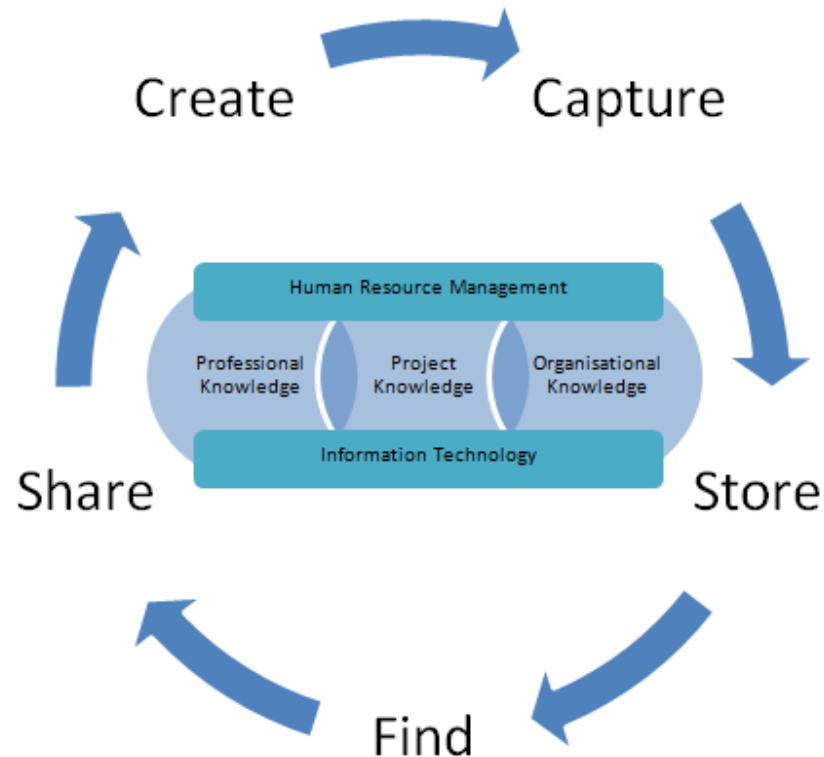


Figure 30: Framework Emerging from Phase 2

It is now apparent that there is a certain amount of overlap between the five paradigms which have been developed. Returning to the advice of both Goulding (2002) and Gibbs (2002) a revised framework has been developed in diagram form which attempts to further integrate the overlapping relationships. As can be seen in Figure 30, the various processes associated with KM at different levels have been refined to include five common processes; create, capture, store, find and share. There is evidence of these processes in relation to professional, project and organisational knowledge, which will require further integration as the research proceeds. Organisational knowledge, in a broad sense, refers to the people, projects, processes and systems and external business environment. Project knowledge comprises the context in which it was undertaken (type of project, management team, location, value), specialist technical and management knowledge, and performance factors, such as finance, programme, quality, safety, suppliers and subcontractors. Professional knowledge is concerned with the individual's previous experience, past projects,

background, role and other relevant skills. With regards to professional, project and organisational knowledge, the linkages between Information Technology and Human Resource Management are reflected in their respective roles at each level. For example, IT can support professional knowledge through online CPD and a skills database, project knowledge through a lessons learned database, and organisational knowledge through an intranet. Whilst HRM has a role to play in organising a variety of activities, such as CPD, focus groups and workshops at the different levels. Specifically, the overlap between identified CPD and KM activities is an area that merits further investigation in the context of the role of HRM. There is also a need for further consideration of the overlap and interrelationships between the three levels of knowledge. The important role of middle managers as a potential hub for KM across professional, project and organisational knowledge and the effect of experience on involvement in KM are areas which require further consideration also. The challenges associated with managing knowledge identified in Chapter 4 (i.e. relating to the industry, organisation and specific to knowledge) have been subsumed into a number of the paradigms, as has the supportive learning environment category. The location of external knowledge within the framework also requires further consideration, as does the role of professional bodies in the context of both individual CPD and organisational KM, particularly in the context of Engineers Ireland's CPD scheme.

With regard to the areas for theoretical sampling identified in Chapter 4, both case studies focused on the construction professional and additional literature relating to lessons learned and CPD. Other areas identified in Chapter 4 included HR Managers, Professional Bodies and Other Industries. Considering the preceding discussion, it is evident that further exploration of the role of HRM is still required particularly in relation to supporting learning and development, facilitating CPD and KM activities, inductions, performance appraisals, managing staff records and liaising with professional bodies. Given that Engineers Ireland's CPD scheme has emerged as an important focus for many of the leading Irish construction organisations, this will also require investigation in terms of how both construction and non-construction organisations are meeting the KM criteria. A further review of literature is also necessary to explore the role of HRM in KM, the potential alignment of CPD with KM, and the development of work-based action learning for more experienced professionals.

7.7 Summary

Building upon the emerging issues and initial framework identified in Chapter 4, and through axial coding of the findings of the two case studies, the emerging issues associated with KM in the leading construction organisations have been consolidated into five paradigm models as follows:

1. Managing Organisational Knowledge: now seen as a critical resource, the management of organisational knowledge within the leading Irish construction organisations has been given considered as a result of their involvement in Engineers Ireland's CPD accreditation scheme. Due to the nature of the construction industry, and the inherent characteristics of these organisations, in developing a more formal approach to KM there is a need to consider resources, culture, the nature of knowledge and senior management support, amongst other things. Whilst it must be acknowledged that much knowledge is 'managed' in an unplanned manner, there are a variety of formal strategies associated with creating, capturing, analysing, storing, findings and sharing knowledge, the development of which can lead to improved organisational performance
2. Managing Project Knowledge: one of the main areas of concern to construction organisations is the management of project knowledge, the loss of which can lead to reinventing the wheel and repeating mistakes across the organisation. The adoption of lessons learned practices can aid the management of specialist technical, management and performance knowledge. The nature of construction projects inhibits the capture of important lessons learned, with other factors such as intra-organisational fragmentation, perceived usefulness of the LL, and the need for an effective process also having an effect. A combination of human interaction and IT tools appears to be the preferred approach to lessons learned, with the lessons captured during a post-project review being subsequently verified by an expert and stored on a database. The lessons should also be integrated into existing work practices and become part of company policy where relevant. Whilst the adoption of such practices should lead to improvements in organisational performance, it is imperative that the engagement of staff in the entire process is given careful consideration

3. Managing Professional Knowledge: as construction professionals progress through their careers, their learning and development needs change, moving from formal training towards mode 2 knowledge production (which is socially generated and anchored in practical, context-specific here-and-now problems). Whilst the nature of the industry can inhibit engagement with CPD, the leading Irish construction organisations place significant emphasis on providing opportunities for staff to engage in CPD activities in order to meet the requirements of their relevant professional bodies. The individual's age, background, role and experience, the presence of a supportive learning environment, and visible senior management support, all have an impact on engagement with CPD. There are a variety of both formal and informal activities which are recognised as CPD, which can deliver benefits not only to the individual, but the organisation also. Middle managers have been identified as having a central role in managing knowledge within construction organisations, through their involvement in a range of CPD and KM related activities
4. The Role of Information Technology: IT has a role to play in facilitating KM within the leading Irish construction organisations, overcoming some of the challenges of geographical dispersion and intra-organisational fragmentation and aiding the connection of people within the organisation. The use of an intranet as a central source of information could potentially facilitate a people finder/skills database, a lessons learned database and online CPD activities; whilst email could aid the sharing of information/explicit knowledge across the organisation. However, the use of such technologies may not have a positive effect if there is a tendency for information overload. It should also be recognised that site-based staff such as Foreman and Site Engineers tend to use IT on a less frequent basis than their counterparts who are based in an office
5. The Role of HRM: the selection, recruitment, retention, reward and development of construction professionals is of great concern to the leading Irish construction organisations. The HRM function, which typically oversees such issues, is also responsible for formal training, informal learning strategies, managing staff records, identifying expertise, and managing performance

appraisals and inductions. The effective deployment of these can facilitate the use of available knowledge, and encourage people to learn more effectively

Subsequent discussion identified significant overlap and interrelationships between all of these paradigms, whilst also highlighting the need for additional exploration of the role of HRM.

Chapter 8
Engineers Ireland's CPD
Accreditation Scheme

8 ENGINEERS IRELAND'S CPD ACCREDITATION SCHEME

The role of the HRM function within KM has been identified as significant and meriting further investigation. As discussed previously, the EI CPD Accreditation Scheme has emerged as a driver for the implementation of KM within the leading Irish construction organisations. Through consultation with the CPD Accreditation Manager, fourteen champions of the CPD scheme, from both construction and non-construction organisations, were identified and interviewed; the majority of these work within the HRM function. The latter were selected on the basis of best-practice KM, with the anticipation that this would aid the development of the emerging grounded theory and address the research questions from an out of sector perspective also.

As can be seen in Figure 31, the findings of the semi-structured interviews with the 'CPD champions' are presented in this chapter (see Appendix M for the interview questions). Through further axial coding, these findings are then discussed in the context of relevant literature and the five paradigms (developed in Chapter 7), with a specific focus on developing the HRM paradigm model in further detail.

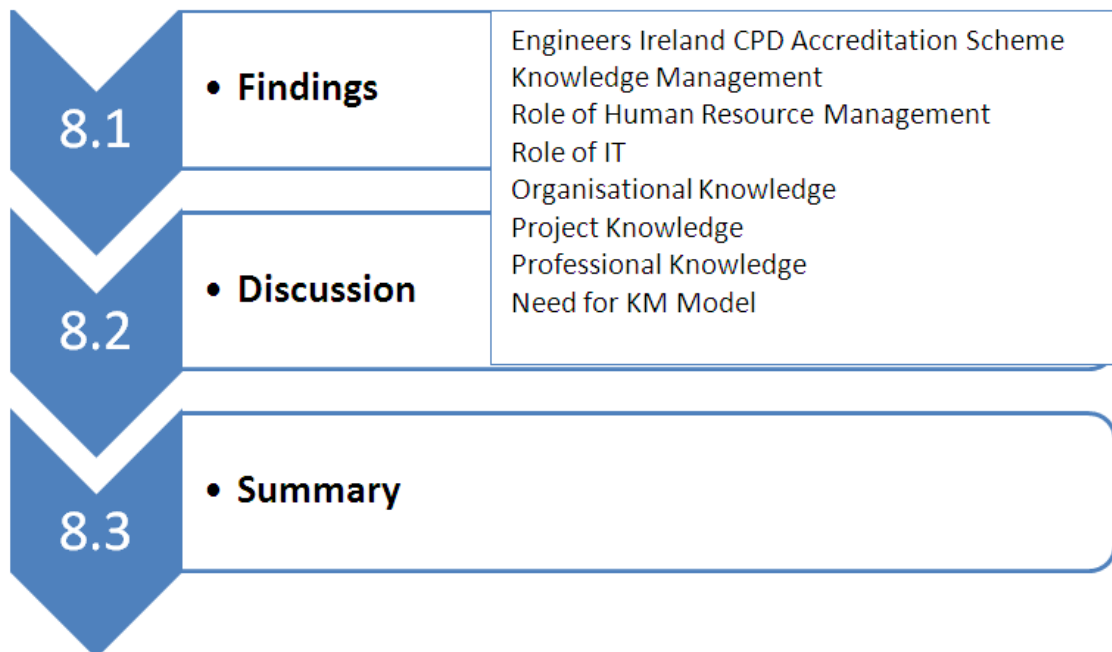


Figure 31: Chapter 8 Overview

8.1 Findings

Based on discussions with EI's CPD Accreditation Manager, a number of participating organisations were identified, drawn from both construction and non-construction organisations. Many of these organisations were selected on the basis of the EI's experience of auditing them as part of the accreditation process, having found interesting practices in a diverse range of organisations. Both Case Studies A and B, along with a further three leading construction organisations, participated in this phase of the research. Six organisations that were not construction firms also participated, including two engineering consultancies, a local authority, manufacturer, a road design office and a utilities group also took part. As can be seen in Table 32, the majority of the participants work within the HR function of their organisation. Their roles included: HR Manager, Training Manager, Learning & Development Specialist, CPD Manager and HR Specialist. At the time of the interviews, only one organisation, Engineering Consultancy A, was found to have a dedicated Knowledge Manager, who had only been recently appointed. All but two of the participating organisations had achieved accreditation with EI.

	Interviewees Role	Employees Irish (Global)	Operations	EI Scheme
Construction Organisations				
Case Study A	HR Manager	750	National	Accredited
Case Study B	HR Manager & Intranet Manager	1,700	National	Protocol
Contractor C	HR Manager	1,200	National	Accredited
Contractor D	Quality Manager	400	National	Accredited
Contractor E	HR Manager	800 (26,000)	International	Protocol
Other Organisations				
Eng. Consultant A	Knowledge Manager	500 (10,000)	International	Accredited
Eng. Consultant B	Business Development Director	100 (12,000)	International	Accredited
Local Authority	Training Manager	500	City	Accredited
Manufacturer	Learning & Development Specialist	1,700 (13,000)	International	Accredited
Road Design Office	Director & Senior Engineer	20	County	Accredited
Utilities Group:				
- International	CPD Manager	1,500	International	Accredited
- Networks	HR Specialist	3,700	National	Accredited
- Power Generation	HR Specialist	1,200	National	Accredited
- Customer Supply	Training Manager	550	National	Accredited

Table 32: Interview Participants involved in EI CPD Accreditation Scheme

It can also be seen in Table 32 that the size and scope of the organisations varied greatly, from the Road Design Office, who employed 20 people and operated within one county, to

Contractor E, who employed 26,000 people across the globe. The diversity should lead to a range of different approaches to KM, from which suitable lessons could be applied to the leading Irish construction organisations. While the main focus of this phase of the research is on the role of HRM, the following sections also present a summary of the findings drawn from the fourteen interviews relating to EI's CPD Accreditation Scheme, KM, the role of IT, organisational, project and professional knowledge and the need for a KM framework.

8.1.1 Engineers Ireland CPD Accreditation Scheme

The interviews commenced by asking the respondents to discuss the reasons behind their organisation becoming involved in the CPD scheme, and any subsequent benefits they have derived. Table 33 illustrates the main reasons cited for becoming involved in the scheme, along with the main system identified for fulfilling the KM criteria. Twelve of the participants identified 'an intranet' as fulfilling the KM system criteria.

	Reasons for Involvement in EI CPD Scheme	KM System
Construction		
Case Study A	Review graduate retention & performance management	LLDB
Case Study B	Recognition of existing CPD practices	Intranet
Contractor C	Improve training and development; marketing tool	KM Forum
Contractor D	Marketing tool; improve focus on staff development	Intranet
Contractor E	Improve recruitment and retention of staff	Intranet
Non-Construction		
Eng. Consultant A	Marketing tool; recognition of existing CPD practices	Intranet
Eng. Consultant B	Improve recruitment and retention of staff; marketing tool	Intranet
Local Authority	Recognition of existing CPD practices	Intranet
Manufacturer	Recognition of existing CPD practices	Intranet
Road Design Office	Recognition of existing CPD practices	Intranet
Utilities Group:	Group HR strategy to pursue accreditation	
- International	Improve recruitment and retention; marketing tool	Intranet
- Networks	Improve recruitment and retention; validate work of HRM	Intranet
- Power Generation	Recognition of existing CPD practices	Intranet
- Customer Supply	Recognition of existing CPD practices	Intranet

Table 33: Reasons for Involvement in EI CPD Scheme

As identified in Chapter 5, Case Study A developed a Lessons Learned Database, whilst Contractor C holds bi-annual knowledge sharing sessions for staff in the form of project presentations, followed by Q&A and discussion. Some of the more pertinent responses with regard to involvement in the CPD scheme are described below.

In Case Study A, the Director with responsibility for HR wanted a review of graduate retention and the company's performance management system. By focusing on these business concerns, the HR Manager felt that the scheme has made the company *"more structured in the way we approach graduates, taking on a set number each year, having a programme for them...also being quicker at pinpointing people who are star performers."*

According to their HR Manager, Contractor C became involved in the scheme, *"hoping for a knock-on effect in terms of retention and it was nice to put on advertisements;"* he continued, *"it was like doing a health check on your training and development, it forced us to focus on it and improve it."*

The Knowledge Manager with Engineering Consultancy A admitted that *"we would always have had good CPD practices...but Engineers Ireland have formalised it and it is something that we can put on our company's CV, when we are putting ourselves in for a job... we have the CPD accreditation and ISO 9001...that tells people that we employ staff who are continually developing."*

The Business Improvement Manager with Engineering Consultancy B stated, *"when it comes to dealing with clients and bidding for projects, you need to have an accredited learning and development system in place... it has also helped us to refine our training and development programme and in terms of staff it has certainly motivated them in meeting their CPD requirements."*

According to the Senior Executive Engineer with the Road Design Office, the organisation was already fulfilling a lot of the criteria for accreditation, which are all linked into their *"ISO system of continuous improvement...so with the appraisals, the quality management system, the KM system, training days, so just to tie it all up, the CPD accreditation scheme seemed to make sense, also having someone looking at our systems and giving us feedback on what we were doing."*

Historically, the Utilities Group have strong links with EI, which according to the Training & Development Team Leader with the International unit, led to *"the group as a whole*

wanting to get involved in CPD, it was a group HR strategy that had been developed at the time.”

The Learning & Development Manager with the Networks business views the scheme from two perspectives, it “*is seen as a commitment to the continuing professional development of existing staff,*” and “*from a HR point of view it acknowledges the work that has been done, which is very important for us as a business function.*”

The HR Specialist with Power Generation stated that “*we were able to align a lot of our processes with their requirements...the fact that we had a lot of elements already in place meant that was easier for us to seek accreditation.*”

According to the HR Manager of Customer Supply the other three business units were already accredited and although “*we would be seen as the softer side of the business we do have a number of engineers employed and as a business unit of the group we felt it was a good thing to become accredited.*”

It is apparent from the above findings that an intranet is the predominant KM system utilised by the participating organisations. There were various reasons offered for becoming involved in the CPD scheme including: to improve recruitment and retention of staff, as a marketing tool when tendering for work and to gain recognition of existing CPD practices.

8.1.2 Knowledge Management

Based on their involvement in the EI CPD scheme, particularly in developing and implementing a KM system, the interviewees were asked to articulate their understanding of KM.

The HR Manager from Case Study A responded: “*it involves being able to put systems in place to retain knowledge from people who are retiring, people who are moving...it's trying to take the practical, technical knowledge that people have and pass it on.*”

According to the HR Manager with Contractor E, *“people come and go, but the business is learning all along and it's about retaining that knowledge and sharing it, so if people come into the business, they have access to that knowledge, learning and innovation... and it's how you disperse that across the business, making it available to everybody.”*

The Engineering Director from the Road Design Office, who designed their KMS, discussed KM as follows: *“if you have knowledge and you have to harness it in some place, having it in people's heads is fine, but when those heads go you've lost the expertise, so you really have to harness it in other formats, in hard copy or electronic formats.”*

“We've been looking at knowledge management in terms of the people we have and what we need for the business going forward, identifying gaps in the staff's knowledge and skills,” the HR Manager of Customer Supply stated.

The Learning & Development Manager from Networks commented, *“we have a lot of systems in place to capture knowledge, but the real value of KM is when a new recruit walks into the company, how quick and easy is it for them to find out what they need to know to carry out the role.”*

The HR Specialist from Power Generation was of the opinion that *“in terms of a common understanding and an accepted definition, I don't think we are at that point, where everybody knows exactly what we are talking about.”* He continued by identifying a number of KM-related activities, *“the intranet, the learning and development infrastructure, lunchtime lectures, general presentations, policies and guidelines would be seen as the main devices as transferring knowledge.”*

A number of issues relating to the implementation of the KM system were discussed by the respondents including getting buy-in, integrating a number of existing systems, the important role of a KM champion, and measuring the effectiveness of the system.

In rolling out new systems and procedures, the Business Improvement Manager from Engineering Consultancy B admitted, *“getting buy-in can be a challenge because sometimes staff will look at this as just another process.”*

The Training Manager with the Local Authority also admitted, *“getting people to use the intranet is probably the biggest challenge, and keeping the information that is in there up-to-date.”*

In order for KM to be effective, the Training & Development Manager with the International operation felt that *“providing opportunities for sharing knowledge is really about doing things that fit in around people's work, on the other side is making sure that were doing things that are relevant to people's work.”*

The Learning & Development Manager with Networks identified the main challenge of KM as *“alignment, we probably have a lot of systems out there that are doing a very good job, but it would be good to have a one-stop shop, or a hub that you can go into, which directs you to information and knowledge.”*

The Road Design Office's intranet is *“one integrated system, there are no standalone components, everything feeds into it...there is the training, the ISO, surveying and equipment, the IT...it has to be integrated really.”*

The important role of a KM champion was identified by a number of respondents. The HR Manager from Case Study A spoke about the level of resources afforded to KM in other industries, *“at the last Engineers Ireland CPD symposium someone from another company gave a talk on knowledge management in their organisation, it was interesting to see how they did it, but they were so far advanced, they have a knowledge manager!”*

The QA Manager from Contractor D views himself as the champion of the new KM system in place, *“I would have been a champion, yes...I brought it to the point where I convinced enough people that they really need to do this.”*

The Training & Development Manager with the Manufacturer also discussed the need for a KM champion, *“from an encouragement point of view, I think if there was a focus, a group or champion who maybe strategically looked at it... on a departmental or organisational level but it needs to be driven from somewhere.”*

The challenge of measuring the effectiveness of KM activities was also highlighted as a challenge. In discussing the impact of the recently introduced management meetings, the HR Manager from Case Study A stated, *“we don't measure them as such no...measuring what people have learned from something is quite difficult.”*

The Training & Development Manager with the Manufacturer was of a similar view, *“it's hard because with learning and knowledge it's difficult to have defined measures.”*

Whilst Contractor E have well-developed systems, the HR Manager discussed the challenges of measuring the impact of KM, *“it is very difficult...it is something the company talks about and we do produce a human capital report, but they are intangibles and it is difficult to measure them in terms of return on investment.”*

The Knowledge Manager from Engineering Consultancy A spoke about reporting on the impact of his new role, *“I've met with the MD a couple of times about this, and recently compiled a one page report on activity related to KM...and I aim to do that on a monthly basis. As that builds up over a period of time, I would like to be able to look at it from a time/money point of view and results point of view, but that's the only way I can see at the moment.”*

The Senior Executive Engineer with the Road Design Office stated, *“we do think that it is working, but trying to actually quantify that is very difficult!”*

The International Operation's Training & Development Team Leader discussed the need for quantifiable measurement: *“I wouldn't necessarily say it's a difficult thing to do, but you have to have the willingness of the management to do that...the need for quantifiable benefits is not seen as a priority in comparison to other business issues...it's not going to be*

of use to the management team to do that, they see that once staff are having good quality conversations with the managers... that's the best feedback on the system, the qualitative feedback."

The HR Specialist from Power Generation also discussed the merits of measuring the benefits of KM, *"it's very difficult to bring measurement into the organisation and say for certain that the improvement in productivity or improvements in profit over the past 12 months is solely attributable to something like knowledge management or a training and development programme, anything HR-related is difficult to demonstrate value-add to business and quantify it."*

In discussing KM, many of the respondents spoke about various processes related to managing knowledge such as retaining, sharing, harnessing, learning, capturing, and transferring knowledge. In terms of implementing KM, a number of associated challenges were identified including getting buy-in from staff, integrating existing systems, the need for a KM champion and the difficulty in measuring the impact of KM. Many of these themes confirm the findings from the previous phases of research, aiding the further consolidation of the emerging paradigm models.

8.1.3 The Role of HRM

Many of the respondents discussed the role of the HRM function in their organisation's KM activities. In this regard, the Training & Development Team Leader with the International Operations of the Utilities Group spoke at length about the role of HRM in KM, *"providing advice on where the best practice HR would be...it's as much about HR as anything else, because of the implications for people...it has to be made real, it has to be about delivering real business benefits, it has to create efficiencies without causing too much pain to the people who are going to be involved."*

Whilst much of HRM's work is well-defined, the HR Specialist with Power Generation discussed the difficulty in integrating KM into HRM's activities, *"every year we sit down to do our HR business plan... we can get on and support the performance management*

system, CPD... but knowledge management tends to get left hanging there because it's hard to clarify what exactly we are talking about."

Specifically, the respondents discussed a number of HRM activities including induction, performance management, training and development, networks and relationships, managing staff records and providing incentives.

Whilst all organisations reported having an induction course of between half a day and a day, new recruits in Networks, *"would be put on a development programme, soft skills and technical skills, they also have mentors for 18 months,"* according to the Learning & Development Manager. The HR Manager from Case Study B spoke of using the Intranet for orienting new staff, *"they would be set up on the intranet and have an easy way of getting up to speed, they're not waiting for an induction course...it's a completely different way of learning."*

In line with the requirements of the CPD scheme, all of the organisations have a performance management system in place. The Knowledge Manager with Engineering Consultancy A spoke of the role of HR in this regard, *"our staff appraisals are also managed by HR, and there are outcomes from the appraisals such as identifying the needs of particular training and they come through HR, where they try to identify any commonalities."* Individual learning objectives are now aligned with the company's strategy, according to the Training & Development Team Leader with the International operation, *"what we have done with the revised performance management system is, we have a cascade process so we start off linking it to the company objectives, because people were saying that the objectives that were set in the performance management weren't really relevant to the company strategy."*

The benefit of training and development activities was discussed by the HR Specialist with Power Generation who stated, *"training programmes are great forums for shared learning, if you get 12 people in the room there is a wealth of knowledge, the debate is great."* In addition to externally provided training programmes, the respondents gave examples of internal training and development activities.

- Development Programmes: the Manufacturer has an in-house training programme where *“over a period of 3 months, we brought 80 people through our project management procedures, got some of our really good project managers in here to talk to them about project management, and we brought a PM guru in from abroad who went through the generic PM stuff, and resulting from that we chose a number of people to go on to do a certified project management programme...so what I try to do is capture the trends based on the individual training needs and see are we aligning them properly to the business.”* Networks have also initiated a development programme for over 200 of their middle managers.
- Staff Presentations: many of the organisations get staff to make presentations to colleagues on a variety of technical and management topics. The International operation organise ‘lunch and learns’ for staff, which have *“been really good as a knowledge sharing tool.”* As part of a change management process, Customer Supply *“had breakfast briefings every second week which were made by our staff...so there was a wonderful sharing of knowledge there, and they were given by staff at all levels from senior management right down.”*
- Lessons Learned Seminars: as discussed in Chapter 5, Case Study A deliver lessons learned seminars to staff, with the HR Manager *“facilitating that and working with the quality department to coordinate the seminars.”*
- Meetings: the Training Officer with the Local Authority spoke of her *“involvement in setting up knowledge sharing meetings”* which bring together staff from different departments, a similar initiative has been setup in Case Study A where all middle managers meet on a monthly basis to share knowledge. In organising such meetings, the HR Specialist with Power Generation stated, *“people will always attend meetings more willingly if there is a proper context set, there is some clear objective...you've got to choreograph all of that.”*

- Develop Informal Learning Strategies: the Training & Development Manager with the Manufacturer spoke of the increasing recognition of work-based learning, *“I’m finding that there is a swing away from going on courses to some deep learning in the workplace.”* The HR Manager with Contractor E stated, *“I am doing some information sessions on how we learn, on-the-job, off the job... that is going to be quite interesting to see how people pick that up and run with it.”*
- Monitor CPD Activity: the HRM function in Engineering Consultancy A *“monitor staff to ensure that everyone reaches those 37.5 hours a year per person and that ties in with our online timesheets, where we are supposed to log our time spent on particular projects, and CPD has a job number.”*

A number of the respondents spoke of HRM's role in facilitating the development of relationships within the organisation. The HR Manager with Contractor E spoke about this in the context of knowledge sharing, *“the most recent thing we have done was team building, which was great fun, but again it builds up the relationships, it's about knowing the person to ring, it's who you know not what you know, if you don't know the answer you know someone who might and that's encouraged.”*

The Knowledge Manager with Engineering Consultancy A spoke about a recent project review that staff were invited to, *“it was off-site...that review finished around five o'clock and afterwards there were some drinks for staff, so that kind of thing where you mix work with a bit of fun is a good idea...it is a good idea to meet people you wouldn't normally meet.”*

Building relationships was viewed as particularly important for new recruits to the organisation, according to the HR Specialist with Power Generation, *“I had a new recruit in with me yesterday and I was reinforcing that point, it's a very important way of doing business in this company, building contacts and relationships within the company and they remain important throughout your career.”*

The importance of building relationships between staff from different regions was highlighted by the HR Manager with Contractor C, *“given the setup geographically it's trying to get the fellas to meet, a lot of knowledge is person to person in the construction industry, so if we can get the guys in Cork to meet with the guys up in Dublin and get them to establish contacts and discuss things, that is where KM happens.”*

Similarly with Networks, *“one of the big benefits of [the middle management programme] is the setting up of informal networks and sharing of knowledge.”*

In terms of managing staff records, Engineering Consultancy A's Knowledge Manager spoke about staff CVs: *“each professional staff member would also have a CV for submissions, which includes educational qualifications and professional qualifications, so I have started to track them in conjunction with HR.”* This was a theme continued by the Intranet Manager from Case Study B, who spoke about putting CVs on the newly developed intranet, *“we're also looking at putting up staff CVs, because when you make a submission you have to include management team CVs.”*

The Knowledge Manager with Engineering Consultancy A believes that *“you have to give people incentives, one of the reviews we did on a project we were working with a Portuguese engineer and the review took place in Portugal...so you're trying to incentivise people.”*

The International operations of the Utilities group use incentives *“in some cases for example if someone makes a publication or a presentation to a national or international forum, we incentivise in that respect to try and encourage people to use and develop the technical knowledge,”* the Training & Development Team Leader stated.

In discussing getting people to buy-in to the new intranet, the Intranet Manager with Case Study B commented, *“we are thinking of putting up a section where staff can make suggestions on how we can make improvements within the company and there might be a prize for the 10 best suggestions every quarter or something.”*

The HR Specialist with Power Generation spoke of the dilemma of basing rewards and incentives for knowledge-sharing on an individual basis, *“at an individual level, the old notion of knowledge being power is always going to be there, if somebody has some knowledge that someone else doesn't have that puts them in a more powerful position and in organisations where there is competition for how you advance, that is a challenge and we debate this in terms of moving to a team-based approach to work...that's all well and good on one hand, but people are being rewarded on an individual level.”*

With the central focus of this phase of the research being on the role of HRM in supporting KM, the interviewees highlighted a number of areas where this can occur. These included inductions, performance management, training and development, building relationships, managing staff records and providing incentives.

8.1.4 The Role of IT

With the majority of organisations identifying IT systems as the focal point of their KM activities, much of the discussion centred on the role of IT in KM and more specifically the role of HRM in supporting such systems. All of the respondent organisations have an intranet, apart from Case Study A, where the HR Manager spoke about the need for further development of IT, *“it would be good if we had an intranet as opposed to the K drive, we have still a way to go in that regard.”*

Case Study B are currently developing their Intranet, and have an Intranet Manager dedicated to this task on a full-time basis; their Intranet Manager commented *“the idea is that all of the information within the company is on the intranet... in terms of knowledge management, we are looking at developing a section on lessons learned for each sector of the business.”*

The HR Manager added, *“we have also developed e-learning modules, health and safety have developed some modules on-site housekeeping, and that will be rolled out through the intranet.”*

The HR Manager with Contractor C admitted that *“we're not quite good on the formal side of KM; we are using the intranet for posting information here and there.”*

Contractor E has developed their own intranet which facilitates online communities of practice, has a document repository and *“a facility under our KM banner, where people can submit documents on project or innovative practices or new practices and they would be made widely available.”*

Whilst the Knowledge Manager from Engineering Consultancy A acknowledged that the intranet provided a focal point for KM, he stressed that KM comprised a variety of technologies and social activities, *“we find there has to be a mix and I'm striving to maintain that mix.”*

Engineering Consultancy B has an intranet which facilitates communities of practice based on disciplines, a best practice section, a search engine and a discussion forum. The intranet is also used to provide *“access to CPD courses online, we provide training online in certain areas, such as report writing, letter writing, finance...I suppose because we are such a big company we have a lot of processes and systems in place.”*

When staff log onto their computers in the Local Authority, *“the intranet home page comes up. There are a number of features on it that would prompt people to use it, such as the phone book, notices, and social aspects.”*

The Training & Development Manager with the Manufacturer also identified an Intranet, on which they have a *“company university where you can go online and take various courses, listen to lectures, view presentations etc. We also have an engineer's community online for sharing knowledge, a learning management system within this plant for managing development and training, and there are also e-rooms for collaborating on projects.”*

The Road Design Office have developed their Intranet *“around our ISO system, which includes document templates, project management, the KMS, a library...but it's handy to have everything in the one place, so that people can easily find it.”*

“Day-to-day the intranet is the main vehicle for getting people to buy into knowledge management,” within the International business unit, *“we have information about the company, information about processes and procedures, different business tools, technical knowledge, we've a lot of different systems, a lot of information about HR.”*

“The intranet would be used a lot for sharing safety information, monthly briefings are posted, video clips, accidents and incidents,” according to the Learning & Development Manager with Networks, while a HRM information section has also been set up recently.

Power Generation, *“have an intranet which provides up-to-the-minute information...if you want to look at safety, there's a whole catalogue of safety guidelines... so all that is available there on the intranet if people want to access it.”*

Four of the respondents identified a skills database within their organisation, whilst the Intranet Manager with Case Study B spoke about developing such a database on the intranet, *“where we would have pictures of all the staff... the big problem with those at the moment is that we have so many sites, it's hard to keep track of where people are, so this new system on the intranet will allow people to go in and change their details, what site they are working on, their contact details.”*

Contractor E already has such a system in place, *“you can look for people who've been involved in similar projects and on our homepages it has our addresses so we can be contacted. People will update their training and employment history, you can search for people based on previous employment, that kind of thing... but again the challenge is trying to get people to keep it up-to-date which can be a bit of a struggle.”*

Engineering Consultancy A have a long established people finder across their international operations, but according to the Knowledge Manager *“we probably don't use that much*

here...they use it more in the UK to be honest...everyone is signed up to it, but we haven't kept up to date with it, it's something on my list to see how we can push it on.” He continued, *“the homepage consists of your name, role and level, professional interests, your previous projects and outside interests.”*

The role of HRM in developing such systems was discussed by the HR Manager with Customer Supply: *“we have a system set up that we developed from our own staff records, where we developed a database of the types of skills and qualifications that all staff have, so for example, if we needed someone with a marketing skill we could go back to that database and see who we had, but that was only available to management and HR.”*

The International operation has a *“system we developed called ‘find an expert.’ It's been a system that we found has been particularly useful for new staff coming in who wouldn't have experience in particular areas. The idea behind it is that we identified in it technical skills across the company, and then the managers identified the people who would be an expert in those areas, so when you actually see the system you can go down through the various skill sets, drilling right down there's different filtering facilities you can use, and then it brings up a picture of the person and a phone number.”*

Broader issues concerning the use of IT by staff such as accessibility, a user-friendly interface and information overload were also raised during the course of the interviews. The HR Manager from Case Study A discussed the challenge for certain staff in accessing IT, *“the professional staff might have their own computer on-site, but some people, such as foremen might not have access.”*

This issue, it appears, is not exclusive to construction, according to Power Generation's HR Specialist, *“the intranet is fine for people based in an office, but of the 1200 people we have, only a small percentage will be based in an office, the majority of guys are walking around stations, now they can get access to a computer if they want, but it's not going to be a natural part of the day.”*

The Intranet Manager discussed the security aspects of Case Study B's intranet, *"all users will have access to the main page, health and safety, human resources, but there will be areas that they won't be able to get into... we can password protect down to a document or a library or a section within the site, so it is very good on the security side. For example business development and marketing, that will only be accessible to directors, contract managers and senior quantity surveyors."*

In discussing their new KM system, the QA Manager from Contractor D spoke about *"levels of authority within it, the higher up in the food chain you are, the greater spread of access you have, the MD will see everything if he wants to."*

There are similar controls within the Local Authority, *"we have limits on accessibility within the intranet, for example you can share the information within your department, your section or everyone in the organisation, so there are different limits on the privileges of who can see what on the intranet."*

The new system in Contractor D will allow users to *"have their own homepage...you would design your homepage based on what you want, you can also have alerts if there was a certain subject you were interested in...it can be linked into Outlook and that can alert you when something new comes up."*

A similar feature is available on Engineering Consultancy B's intranet, *"when you first log on to the system everyone sees the same page but it allows you to customise the homepage to suit your own preferences."*

Information overload was a theme continued by the Training & Development Team Leader with the International Utilities business, *"it's very well laid out and sensible to navigate, the only downside, perhaps, is that there might be too much information on it, and sometimes it can be difficult to find what you're looking for, or you may not even know that it's up there."*

The Knowledge Manager with Engineering Consultancy A also discussed the intranet in this regard, *“at times there can be such a huge amount of information and knowledge that you obviously need a search engine, the information also needs to be kept up to date and continually updated, there is no point in putting up a whole load of information and then walking away, people will be more inclined to look at and access the intranet if the information is kept up-to-date.”*

The HR Specialist with Power Generation confirmed this, stating *“one of the challenges is how you keep the intranet attractive enough for people to use it, keeping it up to date with news, whilst on other pages you have your staple of information that you know you can draw upon, but it is always a challenge and you need to have regular news to keep as current as possible.”*

In relation to developing and supporting IT, both senior management and technical support were identified as important during the interviews. The HR Manager with Contractor C spoke about the role of senior management in supporting the development of IT within his organisation, *“we haven't really been using IT to its maximum potential, we've used it as a support service at a low level. The senior management hasn't really seen IT as a resource which can drive and put a cutting edge on some of the stuff we do internally, we're trying to address that, but it is an education process.”*

The resources deployed to support IT vary across the respondent organisations. For Contractor E's intranet, *“there is a whole team of people based in India, who manage it, it is updated daily... there is industry news available on it, project information, various other things... it's huge.”* In the International Utilities business, *“the IT team looks after it but you will find the actual information comes from the different units in here,”* according to the Training & Development Team Leader.

Given that the majority of the respondents identified an intranet as the focal point of their KM activities, there was considerable discussion surrounding the role of IT in KM. An intranet was employed to varying degrees in all but one of the fourteen organisations, with a variety of resources deployed on it, including lessons learned, e-learning and learning

management systems, communities of practice, best practices, search engine, discussion forums, document templates, and company news and information. Another KM resource identified was a staff skills database, which the HRM function had an important role to play in managing. The interviewees also confirmed a number of themes which emerged in the IT paradigm model in Chapter 7, including the need for systems to be available, accessible, user-friendly and secure, the resources required, and the importance of senior management support.

8.1.5 Organisational Knowledge

In terms of the organisational knowledge paradigm, the interviewees recognised the challenges of intra-organisational fragmentation, the need for a supportive learning environment and the use of policies and procedures as a means of capturing knowledge. The size of the organisation was discussed in relation to intra-organisational fragmentation by the HR Manager with Case Study B, *“in such a large company, communication is not going to happen naturally, we've got approximately 250 sites and people moving between them all the time, and the sharing of information and knowledge has to be more structured, people don't have the relationships throughout the organisation that they had previously.”*

The Training Manager with the Local Authority also recognised this problem, *“even at the moment we have new teams set up to look at knowledge sharing across the organisation as a whole, in each department...it's hard with such a big organisation.”*

The regional divide was discussed by the Knowledge Manager with Engineering Consultancy A, *“things are probably easier in Dublin because we are all in the one building now, but at regional level I need to be continually aware that it's not just Dublin I'm dealing with.”*

The HR Manager from Contractor C also spoke of the problems of such regional fragmentation, *“basically the Cork guys were doing the same jobs as us up here, but neither of us were talking to one another, we were starting a job maybe six months after them, we were meeting the same problems that they faced and overcame and of course we*

weren't learning from it and that's where KM is important. But sometimes the structure of the organisation works against you."

In attempting to identify a supportive learning environment, many of the interviewees discussed the supports in place for providing CPD opportunities, financial support for professional membership, fees and further education.

"There is definitely a good learning environment in that people are encouraged to learn and feel that if they don't learn it may hold them back," the HR Manager with Case Study A remarked.

The Training & Development Team Leader with the International Utilities operation identified a number of activities which are evidence of a supportive learning environment, *"lunch and learns...payments for publication awards...we very much support chartered membership of professional institutes...we have an education policy...the leadership and management development programme we have internally, so we put a lot of emphasis on trying to improve knowledge of our staff."*

Whilst the HR Manager with Contractor E acknowledged the need for a supportive learning environment, she stated, *"pushing it back to the individual is the only way that it can succeed, creating a culture of learning within the organisation and being very supportive, financially and in terms of time off is important, but the individual has to drive it."*

"It's definitely about creating an environment where people support each other and share knowledge," the HR Specialist with Power Generation commented, continuing *"I think all that an organisation can do is to create an environment and provide the opportunities for people, you can't force them to share knowledge."*

Senior Management Support was also recognised as important. In making a case for the new KM system, Contractor D's QA Manager *"realised very early on that my enthusiasm would only carry me as far as the board room door, after that it had to be a director."*

Similar discussion focused on the importance of senior management support in relation to a variety of other initiatives; with Case Study A's HR Manager acknowledging *"there is very good support from senior management for training and development in general."*

The Intranet Manager viewed such support as crucial in developing the intranet in Case Study B, *"apart from me, there are two directors heavily involved and they have had a lot of input."*

In ensuring the success of the middle management development programme, the Learning & Development Manager with Networks stated, *"the executive director would have issued notice of that programme so there is evidence of strong leadership and support."*

The concept of linking creating new knowledge through continuous improvement, and linking it to organisational processes and procedures was discussed by a number of the interviewees. In discussing the KMS, the Engineering Director with the Road Design Office stated, *"the key to it is continuous improvement...how we harness the information and knowledge coming in from those things such as circulars, training courses, books in the library, resident engineers, site feedback."*

The HR Specialist with Power Generation gave his views in relation to this issue, *"we would have very well-developed procedures and policies, we would be a heavily procedure-oriented organisation, with a lot of documentation and guidelines about how things should be done, and in a way that is knowledge management."*

In Case Study A, *"the quantity surveyors have developed a site administration handbook and they are going to roll out training in the next 6 to 12 months on that handbook, which includes everything you need to know."*

Similarly, Case Study B, *"have developed a quantity surveying handbook between a lot of different people...so if you were a new quantity surveyor joining the company in the morning, you could go on to the intranet and see exactly how we operate in terms of*

quantity surveying, and we are hoping to do that for engineering, planning, estimating etc.”

The Road Design Office, according to the Engineering Director *“have a forum called a monthly technical review meeting where suggestions are invited from team members, as well as that people can volunteer information and apply to get our process improved.”*

A number of respondents spoke of developing CPD around their organisation's policies and procedures. Contractor E, for example, *“are going through a programme at the moment of upskilling and reskilling in relation to our standards...because we are so process driven we have documentation on absolutely everything and we would take people through the relevant processes.”*

In relation to organisational knowledge the key themes to have emerged include intra-organisational fragmentation, the need for a supportive learning environment (particularly senior management support), and the capture of valuable knowledge in organisational policies and procedures. This confirms a number of the themes identified in ‘managing organisational knowledge’ in Chapter 7.

8.1.6 Project Knowledge

The construction industry is by no means unique in its project-based nature, an issue that was reflected by a number of the non-construction organisations. The Learning & Development Manager with Networks reflected upon this aspect of her organisation, *“the main focus is on project delivery, getting it over the line, but I'm not sure how much of the learning is captured along the journey. By the time the project has peaked, people are probably moving onto the next one and it's such a fast pace, but we probably don't reflect enough on where we are at and what we've learned, and look at how we can approach it the next time.”*

This was confirmed by her colleague in the International operations, *“the culture here is very much work to the deadline, get the project done and move on to the next project...so the time for reflection when busy is not going to happen.”*

Whilst all of the non-construction organisations indicated that projects form an important part of their business, only three have formal lessons learned procedures. The Local Authority conduct a *“lessons learned, and that will happen at the end of every major project that goes on here, the good and the bad, and all of those reports will be made available to the relevant people on the intranet.”*

The Road Design Office are required to generate reports for the National Roads Authority (NRA), *“our projects are divided into seven phases...and you have a general wrapping up at the end of each phase and that's when things go back into the system.”*

Engineering Consultancy B *“have a project review sheet where the team sit down and review all of the areas, where we've done well and where we could improve, perhaps where we lacked experience or technical ability.”*

In contrast, the HR Manager with Contractor C stated that the company has considered introducing project reviews and lessons learned, *“we've actually talked about them, but fellows here think if you're doing that, you are allotting blame, it's a witch-hunt!”*

In keeping with the themes contained in the ‘managing project knowledge’ paradigm (in Chapter 7), the interviewees confirmed a number of issues. The nature of projects in terms of pressure, deadlines and resources was highlighted, as was the importance of conducting post-project reviews and capturing lessons learned.

8.1.7 Professional Knowledge

The important role of middle managers in KM was confirmed by both Case Study A and Networks, who have specifically targeted them in an attempt to improve knowledge sharing

throughout the wider organisation. Case Study A have “*recently started monthly manager meetings, where departmental and contracts managers come together, and that's helping the flow of knowledge because people are discussing their projects. The meeting will kick off with an update on projects, then a presentation on a live project, it gives people an overview of the company, especially with the departmental managers there, if these recurring problems are mentioned in a room where its non-confrontational, it takes the personal aspect out of it and things are ironed out a lot easier and they seem to be working quite well.*” According to the HR Manager, the participants at the meetings are sometimes asked to disseminate information to staff, “*if we are trying to roll something out across the company, people would be directed to go back and inform their staff about it.*”

According to the Learning & Development Manager with Networks, the organisation are currently running a development programme for over 200 middle managers, “*one of the big benefits of which is the setting up of informal networks, sharing knowledge and information.*” Part of the programme involves groups of five middle managers exploring process improvements in forty different areas across the company where “*they would be assigned a mentor...they would have to conduct some research and come back with ideas, out of the 40 to 45 projects, maybe five or six will come to fruition. In terms of knowledge management that is a good thing, because it's very practical, it took issues that senior managers would have identified and sponsored.*”

The significance of middle managers for KM, as outlined in ‘managing professional knowledge’ in Chapter 7, was verified by two of the participating interviewees.

8.1.8 Need for KM Framework

The interviews concluded by discussing the need for further guidance on KM, with a number of the respondents confirming the need for a framework of KM. “*Knowledge management is huge, if you were to really look at it there is probably so much that we could be doing,*” the HR Manager from Case Study A commented, “*I think it is something that companies, at a strategic level, need to look at... I don't think they realise the benefit of actually structuring it.*”

The Knowledge Manager with Engineering Consultancy A commented, *“what is interesting is the amount of stuff that could potentially fall under knowledge management.”*

The Manufacturer's Training & Development Manager suggested that *“there is a need for a framework of knowledge management for companies because it's such a broad area, you talk about the intranet, individuals, groups and communities, external knowledge... so a framework would be good, I think knowledge management does happen, but to present how we do it is a challenge.”*

The HR Manager with Contractor C stated, *“the biggest issue to me with knowledge management is what is it, why do you want it, do you know what that is, where does it fit in the strategic business?”*

The need for a definition as a starting point was discussed by Power Generation's HR Specialist, *“I think having some sort of accepted, well researched definition of what it is... a definition that is understandable and can be put in layman's terms, and then give people a process for implementing knowledge management, certainly that would be more than useful for the likes of ourselves...I think that would be useful from a practitioner's prospective.”*

In discussing the need for a KM framework, the interviewees highlighted the range of activities which could fall under the KM umbrella, the need for an accepted definition and framework for implementation, and a clear outline of how KM fits into the business at a strategic level. These concerns will be borne in mind when formulating the KM framework in Chapter 9.

8.2 Discussion

Whilst the role of HRM is of primary concern, the reasons for the organisations seeking CPD accreditation and the other paradigms (which include: role of IT, organisational, project and professional knowledge), will also be considered.

8.2.1 *Engineers Ireland CPD Accreditation Scheme*

It is interesting to note that six of the nine non-construction organisations cited 'recognition of existing CPD practices' as their primary motivation for engaging in the scheme. This indicates, in broad terms, that these organisations may have more advanced practices than those of the construction organisations, four of whom used the accreditation process to improve HRM practices such as staff retention, performance management, training and development. Where organisations had to tender for work, the use of accreditation as a marketing tool with clients also figured quite highly.

8.2.2 *Role of HRM*

With ten of the fourteen respondents working within their organisation's HRM function, they were well placed to discuss the role of HRM and KM. The Training & Development Team Leader with the International Operations discussed the role HR plays in supporting people and KM, confirming the view of Edvardsson (2008). A number of authors have identified a variety of HR-related interventions which can be linked to KM, including recruitment and selection, training and development, performance management, pay and reward, job and organisation design (Storey, 2005, Jashapara, 2004, Hislop, 2002, Olomolaiye and Egbu, 2006). The respondents discussed a range of HR activities related to KM, including inductions, training and development (CPD), building relationships, managing CVs, identifying expertise, performance management and the provision of incentives. Each of these findings will be discussed individually and then considered in terms of improving the HRM paradigm.

An effective induction programme plays an important role in bedding new recruits into the organisation, it can also help to develop social connections with fellow employees and

improve retention of staff (Davis and Kleiner, 2001, Lengnick-Hall and Lengnick-Hall, 2005). Whilst Networks have a comprehensive 18 month programme for new recruits, the HR Manager with Case Study B spoke of the potential use of the intranet as a resource for orienting new staff, particularly with regard to getting to know other people in the organisation. Mondy and Noe (1996) identify other areas requiring consideration as: organisational information and structure, policies and procedures, departmental information, safety information, and other employees.

In addition to appraising performance and making decisions relating to goals, rewards and promotions, the performance management process is used by the HRM function in identifying training and development needs across the organisation, and ensuring that they are aligned with business strategy (Cleveland et al., 1989, Longenecker, 1997). Whilst it is difficult to appraise knowledge, Pettijohn et al. (2001) suggest that subjective measures relating to skills and knowledge are preferable. Having recently reviewed their performance management system, the International Operation have linked it to their company strategy in order to make it more relevant to the business.

The provision of training and development opportunities is one of the main functions of HRM, the development of professional knowledge being seen as central to fulfilling business strategies and improving organisational performance (Raidén and Dainty, 2006, Edvarsson, 2008). Under the EI CPD scheme, participating organisations are required to have a CPD policy and provide a minimum of 5 days formal CPD per annum for staff. In addition to externally provided training, many of the organisations place significant emphasis on the development of internal programmes as a vehicle for problem-solving and knowledge sharing. For example, the project management programme in the Manufacturer, the bi-annual KM forum in Contractor C, the monthly management meetings and Lessons Learned seminars in Case Study A, lunch and learns in the International Operations, breakfast briefings in Customer Supply and the middle manager development programme in Networks, are all initiatives developed to further enhance the knowledge of staff. Such programmes go beyond the dissemination of explicit knowledge as proposed by Gourlay (2001), the comments of the HR Specialist with Power Generation reflecting this point, *“training programs are great forums for shared learning.”* There is also evidence of

increasing awareness of informal learning strategies and on-the-job learning as identified by McDougall and Beattie (1998) and Storey (2005) respectively, with respondents from Contractor E and the Manufacturer both discussing a move in this direction.

The development of relationships and informal networks was confirmed by a number of the respondents as being an important part of HRM's role (Lengnick-Hall and Lengnick-Hall, 2005). The respondents identified knowledge-sharing meetings, team-building, social events and training and development as activities which contribute to developing such relationships. The middle managers meetings in Case Study A and the bi-annual knowledge sharing forum in Contractor C enable what Svetlik and Stavrou-Costea (2007: 201) term as "*cross-functional cooperation.*" The Learning & Development Manager with Networks identified the development of informal networks as a "*big benefit*" of their middle management development programme. Training, which the respondents discussed extensively, was an area identified by Lengnick-Hall and Lengnick-Hall (2005) where HR could mix employees from different parts of the company. The use of the company intranet to support communities of practice was identified in Contractor E, Engineering Consultancy B and the Manufacturer. Bringing people together from different parts of the organisation is recognised as important by both Olomolaiye and Egbu (2004), and indeed many of the respondents, and is seen as particularly important in geographically-dispersed construction organisations.

A number of interviewees discussed their role in maintaining staff CVs and recording staff experiences, skills and qualifications. While Case Study B are exploring the possibility of using their intranet to store staff CVs, the International Operations have developed an online 'find an expert' system which allows staff to find staff with specific expertise. This is an area where Matsumoto et al. (2005) believe HRM can be involved in the development of IT systems such as skills and training databases; with Bartholomew (2008) stating that such systems can be built around existing HR systems. Furthermore, both Wiese and Buckley (1998) and Walsh and Fisher (2005) discuss the use of performance appraisals as a means maintaining such HR systems and personnel documentation.

Whilst many of the respondents acknowledged the difficulty in linking rewards to KM-related activities, there was evidence of incentivisation of activities such as project review, presenting papers and staff feedback with prizes, social activities and trips abroad. A number of authors have discussed pay and reward in relation to KM, an issue that did not emerge during the interviews (Edvardsson, 2008, Jashapara, 2004, Olomolaiye and Egbu, 2006). One respondent discussed the challenges of rewarding staff on an individual basis, whilst attempting to improve knowledge-sharing, suggesting the need for a team-based approach to incentivisation.

The findings already discussed in this chapter have highlighted the important role which HRM plays in developing and facilitating KM within organisations. Through additional axial coding, the identified issues have contributed to the further development of the paradigm model which emerged during previous research, leading to that which is outlined in Figure 32. However, as a number of authors have highlighted, the role of HRM requires further integration with KM (Svetlik and Stavrou-Costea, 2007, Haesli and Boxall, 2005, Hislop, 2002). This integration will be achieved through the selective coding process, outlined later in this chapter.



Figure 32: Revised HRM Paradigm Model

8.2.3 Role of IT

Whilst it has already been acknowledged that IT cannot manage knowledge, it is recognised that it can connect people with information, and other people, in order to encourage the sharing of tacit knowledge (Payne and Sheehan, 2004). An intranet was identified by twelve of the fourteen respondents as the 'focal point' for KM within their organisations, and was viewed as a means of centralising information. A range of content and services were provided on the intranets, including company, departmental and project information, lessons learned, communities of practice and discussion forums, best practice and innovation, a search engine, staff contact details and skills databases, document templates, organisational policies and procedures and online courses. Contractor E, Engineering Consultancy B and the Manufacturer, who are all part of wider global organisations, have access to a variety of resources such as online CPD, a company university and online communities of practice. The Road Design Office, which employs 20 people, uses their intranet as a focal point for quality management, KM, and documentation. The identification of such facilities on an intranet confirms the important role of IT in KM, and validates the findings from the previous research and emerging issues. In advancing the role of KM technologies, Tiwana (2000) recommends that existing systems such as intranets are used.

The ability to find people with specific knowledge has already been recognised as an important part of KM. Whilst a case study by Matsumoto et al. (2005) identified three different systems for managing and organising staff skills, a number of the research participants identified the use of a single skills database on their intranet. Typically, such databases include the staff member's name, role, contact details, professional interests and skills, previous projects, employment history and training history. Bartholomew (2008) suggests that existing HR information can be used to initially populate such systems, something which was confirmed by the HR Manager with Customer Supply. However, there was recognition of the challenge in ensuring that staff take ownership of the system and keep their details up-to-date, which the HR Manager from Contractor E acknowledged to be "*a bit of a struggle.*"

The interviewees confirmed the view of Walker et al. (2004), in that KM technologies need to be available and accessible, supportive, user-friendly and secure. However, the challenges of making IT available to all staff is not unique to construction, with the HR Specialist from Power Generation confirming that not all of their staff are office-based, thus limiting their use of computers. In terms of security, a number of respondents spoke of varying levels of authority within their systems, where staff could access information based on their role. Typically this was achieved by means of a username and password which was linked to the staff members system privileges. The ability to customise the homepage was also a feature of some intranets, where following log-in, staff would be presented with a homepage based on their own preferences. One of the main challenges associated with the use of technology is information overload, which many respondents believed could be off-putting for staff, particularly if they had to trawl through information to find what they required. The use of a search engine, coupled with the ability to customise their homepage was viewed as important, as was the need to keep information relevant to staff, and up-to-date. Whilst the HR function has an important role in providing and managing content on the intranet, the IT department/support function has an important role to play in supporting the technological aspects.

Although HRM has been the focal point of this phase of the research, the role of IT in KM has also been explored. With the majority of respondent organisations employing an intranet as a focal point for KM, it is clear that IT systems have an important role to play. Based on the preceding findings, the IT paradigm model has been further developed particularly in relation to the use of an intranet and skills database. As can be seen in Figure 34 (in Chapter 9), the following issues have been included in the 'role of IT' paradigm model:

- The intranet should provide a focal point for organisational KM, and can include company, departmental and project information, lessons learned, communities of practice and discussion forums, best practice and innovation, a search engine, staff contact details and skills databases, document templates, organisational policies and procedures and online courses
- A staff skills database which can include staff member's name, role, contact details, professional interests and skills, previous projects, employment and training history

can be used to support the identification of people with particular knowledge, and lead to the development of knowledge-sharing relationships

- IT systems employed by the organisation need to be available, accessible to staff, user-friendly, up-to-date and secure

8.2.4 *Organisational Knowledge*

Whilst many of the respondents struggled to define KM, a number of recurring themes were evident. Processes associated with knowledge include: retaining, sharing, learning, harnessing, creating (through innovation), capturing, finding, identifying and transferring. Types of knowledge such as technical, skills, business, and social and technological interventions were also identified. The single most recurring theme was that of people; both in relation to the knowledge they have, and the knowledge they need to be effective within the organisation. In terms of the 'organisational knowledge' paradigm model developed in Chapter 7, the findings from this phase of the research have confirmed a number of aspects, including:

- The challenge which intra-organisational fragmentation creates for managing knowledge
- Knowledge of people, projects and the organisation are central to organisational KM. In this regard, the identification of expertise, building relationships and the use of an intranet have all been identified within other paradigms
- A supportive learning environment where senior management recognises the need for continuous improvement and provides opportunities for reflection and learning
- Much valuable organisational knowledge can be captured in a company's policies and procedures

In addition to the previously identified intervening conditions for successful KM, the need for staff buy-in and a KM champion were also identified. KM should utilise and integrate existing organisational processes and systems, and in doing so fit in around people's workload. The issue of measuring the benefits of KM initiatives was raised during the interviews, with the majority of respondents citing the difficulty in quantifying knowledge. Furthermore, the willingness of management to dedicate time and resources to such an

activity was called into question, as was the ability to isolate the effectiveness of KM from other business processes and activities.

In discussing the requirements of a KM framework, the potential scope of KM within an organisation was seen as a barrier to its success. The HR Manager with Case Study A, Knowledge Manager with Engineering Consultancy A, HR Manager with Customer Supply, and Training & Development Manager with the Manufacturer all felt that a lot of activities could fall under the KM banner, and that there was a need for a framework which provided a definition of KM, its links with other activities, and a process for implementation/development. Both HR Managers from Case Study A and Contractor C recognised that KM needs to be aligned with the strategic objectives of the organisation if it is to succeed, particularly in terms of the benefits it could potentially deliver.

8.2.5 Project Knowledge

The interviewees confirmed a variety of issues relating to the management of project knowledge, with a number of the non-construction organisations identifying knowledge loss and the inability to transfer it from one project to the next; the main intervening condition identified being that people have moved on by the end of a project, with little or no opportunity for reflection. In three of the non-construction organisations, project reviews/lessons learned are built into organisational procedures. The HR Manager with Contractor C highlighted that such practices might be perceived as apportioning blame where mistakes have been made on projects. These issues are supported in the project knowledge paradigm model which was developed in Chapter 7.

8.2.6 Professional Knowledge

In terms of the 'professional knowledge' paradigm, the important intermediary role of middle managers in KM was verified by a number of respondents during the interviews (Styhre and Josephson, 2006). Based on recommendations from the research in Chapter 5, Case Study A have initiated monthly meetings for departmental and contracts managers. Networks have organised a development programme specifically for middle managers

within the organisation. Both respondents acknowledge the benefit of such initiatives, in terms of both building relationships and sharing knowledge across the organisation, issues which Koch (2003) believes are important in project-based organisations. Part of the Networks programme involves groups of middle managers working on improving specific business issues identified by senior management. The middle manager's ability to coalesce the tactical and strategic levels of the organisation leads to them being central to organisational knowledge creation (Nonaka and Takeuchi, 1995). This confirms and reinforces the identified central role of middle managers, as identified in the professional knowledge paradigm model developed in Chapter 7.

8.3 Summary

In order to explore both the emerging KM issues further and develop the HRM paradigm, interviews were conducted with fourteen CPD champions drawn from both construction and non-construction organisations. Based on the findings from these interviews and subsequent analysis through axial coding, the following is a summary of the main issues identified in this chapter:

- Engagement in EI's CPD accreditation scheme is prompting participating organisations to reflect on their existing CPD practices and to adopt a more formal approach to KM. The respondents confirmed a number of previously identified issues including: a process oriented approach to KM, intra-organisational fragmentation, people, project and organisational knowledge, the need for a supportive learning environment, and the capture of much valuable knowledge in policies and procedures. The need for an accepted definition of KM was also highlighted, as was the need for a framework of KM. The ability and willingness of an organisation to quantify and measure the benefits of KM, was viewed as a step too far
- The HRM function has a significant role to play in supporting KM in a number of areas: developing induction programmes that facilitate new employees in terms of access to organisational knowledge, maintaining staff CVs and records, the design and delivery of training and development activities which focus on knowledge-sharing and problem solving, facilitating the development of relationships within the organisation, providing incentives for staff participation on KM activities, aligning the performance management process with KM, and supporting the development of IT systems such as skills databases and intranets
- The use of an intranet as a focal point for organisational KM was also a recurring theme, with the majority of participant organisations citing its application. Whilst the use of such a system varied from quite basic to sophisticated, there are a number of applications which could be adopted by construction organisations in relation to this, such as the development of a skills database for professional knowledge, a lessons learned database for project knowledge and more general uses including:

online discussion forums, eLearning and CPD, document templates, policies and procedures, and company news and information

- The challenges of managing project knowledge are by no means unique to the construction industry, with a number of organisations having incorporated project reviews/lessons learned into organisational procedures
- A number of organisations confirmed the important role of middle managers within KM. One organisation have recently introduced monthly meetings for all contracts managers and departmental heads, whilst another have implemented a development programme where teams of middle managers are exploring process improvements within the organisation

The findings already outlined and subsequent discussion, have led to the further development of the five original categories, confirming a number of previously identified issues relating to professional, project and organisational knowledge. The important role of IT has been substantiated, particularly in terms of the use of an intranet and staff skills database, whilst HRM has been further developed to reflect its important role in KM. Additionally, the research in this chapter addressed a number of issues raised by the research questions, namely:

1. That construction organisations are not managing knowledge as effectively as their counterparts in other sectors/industries
2. It confirmed many of the strategic, cultural and technological issues raised in previous phases of the research (and which are outlined above)
3. That the alignment of KM with other existing organisational processes and activities (e.g. HRM, CPD, intranet) can improve the level of engagement of professionals

Based on these developments, it is reasonable to suggest that theoretical saturation has been achieved, as no new categories have emerged. The next stage of analysis, which will be addressed in Chapter 9, involves moving from five disparate paradigm models, towards the development of a coherent, integrated framework.

Chapter 9
KM Framework Development &
Evaluation

9 KM FRAMEWORK DEVELOPMENT & EVALUATION

In order to consolidate the emerging issues and move towards a KM framework, the analysis will now focus on selective coding, which Strauss and Corbin (1998: 143) define as “*the process of integrating and refining the theory.*” With selective coding, the selection of the central or core category is important; this category represents the main theme of the research, to which all other categories can be related. ‘Managing organisational knowledge’ is selected as the central category, to which the other paradigms are related and integrated through the selective coding process. This leads to the development of an integrated KM framework for the leading Irish construction organisations. As evidenced in Figure: 33, this incorporates a definition of knowledge, drivers for KM, a definition of KM, developing a KM strategy, the role of HRM and IT, the role of middle managers and the management of professional, project and organisational knowledge. The developed framework was then evaluated with staff from a leading Irish construction organisation, who confirmed its validity.

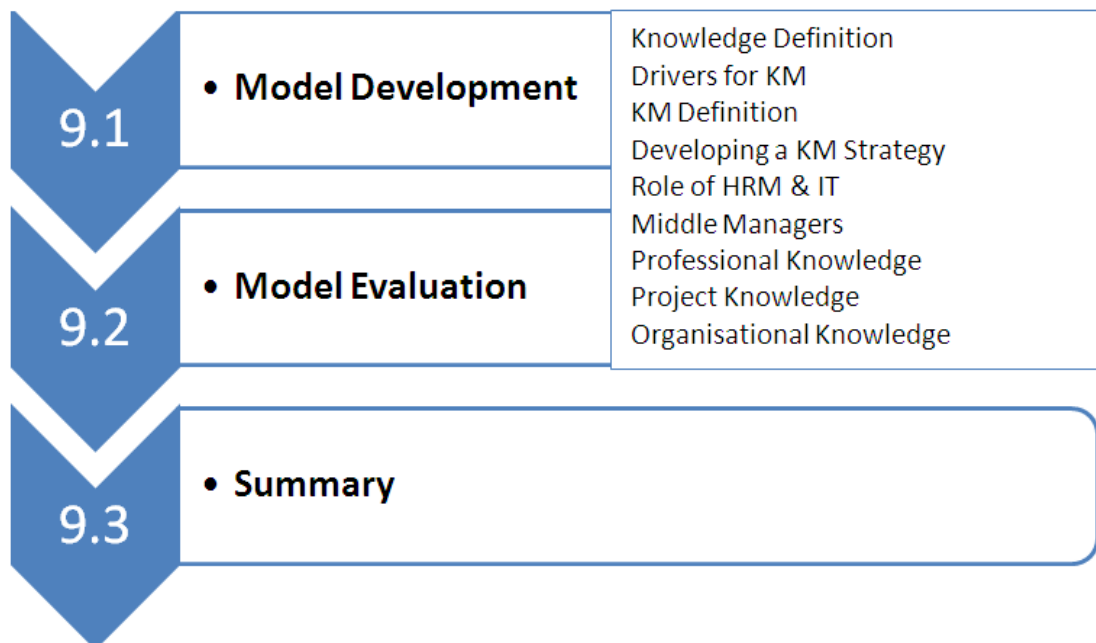


Figure: 33 Chapter 9 Overview

9.1 Framework Development

The selection of a central category, which represents the main theme of the research, is the first step in the selective coding process. As the main focus of this research is on identifying the main issues associated with KM within the leading Irish construction organisations, the central category selected is ‘managing organisational knowledge.’ This category comprises aspects of professional and project knowledge and makes reference to both HRM and IT. It also appears frequently in the research and could potentially be abstracted to other situations. Once the central category has been selected, it should be systematically related to the other categories. Much of the selective coding process is more abstract than open and axial coding, with less reference back to the findings (Gibbs, 2002). At this stage of analysis, the use of diagrams is particularly beneficial in prompting more conceptual thinking about the interrelationships between categories. According to Strauss and Corbin (1998: 153), these diagrams *“need not contain every concept that emerged during the research process, but they should focus on those that reach the status of major categories.”*

In order to aid the analytical process, Figure 34 has been developed to allow for comparison between, and integration of, the four paradigm models to the central category. It can be seen that there are a number of recurring themes across the models/categories, including: the nature of the industry, the organisation as the best place for learning, problems associated with intra-organisational fragmentation, the need for a supportive learning environment and a variety of actions/interactions which mirror the KM processes at professional, project and organisational levels. As previously discussed, there is also significant overlap between a number of the categories: for example the role of HRM in supporting the development of professional knowledge through a variety of activities, and the role of IT in supporting organisational knowledge (intranet), project knowledge (LLDB) and professional knowledge (skills database).

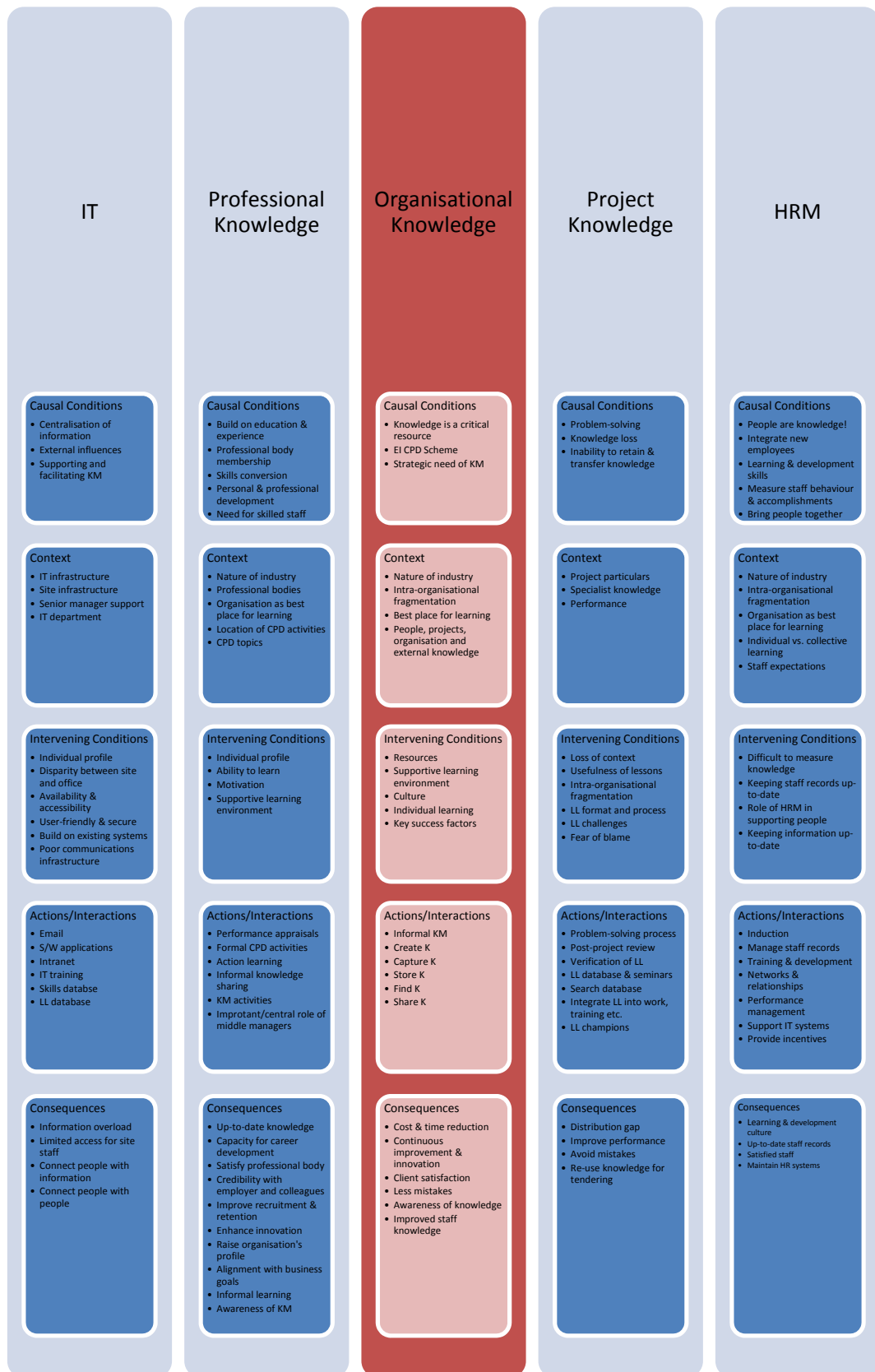


Figure 34: The Five Paradigms

Moving from the comparative nature of Figure 34, and utilising the paradigm model as a template for integration, the four remaining categories have been integrated with 'organisational knowledge,' leading to a more cohesive explanation of KM. As can be seen in Figure 35, through the selective coding process, a number of issues have been moved to suit the central category of 'organisational knowledge.' For example, both the HRM and IT paradigms can be viewed as intervening conditions for organisational KM, whilst the 'nature of the construction industry,' 'intra-organisational fragmentation' and a 'supportive learning environment' can also be viewed as intervening conditions within this broader context.

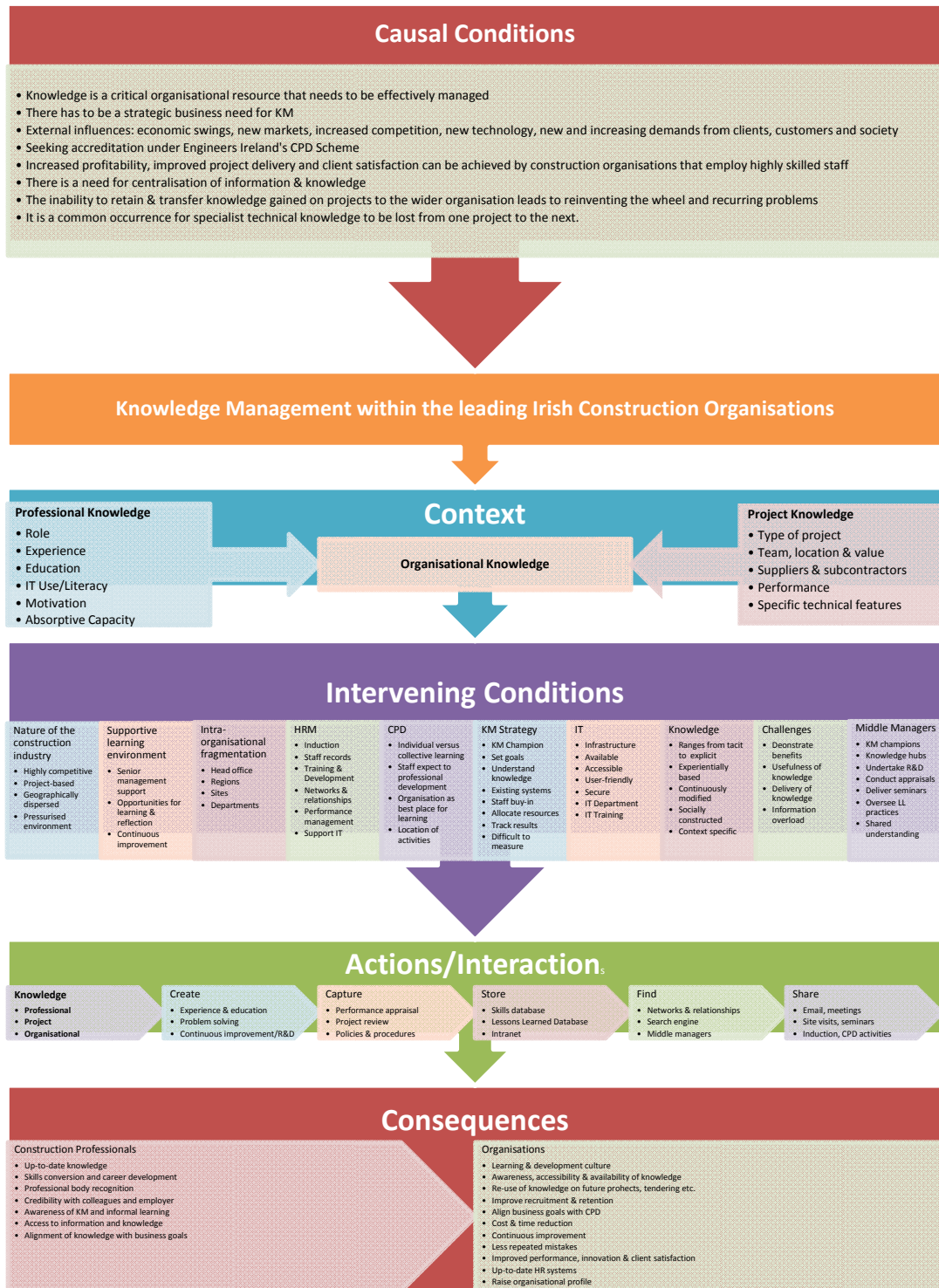


Figure 35: Integrating the Five Paradigms

To facilitate the integration of these concepts, the following passages have been written, in line with the recommendations of Strauss and Corbin (1998).

Causal Conditions

In a highly competitive business environment, with increasing demands from clients and society, knowledge is as a critical organisational resource, which needs to be effectively managed and retained within the organisation. With the introduction of new and complex procurement routes and the need for innovative construction methods, there is a requirement to maintain a highly skilled workforce. Indeed, learning and continuous improvement are now recognised as core strategic competencies. In a project-based industry such as construction, it is a common occurrence for specialist, technical and management knowledge to be lost from one project to the next. The inability to retain and transfer knowledge gained on projects to the wider organisation leads to ‘reinventing the wheel’ and recurring problems. However, if this knowledge can be used to develop highly skilled staff, increased profitability, improved project delivery, and client satisfaction can be achieved. From the perspective of the leading Irish construction organisations, external influences such as EI are driving the development of KM through their CPD accreditation scheme. This alone is not enough; a strategic business need for KM should be recognised and understood by the organisation.

Context

KM within the leading Irish construction organisations encompasses a number of distinct, yet interrelated elements: professional knowledge (staff skills and experience), projects (characteristics, performance and lessons learned) and organisational processes. In this regard, KM can be defined as: *“the effective learning processes associated with knowledge of the organisation to enhance both the performance of the individual and the organisation.”*

Figure 36 presents a graphical representation of this definition, which illustrates the learning processes (create, capture, store, find, share) and the levels of knowledge (professional, project and organisation).

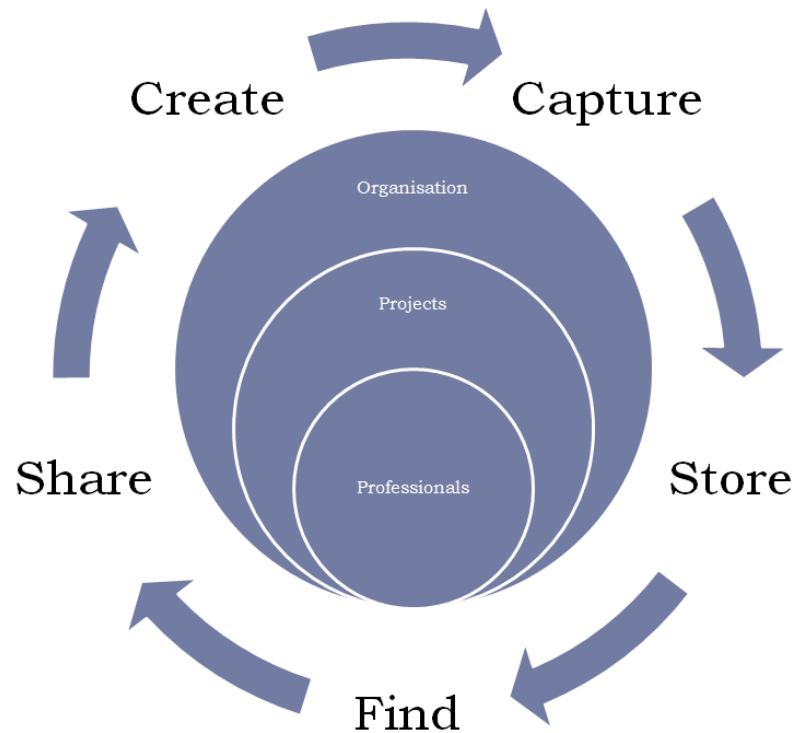


Figure 36: Knowledge Management in Construction

Intervening Conditions

The intervening conditions identified in Figure 35 have been further refined and grouped in three areas, enablers of KM, barriers to KM and the development of a KM strategy.

There are a number of barriers to KM, which must be recognised and addressed, if KM is to be successfully adopted by construction organisations. The nature of the construction industry itself, which is project-based, geographically dispersed, highly competitive and pressurised. This compounds what is known as ‘intra-organisational fragmentation’ where the dispersion of people in various offices, regions, departments and sites hinders an organisation’s ability to successfully manage knowledge. Other specific barriers to KM include: a lack of understanding knowledge and KM, difficulty in measuring and demonstrating the benefits of KM, and a difficulty in sharing knowledge between experienced and inexperienced individuals.

In order to address these barriers, there are a number of enablers which should be in place to support the development of KM. First and foremost, the support of senior management is necessary. Furthermore, a supportive learning environment is required, whereby senior management recognise and support opportunities for learning, reflection and continuous improvement at all levels. KM should augment existing organisational systems such as HRM, IT and CPD, as employees are more likely to accept KM if it is perceived of as part of their normal working practices, as opposed to an additional responsibility. Construction professionals expect their employers to support their training and development needs. As the organisation is viewed as the place for learning, the alignment of CPD activities with KM can enhance the buy-in and level of engagement with such activities. The HRM function has an important role to play in developing people and their knowledge, particularly in providing CPD and KM opportunities for staff. Whilst IT cannot alone manage knowledge, it can be used to support a KM initiative, connecting staff with relevant knowledge and people. The IT infrastructure employed needs to be available, accessible, user-friendly and secure, in both offices and on site. Furthermore, support should be provided by the IT department in managing KM systems and providing relevant training for staff. As the role and experience of each individual staff member within the organisation has an impact on their ability to engage in a variety of KM-related activities, many of these activities will need to be targeted at particular levels within the organisation (e.g. junior, supervisory, middle, senior and executive). Non-financial incentives, such as prizes and awards, should be provided to encourage and reward staff participation in KM-related activities.

With reference to the identified barriers and enablers, a KM strategy should be defined which recognises the importance of knowledge, sets goals and allocates resources for the initiative. There is a need for a 'KM champion' to be appointed to ensure that the initiative is coordinated, with involvement and input required from middle managers (contracts managers and functional heads), especially HRM and IT staff. Whilst measurement of the effectiveness of KM is viewed as a difficult and time-consuming task, anecdotal evidence and feedback will be highly beneficial in the long term development and maintenance of KM.

Actions/Interactions

Knowledge, which is experientially-based, continuously modified, socially constructed and context-specific in nature, is a complex phenomenon. From a practical perspective, for organisations, tacit knowledge is the most valuable type, although the capture of explicit knowledge as information also has value. In order to manage knowledge, a generic KM process has been identified which can be applied to professional, project and organisational knowledge: create, capture, store, find, and share knowledge. Such a process should augment, where possible, existing work practices and routines, which are supported by HRM, IT and CPD-related activities.

Professional Knowledge: is created through a combination of both experience and education. Whilst it is difficult to capture knowledge, performance appraisals can be used as a means of documenting the experience and knowledge of an individual and this can then be stored on a skills database (to include: name, contact details, professional interests and skills, previous projects, employment and training history). People with specific knowledge can be found by searching the database, or through the development of networks and relationships within the organisation. Professional knowledge can be shared through a variety of processes and activities, which are dependent upon the role and experiences of the individual involved. In so far as possible, such activities should be aligned with existing CPD and HRM activities.

Project Knowledge: is created through the problem-solving process on construction projects, and should primarily be captured during post-project reviews, and stored on a lessons learned database; this can then be searched by staff, allowing them to find relevant information/knowledge based on a number of categorisations. The lessons learned can also be shared by integrating them into existing work practices, incorporating them into company policy and using them as the basis for CPD activities. Furthermore, opportunities should be provided for bringing staff with similar experiences, from similar projects, together to share high-grade, specialist knowledge in the form of knowledge-sharing focus groups and site visits.

Organisational Knowledge: the main means for creating organisational knowledge is through research and development activities, undertaken on an individual or project-by-project basis. Much organisational knowledge is captured within policies and procedures, and is increasingly being stored on a company intranet. Such knowledge is found and shared by staff through a combination of both formal systems and informal channels and activities. In a broader sense, organisational knowledge is an aggregation of the knowledge of its people, projects and the organisation itself.

Whilst professional, project and organisational knowledge can be viewed as distinct facets of KM; it is also evident that there is significant overlap between them. This becomes particularly apparent in a scenario where all captured knowledge can be stored on an organisation's intranet, can be found through networks and relationships between staff and the use of a search engine, and can be shared at all levels in the organisation through a variety of activities such as training and development, workshops and seminars, email and discussion forums, site visits, focus groups, induction, mentoring, conferences and social activities. Through sharing, knowledge is 'constructed' between staff, leading to the creation of new knowledge for those involved. The level of experience of the individual will impact upon their involvement in such activities, and there is a need to consider the move from formal training to problem-solving activities as the level of experience increases. Furthermore, to ensure a good level of engagement, accreditation of such activities should be sought from relevant professional and academic institutions.

Consequences

The consequences identified are the benefits which can be derived from KM which have been categorised with respect to both the individual professional and the organisation. From the construction professional's perspective, engagement in KM can lead to the development of up-to-date knowledge, skills conversion and career development. By maintaining their knowledge, professionals can ensure credibility with their colleagues and employer, and gain recognition from their relevant professional bodies. Awareness of, and participation in KM can also lead to an improved understanding of knowledge and learning which is relevant to the employee, their role and the company's objectives.

From the organisation's perspective, the development of a learning and development culture where an awareness, accessibility and availability of knowledge exists can also have positive outcomes. By managing knowledge in a more formal and conscientious manner, less repeated mistakes and reinventing of the wheel can lead to cost and time reductions throughout the organisation, with valuable knowledge re-used on future projects. Furthermore, continuous improvement can be achieved in relation to performance, innovation and client satisfaction. By integrating KM with existing HRM and CPD practices, the business goals can be aligned with those of the individual professionals, leading to improved recruitment and retention, and up-to-date HRM records. Achieving CPD accreditation with EI can also lead to a raised organisational profile for marketing and tendering purposes.

The preceding discussion has led to the development of a more refined diagram which aims to simplify the basic tenets of the integrated KM framework and can be seen in Figure 37. This diagram illustrates the overall KM process moving from the drivers, barriers and enablers of KM, towards the development of a KM strategy, leading to a process for managing organisational knowledge (comprising professional, project and organisational knowledge).

As discussed in Chapter 2, it is important that the proposed framework is pragmatically useful and credible to those whom it is applicable. The following section will deal with the evaluation of the proposed KM framework identified in Figure 37.

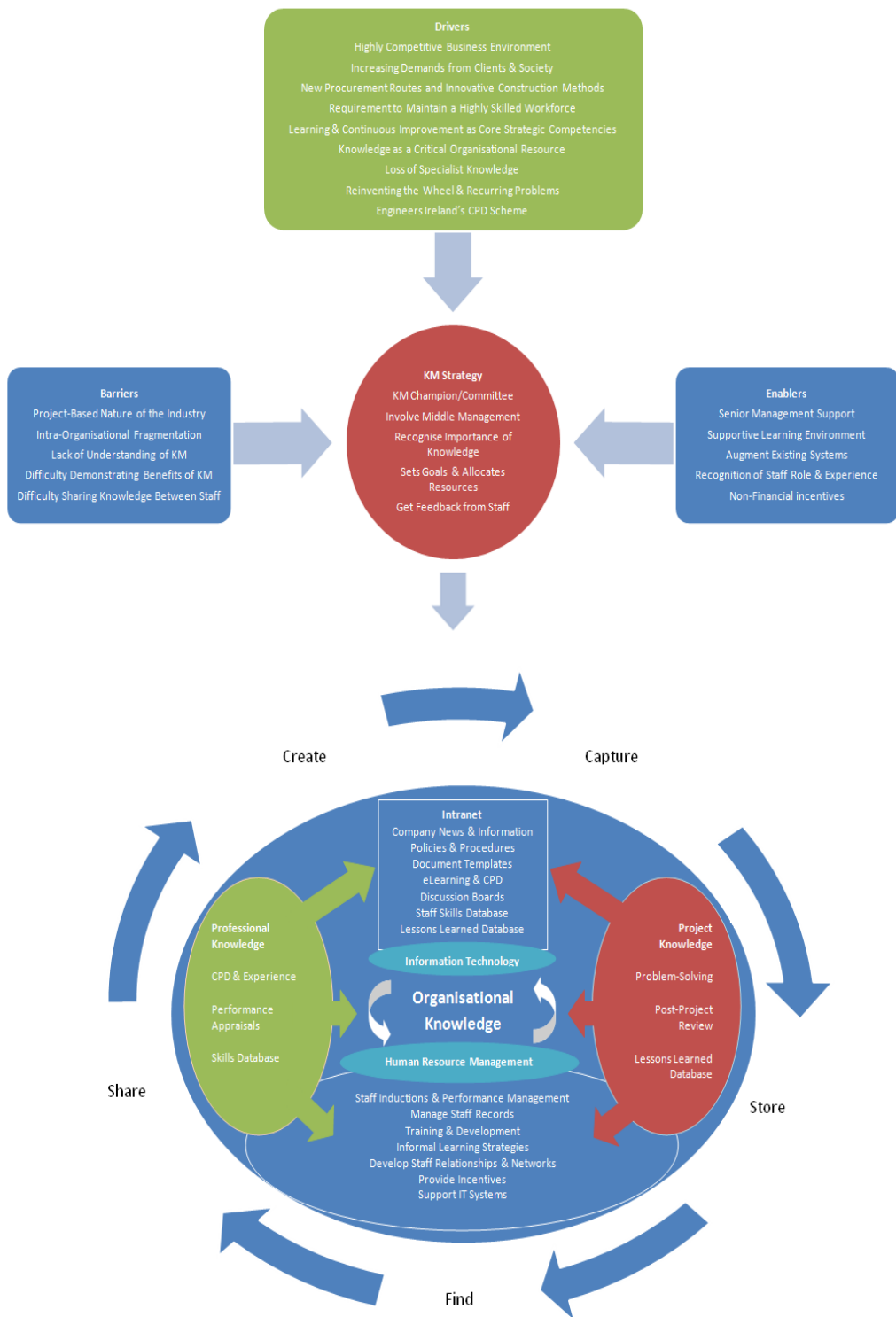


Figure 37: Proposed KM Framework

9.2 Framework Evaluation

It was decided to evaluate the proposed framework with staff drawn from a third leading Irish construction organisation, hereafter referred to as Case Study C. With the cooperation of the company's Learning & Development Manager, the six participants were selected on the basis of their interest and potential role in a KM initiative. As can be seen in Table 34, both Contracts Managers had considerable industry experience, with most of their time having been spent with Case Study C. While the IT Manager has been with the company for a relatively short period of time, he had previously worked in IT in the financial services sector for 20 years. The Intranet Manager had 5 years experience in the banking sector, with both the Learning & Development Manager and Training Manager having 10 and 20 years experience, respectively, in a variety of sectors including electronics, manufacturing and pharmaceuticals.

Position	Construction Experience (Years)	Case Study C Experience (Years)
Learning & Development Manager	4.5	2
Training Officer	8	8
IT Manager	1	1
Intranet Manager	1.5	1.5
Civils Contracts Manager	18	16
Building Contracts Manager	17	15

Table 34: Framework Evaluation Participants

A focus group session with the participants was conducted in the company's head office, which sought to ascertain whether the framework improved their understanding of knowledge and KM, provided a sufficient case for the adoption of KM and confirmed the importance of developing a KM strategy within their organisation. The feasibility of accepting the proposed framework was the main area for discussion with the participants, specifically in integrating professional, project and organisational knowledge with IT and HRM. Based on the framework outlined in Figure 37 and section 9.1, a presentation (Appendix N) and handbook (Appendix O) were developed to guide the discussion. Participants were invited to comment and discuss the different aspects of the framework

throughout the session, which was recorded for later analysis. The following is a summary of the main findings derived from the focus group session which lasted for approximately two and a half hours.

9.2.1 Knowledge Definition

The participants confirmed the definition of knowledge provided as being understandable, with the Intranet Manager discussing the context specific nature of knowledge in construction organisations as being, *“relevant to the people in that area, be it civil or marine engineering or whatever, so knowledge is very specific to certain areas of the organisation.”* The IT Manager commented on the highly-individualised nature of knowledge, *“the hardest thing is to actually capture that experience, it’s valuable to the individual, and it can be difficult for someone to share that with others.”* In order to make the definition more meaningful, the Training Officer suggested the inclusion of *“a few examples of what knowledge is, it’s quite easy to understand what formal training is, but maybe on the tacit side, a few examples of it in a construction company.”*

9.2.2 Drivers for Knowledge Management

The group were asked whether the drivers for KM were sufficient, with the Training Officer commenting, *“in terms of reasons, the three main points you have there, organisational resource, loss of project knowledge and developing skilled staff...I think what you have there sums it up in a nutshell.”* The IT Manager spoke about the need for KM in the context of the current economic climate, *“we have probably lost a lot of people with a lot of experience...so how do you capture that before they leave the company?”*

9.2.3 Knowledge Management Definition

The group described the KM definition as *“clear and easily understood,”* with the Learning & Development Manager adding that *“it would also be good if you could give examples of KM in practice, evidence of where it is done well in companies and how it is benefitting them.”*

9.2.4 *Developing a KM Strategy*

In discussing the development of a KM strategy, the Building Contracts Manager stated that *“it starts from the top and it needs senior management buy-in.”* This was a theme continued by the IT Manager, who stated, *“in terms of having a KM champion, it’s critical that you have someone at executive level who believes in this, if you don’t have a champion at senior level, it won’t happen.”* This was a key point which all of the participants agreed upon. In the context of the current economic climate, the Learning & Development Manager stated, *“I have a feeling that it will be very difficult to get KM off the ground to the level that we’re talking about here today.”*

The Building Contracts Manager confirmed the need to set goals and allocate resources *“from our point of view, it would take extra resources and more time to do this, so we would need to be clear about what we’re getting out of it.”* He continued by discussing the potential to utilise existing systems, stating *“we already have a lot of this, but it’s more to do with how it is structured.”*

9.2.5 *Role of HRM*

The Learning & Development Manager recognised the important role of HRM in managing knowledge through a variety of activities, but acknowledged that the recent downturn has had an impact on them. He stated, *“performance management has fallen by the wayside in the last year or two, as has mentoring...everyone is under pressure in the company and management are putting all of their energy into winning contracts and keeping people in jobs, so certain things have had to take a back seat, unfortunately.”*

9.2.6 *Role of IT*

In the context of using IT to facilitate KM, the Intranet Manager commented, *“it depends on the tools used to share knowledge...it depends on usability, reliability, accessibility.”*

The role of IT in a KM initiative and the wider business was also discussed extensively by the IT Manager, who commented, *“our role is to facilitate and support the business, but it is up to the business to take ownership of systems like the intranet and manage them. I*

would fully agree that all IT systems need to be available, accessible, user-friendly, up-to-date and secure...that's what we're here to do."

9.2.7 Role of Middle Managers

Both Contracts Managers confirmed the potential for themselves to fulfil the identified roles, although the Building Contracts Manager stated that, *"I would see my role in KM as being that of a facilitator, I wouldn't necessarily do all of the work, but delegate it to my team and ensure that we do things like lessons learned on our projects."* The Civils Contracts Manager is the 'champion' of the knowledge-sharing seminars organised for staff in the civils division, but recognised the support he gets from a director, *"he's really driven that initiative in terms of providing resources such as the hotel venue in Kilkenny and ensuring that people who are supposed to be there, are there."*

The potential for middle managers to participate in knowledge-sharing activities was discussed, with the action research in Case Study B's Pharma division given as an example of such activities. Such an approach was deemed to have potential by the respondents, with the Building Contracts Manager commenting, *"I would certainly welcome the opportunity to meet with my peers in other parts of the organisation and share my experiences of some of the innovative technologies we have used on a recent project."* He continued by giving an example of where he had learned from other managers, *"on the project I'm on at the moment there are construction methods being used that haven't been used in Ireland before so we visited our sister company in the UK to see how they went about it and we spoke to the relevant project managers and contracts managers and it was invaluable really, but again, it was very informal...there's no proper mechanism for sharing knowledge"*

9.2.8 Potential Benefits of KM

The identified benefits were viewed as acceptable by the participants, although much discussion focused on linking KM to an impact on the bottom line. According to the IT Manager, *"trying to define an ROI is very difficult with something like KM, it's a long-term thing and it's really hard to put tangibles on it."*

9.2.9 Professional Knowledge

The participants recognised the importance of both education and experience in developing a construction professional's knowledge. It was suggested that staff experience could be captured in the form of a standard company CV and on a skills database, identifying areas where an individual had expertise. The Civils Contracts Manager discussed the impact an individual's experience will have with regards to capturing knowledge *"there are not that many people left in the company whose expertise we need to identify, we don't need to go down as far as the site engineer, you're working at a level above that, the value that people with 3 or 4 years experience can give you is quite small."*

In relation to finding knowledge, the IT Manager stated *"I still think that parochial view is prevalent in the company where people think that their informal network is enough to get what you need in the company, but it might not be good enough for someone who joins the company, they don't have that span of network."* The Training Officer added that *"the ramp up you need to get to that level is an issue, and in the meantime, you're missing out on all of that potential."*

9.2.10 Project Knowledge

The potential benefit of managing project knowledge was recognised by the participants, with the Civils Contracts Manager stating, *"there is a benefit to be gained from capturing the lessons learned on a project, but nobody is going to go off and do it off their own bat...there has to be a requirement to do so."* With the Building Contracts Manager adding *"we have an end of project report, but that doesn't reflect the project experiences, there are no lessons learned, you are never asked about them."* The Civils Contracts Manager highlighted the problem with identifying mistakes on projects and the potential benefits of adopting LL practices, *"people tend to talk about the good stuff, but rarely bring up the bad experiences, the good stuff will save you money, but the bad stuff will cost you money."*

This was a view supported by the Learning & Development Manager, who commented *“the processes associated with project knowledge need to be encouraged and fully supported...when a project closes out, that knowledge needs to be formally captured, so that people can use previous knowledge to gain an advantage at tender stage.”* The IT Manager spoke of the potential benefits of setting up a lessons learned database on the intranet, *“if you’re trying to find something from a project that has been done, you could spend weeks trying to track that down, whereas if it’s readily accessible, you can go in there and get it.”*

“I think the problem you have with lessons learned, is that people might be reluctant to admit that they have made mistakes on a project,” the Learning & Development Manager stated, *“it’s trying to get over that fear of blame.”* In this regard, the Building Contracts Manager commented *“I think there’s a need for cultural change in the organisation,”* continuing *“if the lines of communication are open and honest, you will get more out of people.”*

9.2.11 Organisational Knowledge

Combining the preceding elements of professional knowledge, project knowledge, IT and HRM, the final slide presented the developed framework to the participants. *“Everything there is quite do-able,”* the Learning & Development Manager commented, *“but there has to be the impetus from above to do these things.”* The IT Manager stated, *“you probably need to start at the top with company news and information...easy stuff to put on the intranet, and then if people have a willingness to use it, you might move onto the next step. Maybe jumping in with something like the skills database might be a step too far, but definitely the news, policies and procedures, document templates can be easily setup.”*

In terms of the potential for the framework to be adopted, the Intranet Manager stated, *“I think it shows that we are on the way to managing knowledge, but we still have a lot to do.”* The Building Contracts Manager also noted that *“this framework is very simple and effective, but I’m not sure if we could achieve it.”* According to the Civils Contracts Manager, *“I think a big thing with a lot of these initiatives is that people don’t know exactly*

what they want to get out of them, so somebody introduces something without thinking about it...so I think we need to learn from our problems with the intranet and develop it further...it takes time for people to change, to get buy-in and feedback, its an iterative process.”

In terms of improving the framework, the Learning & Development Manager stated, *“I think it would be good if you had some case study references or examples of KM in practice to show how it is done.”* Something which the Building Contracts Manager also picked up on, *“are there examples of companies that do KM well, and are they more competitive as a result of it?”* The discussion concluded with the IT Manager stating, *“it reaffirms my view of KM and its similar to what you’re thinking in terms of the enablers and barriers and the things we need to do, we’ve noticed a lot of things on it that we’re trying to address...I think we could use some of this information in a more summarised format to pitch it to the board of directors.”*

9.3 Discussion

Through the selective coding process, ‘organisational knowledge’ was selected as the central category to which all others were related. Adopting a narrative approach and utilising the paradigm model, the proposed framework was developed. It identified the drivers of KM, definitions of knowledge and KM, enablers of and barriers to KM, the development of a KM strategy, processes for managing professional and project knowledge which can be aggregated into organisational knowledge through a mixture of HRM and IT based interventions and the potential benefits of KM for both the individual and the organisation. A diagrammatic representation of the framework was created (see Figure 37), based on which a presentation and a guidance document were developed. These were utilised as part of the evaluation with selected staff from a leading Irish construction organisation, Case Study C.

The participants recognised and understood both the nature of knowledge and KM, but felt that working examples of both in a construction setting would be useful, providing evidence of where companies are benefitting from KM. The need for KM was acknowledged as being important for the organisation in general, with a focus on professional and project knowledge viewed as appropriate. There was recognition that the organisation already manages knowledge in an informal manner, but there was an identified need for a more formalised structure. The elements required for developing a KM strategy were confirmed, along with the enablers of and barriers to such an initiative. The most important issue in this regard is the need for visible senior management support in championing KM throughout the organisation, without which it was felt, KM would not succeed.

The role of both HRM and IT was well recognised within the organisation, but both functions rely on the core of the business to support the implementation and development of initiatives which they roll out. Middle managers were viewed as being very important to managing organisation knowledge, in terms of both supporting KM, but also in interfacing with others across the wider organisation in terms of sharing valuable knowledge and experiences. The potential benefits of KM were recognised, although a major stumbling

block exists in linking it to a tangible impact on the bottom line of the business. The development of more formalised processes for managing professional and project knowledge was seen as important. Such processes and their related activities require visible encouragement and support from senior management.

In terms of the consolidated framework of organisational KM, the participants were very much positive and accepting of what it portrayed, particularly in terms of integrating professional and project knowledge with HRM and IT. In attempting to apply the framework, it was suggested that an iterative process be adopted whereby simple activities/solutions are initially developed and implemented (such as company news and information on the intranet). Once staff engage with these activities/solutions, other aspects could be rolled out. Such an approach, it was felt, would be most appropriate in the prevailing climate where the company is facing significant staff layoffs and operating in an extremely competitive market for work.

In reflecting upon the rationale for identifying the main issues associated with KM in Irish construction and developing the proposed KM framework, the preceding discussion addresses a number of the issues raised in Chapter 1 which include:

- A focus on KM within construction organisations which KLICON (1999) view as having greater potential as opposed to across temporary project coalitions
- Devising and implementing a cost effective KM solution (Kamara et al., 2002, Quintas, 2005) by building upon existing organisational systems
- The integration of HRM and IT as proposed by Carrillo (2005), through an intranet which is developed and supported by the HRM function
- Unlike the K-Adv model developed by Walker and Wilson (2004), the developed framework was easily understood by the industry professionals through exploration of its individual elements, prior to presentation of the integrated framework, utilising a simplified diagram and handbook

While the competitive nature is identified by Jewell and Walker (2005) as the main motivation for KM, it may also in fact be the main inhibitor to the adoption of the framework by the leading Irish construction organisations.

9.4 Summary

This chapter presented the final stages in the consolidation of the emerging issues and development of a KM framework for the leading Irish construction organisations, through the process of selective coding. The framework was evaluated by staff drawn from Case Study C, with the following being a summary of the main issues discussed in the chapter:

- Moving from axial to selective coding, ‘organisational knowledge’ was selected as the central category to which the ‘project knowledge,’ ‘professional knowledge,’ ‘the role of HRM,’ and ‘the role of IT’ were related. Through further, more abstract analysis, a framework of KM for the leading Irish construction organisations has emerged, identifying the drivers, barriers and enablers of KM, leading to the development of a KM strategy. Specific actions for managing organisational knowledge have been developed, which consider the interrelationship of professional and project knowledge to the organisation’s knowledge through a process of creating, capturing, storing, finding and sharing knowledge. From a constructivist perspective, all of this must be undertaken in the context of the individual’s experience and skills, and their ability to make sense of, and create new knowledge. It is anticipated that successful implementation of such an approach could lead to benefits, not only for the organisation, but for the individual professional also
- To ensure validity within the industry, the proposed KM framework was evaluated by contracts management, IT and HRM staff within a leading Irish construction organisation. In general, the staff found the framework and its constituent elements relatively easy to understand and felt that KM could have a positive impact on the organisation. The main areas identified for improvement centred on providing case study examples of companies that have adopted a more formal approach to managing knowledge and the benefits that they have derived from it. The main stumbling block to the full adoption of the KM framework is the current economic climate and the focus of senior management on ensuring that the company remains successful in the marketplace

Utilising grounded theory, the research has sought to identify the main issues associated with KM, and subsequently develop an integrated KM framework for the leading Irish construction organisations that is recognisable to, and understood by, the participants of the research. The framework has focused on KM within construction organisations, providing a working definition of knowledge and KM and also demonstrating the importance of and the potential benefits to be derived from it. Through the integration of existing HRM and IT practices, a practical approach to managing knowledge has been proposed, which has the potential to be adopted by the leading Irish construction organisations. While the current turmoil facing the Irish construction industry, however, may inhibit the adoption of new practices, it is argued that KM is more important than ever as organisations seek to secure their future viability in an extremely competitive environment. An incremental approach to adoption of the KM framework, which builds upon existing practices, is deemed to be the most appropriate route to take.

Chapter 10

Conclusions & Recommendations

10 CONCLUSIONS & RECOMMENDATIONS

The research outlined in the preceding nine chapters took place over a six year period, commencing in October 2004. Since then a significant volume of secondary and primary research has been undertaken over four phases, leading to the identification of the main issues associated with KM for the leading Irish construction organisations and the subsequent development and evaluation of an integrated KM framework. This chapter presents the main conclusions and associated recommendations arrived at as a result of the research (an overview of the chapter is presented in Figure 38). This is achieved by reflecting on the aim and objectives outlined in Chapter 1 and acknowledging the limitations arising from the adopted approach. The chapter concludes by reflecting on the research questions within the context of the study's overall contribution to knowledge.

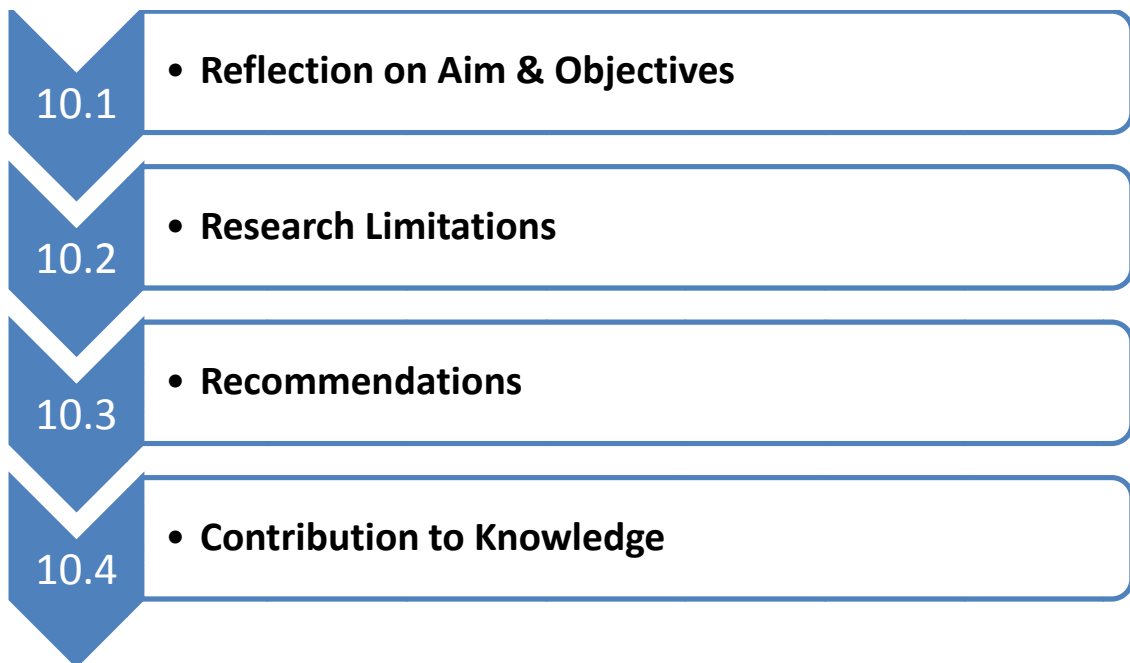


Figure 38: Chapter 10 Overview

10.1 Reflection on Aim and Objectives

The overall aim of this research was to investigate the emerging issues associated with developing and implementing KM within the leading Irish construction organisations. Five objectives were developed from this aim and each of them are reflected upon below.

Objective 1: To develop a critical understanding of knowledge and its management in a construction organisation setting

Knowledge and its management has been considered from two perspectives within this study, namely the methodological issues surrounding research of KM in construction organisations (as dealt with in Chapter 2) and the practical manifestations of managing knowledge in construction organisations (discussed throughout the thesis).

From a methodological perspective, conducting research into KM within any organisational setting is fraught with complexities, particularly as knowledge is intrinsically influenced by human, structural, political and cultural issues. Traditionally, there has been an emphasis on positivistic approaches to KM research; however, researchers need to recognise the socially constructed nature of knowledge and apply multiple theoretical models and methodologies. These issues are given further consideration later on when reflecting upon objective number 5.

From a practical perspective, knowledge is a critical resource for construction organisations which is experientially-based, continuously modified, socially constructed and context-specific in nature. The most common view of knowledge identifies it as ranging from explicit (which can be documented) to tacit (which is difficult to express and share). The main areas of concern for construction organisations include knowledge of people (skills and expertise), projects (specialist technical and management features, performance and lessons learned) and organisational routines and systems. There have been numerous attempts to define KM, with a variety of processes (creating, sharing, renewing, identifying, capturing etc.), approaches (codification and personalisation), and solutions (using IT or integrating KM with social processes). The optimum solution was identified as adopting both personalisation and codification; marrying social processes to IT solutions. In spite of the temporary, fragmented and pressurised nature of the construction industry, which has been viewed as being hostile to the adoption of KM, there are significant gains to be made by organisations who adopt a more formal approach to KM.

Objective 2: To identify existing approaches to managing knowledge within the leading Irish construction organisations and assess how they can be utilised to augment an organisational KM initiative

Both the literature review and primary research conducted throughout this study identified a number of existing approaches to managing knowledge within construction organisations. Specific approaches relevant to the leading Irish construction organisations include: researching new building systems and products, problem-solving, regular meetings (at different levels), annual conferences, site visits, safety bulletins, company newsletter, libraries, databases, social activities, informal networks, and CVs. One such organisation has implemented lessons learned practices for managing knowledge gained on projects, employing a database to store, and seminars to share the knowledge with the wider organisation.

Existing activities, such as those outlined above, were identified as having the greatest potential for augmenting an organisational KM initiative. This is supported by the deployment of an intranet as a focal point for KM activities.

Objective 3: To ascertain how construction professionals can be encouraged to engage effectively in an organisational KM initiative

Many of the leading construction organisations invest considerable time and resources in the development of their employee's knowledge, through the provision of CPD opportunities. Construction professionals value the opportunity for personal and professional development in order to keep their knowledge up-to-date and enhance their career prospects. The alignment of a professional's CPD with an organisational KM initiative presents a significant opportunity for mutually beneficial outcomes.

In adopting such an approach, careful consideration must be given to the experience and management level of those involved. As construction professionals progress through their careers, their learning and development needs change, moving from formal training towards mode 2 knowledge production, requiring tailored approaches for staff at different levels. These activities should be developed with consideration given to the requirements of professional bodies such as EI, the CIOB and SCS. The central role which middle managers have in managing knowledge within construction organisations, through their interaction between senior management and site-based staff, should also be recognised as a key enabler of KM.

Further research is required in relation to integrating such practices with existing HRM and IT-related systems.

Objective 4: To formulate a grounded theory framework based upon the emerging issues, for improving awareness and understanding of KM within the leading Irish construction organisations

While it is recognised that numerous KM frameworks have been developed in recent years, initial research conducted for this study identified the need for the continuing empirical research specific to the context of KM in construction organisations. Central to the KM framework developed during this study are the integral roles which both HRM and IT play in KM in construction organisations. HRM has a lead role to play in this regard, requiring the support of IT. For example, from a practical perspective, HRM should be involved in setting up and maintaining the organisation's intranet, especially in the following areas: providing company news and information, developing eLearning and online CPD resources for staff, populating and managing the staff skills database, promoting staff networks through an online environment. Similarly IT needs to provide the technological know-how required to translate such information into user-friendly and secure systems that are available and accessible to all staff throughout the organisation.

In relation to improving awareness and understanding, this was partially achieved through the evaluation process outlined in Chapter 9, which sought to validate the framework through a CPD presentation and guidance document. The participants found the framework and guidance document to be easily understood, and were able to relate it to their own organisation. There is, however, potential for further development of these resources and a need for delivery of same to a wider audience. Based on the KM framework, a module entitled 'Knowledge Management in Construction' has been developed and approved as an elective for the MSc in Construction Project Management which is run by Waterford Institute of Technology (see Appendix P for module descriptor). There is also the possibility of this module being delivered on its own as a Certificate in Knowledge Management in Construction, which could potentially be accredited by Engineers Ireland. This could be delivered to staff involved in the development of KM within their company, including HRM and IT professionals, contracts managers and senior management.

A by-product of the research process and the feedback mechanism adopted has also led to an improved awareness and understanding of KM within the participating case study organisations. Feedback from these organisations suggests that they have adopted some of the recommendations made to them and are keen to progress the KM agenda further. Indeed recent discussions with the collaborating practitioner in Case Study B have indicated that they are in the process of appointing a Knowledge Manager.

Objective 5: To identify whether the adoption of a constructivist approach to grounded theory is a suitable methodology for investigating KM within construction organisations

By adopting a constructivist approach to grounded theory, the development of a KM framework was very much a consensus-building process, each phase of the research leading to an even more sophisticated construction than the previous phase. Through meaningful engagement with a hermeneutic dialectic circle of key informants in the decision-making process, it was possible to ensure access to appropriate participants for the research in fulfilment of theoretical sampling. The reflective approach adopted during each phase provided opportunities for feedback throughout the research process (Case Studies A, B & C), thus ensuring that the emerging issues remained ‘grounded.’ The adoption of mixed research methods has also proven to be useful in supporting theoretical sampling, allowing for the use of methods which were appropriate to the level of focus (e.g. individual, group, organisational) at different points in the process. Indeed, it can be argued that the mixing of methodologies (grounded theory, case studies, action research) with research paradigms (positivism and interpretivism) under the constructivist umbrella has yielded a deeper insight into understanding the practice of KM in construction.

However such an approach was not without its challenges. The grounded theory methodology is fraught with many different interpretations and once a version had been selected, the anxiety of ‘sticking to the guidelines’ materialised. Much was learned through the use of software to support framework development, particularly when trying to ensure that the correct analytical procedures were followed. While NVivo was extremely useful in the early stages of analysis, especially managing and organising large amounts of information, as the analysis moved from axial to selective coding, more time was spent using manual methods for conceptualisation and Word for sorting and drawing categories.

Aim: To investigate the emerging issues associated with developing and implementing KM within the leading Irish construction organisations.

Based on the preceding discussion, the overall aim of the research has been satisfied, and in this regard the main conclusions of the research can be summarised as follows:

- In a highly competitive industry, where continuous improvement is required, there is a clear strategic need for KM within the leading Irish construction organisations. In developing and implementing KM, a well-defined strategy should be formulated which is aligned with the objectives of the business and existing organisational practices.
- A culture which recognises the need for learning from experience and continuous improvement must be promoted at all levels of the organisation. Through engagement in CPD, construction professionals seek to ensure that their knowledge is kept up-to-date. The alignment of professionals' learning with organisational objectives has been shown to be a key aspect of managing organisational knowledge.
- While there is great potential for advanced technologies to support KM, it must be recognised that the leading Irish construction organisations are in the early stages of IT adoption and should utilise existing systems, such as an intranet, as a platform for KM.

It has been documented throughout the research that the integration of these issues is crucial in developing and implementing KM in the leading Irish construction organisations. The identified issues and developed framework recognises and reflects the need for such integration. It must be recognised however, that there are limitations to the research and that further work should be undertaken in building upon the conclusions.

10.2 Research Limitations

As with any research, there are limits imposed which impact upon the outcome of the study. As discussed in Chapter 2, the methodological approach adopted has sought to reduce such impacts as much as possible. However, it is important to recognise the limitations in order to convey a thorough understanding of the research undertaken. The limitations of the research include the following:

- Time and resource constraints imposed by institutional requirements in completing a Doctoral study constrain the ability of a researcher to pursue all potentially interesting avenues of enquiry
- The perspective of all relevant professional bodies was not given in-depth consideration due to theoretical sampling directing the research towards EI and their CPD scheme. Further engagement with the CIOB, SCS and CIBSE could have provided for a more detailed consideration of CPD and professional body recognition
- Due to the substantial reductions in employment within the Irish construction industry over the past two years, it was almost impossible to return to the original informants to obtain their opinions on the identified issues and developed framework. There have been significant job losses at all levels of the leading Irish construction organisations mainly through redundancies, but also retirements, changes in employer and migration
- The unfolding and emergent nature of the research design meant that access to research participants was dependent upon the goodwill of key informants encountered through the research. Whilst a scientific approach to the selection of research participants is viewed as essential by many, the theoretical sampling employed relied upon good fortune and serendipity in most instances to support the emergent research design
- The evaluation of the developed framework relied on a small sample of staff from Case Study C, potentially limiting its acceptance by a wider industry audience.

In order to address these limitations and build upon the research conducted, there are a number of areas for further research which will be discussed in the following section.

10.3 Recommendations

The research has considered KM from the perspective of the leading Irish construction organisations. Recommendations are now made in relation to those leading organisations, for KM in the wider construction industry and for further research.

10.3.1 Adoption of KM Framework by Leading Irish Construction Organisations

It is clear that a more formal approach to managing knowledge would be beneficial to the leading Irish construction organisations. The full adoption of KM in the current economic climate might not be feasible, but there is potential for an incremental approach. Areas which require minimal time and investment could be initially developed to demonstrate the potential benefits, and get buy-in from both senior management and staff alike. Such areas could include the adoption of lessons learned practices, development of the intranet and regular knowledge-sharing meetings for middle managers.

With many of the leading Irish construction organisations in the early stages of adopting intranet technologies, there is potential for exploring the role of such systems, not only in facilitating KM, but in streamlining other organisational processes and systems. CITA could play a role in assisting these organisations in the development of their internal IT systems through the examination of current and emerging technologies.

10.3.2 Greater Emphasis on KM in the Irish Construction Industry

The research has demonstrated the importance of knowledge to the construction industry in successfully delivering projects. If the industry wishes to learn from experience and be continually innovative, it is important that KM is explored at industry level. From the Irish construction industry's perspective there is potential for relevant stakeholders, including the FCI, CIF, CITA, professional bodies, contractors, consultants, clients, and suppliers to meaningfully engage in advancing this area. It is possible that the interest expressed in KM by both EI and CITA could act as a catalyst for the promotion and development of KM across the construction industry in Ireland.

10.3.3 Further Research

Areas for potential future research are now given consideration in relation to construction organisations, construction professionals, professional bodies and academia.

The leading Irish construction organisations are in the very early stages of KM adoption. There is a need for further testing and development of the KM framework with these organisations. There is also potential to explore the transferability and usefulness of the framework in the context of other project-based industries and EI's CPD accreditation scheme. While the research outlined in Chapter 8 engaged with other sectors involved in the scheme, intervening conditions such as organisation type and size, resources, culture and sophistication of IT systems warrant additional investigation.

The alignment of CPD for construction professionals with KM for construction organisations merits further investigation, particularly in terms of lessons learned practices and knowledge-sharing activities. Specific attention should also be given to the development of an action learning framework, where directed learning in the workplace is recognised and accredited by professional bodies and academic institutions. The consideration of KM in relation to pedagogy and learning theories also merit consideration in this regard.

Given the myriad stakeholders which the leading Irish construction organisations engage with on a daily basis, across numerous projects and scenarios (i.e. clients, subcontractors, suppliers, consultants, regulatory bodies, academic institutions, professional bodies etc.), there is a need for examination of how such knowledge is assimilated into a construction organisation.

In terms of advancing the development of KM, and indeed academic research, within the Irish construction industry, there is a need for more co-operation and interfacing between industry and academia. There is currently great potential for conducting collaborative Construction Management research involving leading organisations, academic institutions, professional bodies and industry bodies, which can lead to real improvements and benefits for all involved.

10.4 Contribution to Knowledge

According to Phillips and Pugh (2005: 61), a PhD is awarded for “*an original contribution to knowledge.*” From an Irish context the National Framework of Qualifications (NFQ) identifies learning outcomes at Level 10 (Doctoral Degree) relating to knowledge, know-how & skill, and competence (see Appendix Q). This section outlines the contribution to knowledge which this study has made in relation to theory (by reflecting on the research questions), methodology and practice (of both the participating organisations and the author).

In terms of theory, the identification of the main issues associated with KM for the leading construction organisations is the first and only study of its kind in Ireland. Furthermore the research adds to the paucity of doctoral studies in the field of construction management in the Irish context. There are a number of areas where this study has made a contribution to the wider body of knowledge, which can be related back to the original research questions:

1. How effectively are the leading Irish construction organisations currently managing knowledge?

Despite recognising the importance of managing knowledge, the leading Irish construction organisations are not doing so effectively. While there is evidence of good organisational KM practices, there is a need for a more coherent, cohesive approach which recognises the complexities of KM and its interface with various processes and activities and at different levels within the organisation.

2. What are the main strategic, cultural and technological issues that must be addressed for the adoption of KM in construction?

As discussed in section 10.1, a clearly defined KM strategy is required which recognises the identified drivers, enablers and barriers to KM. While the nature and culture of construction is recognised as a significant hurdle to KM, many of the organisations acknowledge the need to learn from experience and for continuous improvement; this must be promoted at all levels of construction organisations. The low level of technological sophistication within construction organisations indicates a

requirement to focus on the utilisation of existing IT systems, such as an intranet, for developing KM.

3. Can construction professionals be encouraged to engage in KM through its alignment with existing organisational processes and activities?

Yes, particularly through the alignment of KM with existing CPD practices. Furthermore, the role and experience of an individual construction professional was identified as a key determinant in their engagement with KM and the potential for aligning KM with CPD practices in managing professional, project and organisational knowledge. The role of professional body requirements for construction professionals should be taken into account and aligned with organisational KM objectives. KM should also be aligned with other existing organisational processes and activities such as HRM activities and IT systems.

Whilst the identified issues and developed framework are predominantly modest and localised in outlook, it is expected that they could have application in other countries and project-based industries (e.g. those sectors which participate in EI's CPD scheme). In addition, the research methodology adopted, and the subsequent emergent research design, is novel and should add to the debate for alternative approaches to Construction Management research. These issues have been disseminated to the wider research community through fourteen conference papers, one peer-reviewed journal paper and two industry publications (as outlined in Appendix R). Further papers are expected to be published upon completion of this study.

From a practical perspective, the participatory nature of the research has led to some changes in practice within the three case study organisations. It is hoped that through future engagement with the leading Irish construction organisations and relevant industry bodies, additional improvement in the practice of KM can be achieved.

From a personal perspective, the research process has informed the practice of the author in the teaching of research and supervising minor dissertations at both undergraduate and postgraduate levels. Indeed, a number of students have, or are currently undertaking such

research into KM in a number of areas including: lessons learned practices, KM in the humanitarian aid industry, knowledge loss in construction organisations due to the recession, KM practices for commercial staff and KM in civil engineering and cleanroom projects. Furthermore, the research has led to the development and academic approval of a module on KM in Construction, which it is anticipated will be offered as an elective module as part of an ongoing MSc in Construction Project Management. It is hoped that this module will also be offered as a single certificate CPD course to industry professionals with an interest in KM.

References

References

1. Ackoff, R. L. (1989); *From data to wisdom*, Journal of Applied Systems Analysis, Vol. 16, pp. 3-9.
2. Afiouni (2007); *Human Resource Management and Knowledge Management: A Road Map Towards Improving Organizational Performance*, Journal of American Academy of Business, Vol. 11 No.2, pp.124-30.
3. Al-Ghassani, A.M., Kamara, J.M., Anumba, C.J. and Carrillo, P.M. (2004); *An innovative approach to identifying knowledge management problems*, Engineering, Construction and Architectural Management, Vol. 11 No.5, pp.349-57.
4. Al-Ghassani, A., Anumba, C., Carrillo, P. and Robinson, H. (2005); *Tools and Techniques for Knowledge Management* In Anumba, C., Egbu, C. and Carrillo, P., editors, Knowledge Management in Construction, Blackwell Publishing.
5. Amaratunga, D. and Baldry, D. (2001); *Case study methodology as a means of theory building: performance measurement in facilities management organisations*, Work Study, Vol. 50, No. 3, pp. 95-104.
6. Bartholomew, D. (2008); *Building On Knowledge: Developing Expertise, Creativity & Intellectual Capital in the Construction Professions*, Chichester: Wiley-Blackwell.
7. Best, H. A., Eaton, K. A., Plasschaert, A., Toh, C. G., Grayden, S. K., Senakola, E. and Rohlin, M. (2005); *Continuing professional development – global perspectives: synopsis of a workshop held during the International Association of Dental Research meeting in Gothenburg, Sweden, 2003. Part 1: access, funding and participation patterns*, European Journal of Dental Education, 2005, Issue 9, pp. 59-65.
8. Bhatt, G. (2001); *Knowledge management in organizations: examining the interaction between technologies, techniques, and people*, Journal of Knowledge Management, Vol. 5, No. 1, pp. 68-75.
9. Birley, G. and Moreland, N. (1998); *A Practical Guide to Academic Research*, London: Kogan Page.
10. Blismas, N.G. and Dainty, A.R.J. (2003); *Computer-aided qualitative data analysis: panacea or paradox?* Building Research and Information, Vol. 31, No. 6, Nov-Dec 2003, pp. 455-463.
11. Bolisani, E. and Scarso, E. (1999); *Information technology management: a knowledge-based perspective*, Technovation, Vol. 19, Issue 4, pp. 209-217.
12. Boyd, D., Egbu, C., Chinyo, E., Xiao, H. and Lee, C. (2004); *Audio Diary and Debriefing for Knowledge Management in SMEs*, Proceedings of the Twentieth Annual Conference, Association of Researchers in Construction Management, Heriot Watt University, September 1-3, 2004, pp. 741-747, ARCOM.

References

13. Bresnen, M. (1999); *Institutional and Cultural Barriers to Effective Knowledge Transfer*, White Paper for Construction Research and Innovation Strategy Panel Consultancy Commission, Available at http://ncrisp.steel-sci.org/publications/wbs_fr.pdf [Accessed 15th October 2004].
14. Bringer, J. D., Johnston, L. H. and Brackenridge, C. H. (2006); *Using Computer-Assisted Qualitative Data Analysis Software (CAQDAS) to Develop a Grounded Theory Project*, *Field Methods*, Vol. 18, No. 3, pp. 245-266.
15. BSI (2003); *PD7503 – Introduction to Knowledge Management in Construction*, British Standards Institute Technical Committee KMS/1, London: BSI British Standards.
16. Buck, D. and Newton, T. (2002); *Continuing professional development amongst dental practitioners in the United Kingdom: how far are we from lifelong learning targets?* *European Journal of Dental Education*, 2002, Issue 6, pp.36-39.
17. Burns, G. R. and Chisholm, C. U. (2003); *The Role of Work-Based Learning Methodologies in the Development of Life-Long Engineering Education in the 21st Century*, *Global Journal of Engineering Education*, Vol. 7, No. 2, pp. 179-187.
18. Caddy, I. (2001); *Orphan knowledge: the new challenge for knowledge management*, *Journal of Intellectual Capital*, Vol. 2, No. 3, pp. 236-245.
19. Carrillo, P. (2005a); *Managing Knowledge: The North American Perspective*, Proceedings of CIB W102 Meeting and International Conference, Instituto Superior Tecnico, Lisbon, May 19-20, 2005, pp. 557-566.
20. Carrillo, P. (2005b) *Lessons learned practices in the engineering, procurement and construction sector*. *Engineering, Construction and Architectural Management*, Vol. 12, No. 3, pp. 236-250.
21. Carrillo, P. M., Robinson, H. S., Anumba, C. J. and Al-Ghassani, A. M. (2003); *IMPACT: A Framework for Linking Knowledge Management to Business Performance*, *Electronic Journal of Knowledge Management*, Vol. 1, Issue 1, pp. 1-12.
22. Carrillo, P., Robinson, H., Al-Ghassani, A. and Anumba, C. (2004); *Knowledge Management in UK Construction: Strategies, Resources and Barriers*, *Project Management Journal*, Vol. 35, No. 1, pp. 46-57.
23. Chen, L. and Mohamed, S. (2005); *"Conceptual model linking knowledge management with organisational performance"*, Proceedings of CIB W102 Meeting and International Conference, Instituto Superior Tecnico, Lisbon, May 19-20, 2005, pp.415-23.
24. Chen, L., Mohamed, S. and Chan, E. M. Y. (2005); *Knowledge Management Practices in Construction: Evidence from Hong Kong*, Proceedings of CIB W102 Meeting and

References

- International Conference, Instituto Superior Tecnico, Lisbon, May 19-20, 2005, pp. 435-443.
25. Chien, C. and Johnson, B. (2002); *Knowledge Management*, Research Paper, University of Washington, Available at: <http://courses.washington.edu/cm505/R2.pdf> [Accessed November 2004].
26. Chiovitti, R. F. and Piran, N. (2003); Rigour and grounded theory research, *Journal of Advanced Nursing*, Vol. 44, No. 4, pp. 427-435.
27. CIF (2004) *Construction Industry Federation Website*, Available at: <http://www.cif.ie> [Accessed November 2004].
28. CIF (2005); *Construction: The Official Magazine of the Construction Industry Federation*, Dublin: Dyflin Publications Ltd.
29. CIOB (2007); Continuing Professional Development: Underpinning your commitment to your career [Internet], Ascot, Berkshire. Available from: <http://www.ciob.org.uk> [Accessed 23rd July, 2007]
30. Clark, D. R. (2004); *Understanding and Performance*, Performance, Learning, Leadership & Knowledge Website, Available at: <http://nwlink.com/~donclark/performance/understanding.html> [Accessed: 5th June 2008].
31. Cleveland, J. N., Murphy, K. R. and Williams, R. E. (1989); "Multiple Uses of Performance Appraisal: Prevalence and Correlates", *Journal of Applied Psychology*, Vol. 74, No. 1, pp. 130-135.
32. Clough, P. and Nutbrown, C. (2002); *A Student's Guide to Methodology: Justifying Inquiry*, London: Sage Publications.
33. Coghlan, D. and Brannick, T. (2001) *Doing Action Research in your own Organization*. London: Sage.
34. Constructing Excellence (2004); *Constructing Excellence Website*, Available at: <http://www.constructingexcellence.org.uk>, [Accessed: November 2004].
35. Craig, N., McCarney, M., Sommerville, J. (2004); *Knowledge Management As A Stress Mediator*, Proceedings of the Twentieth Annual Conference, Association of Researchers in Construction Management, Heriot Watt University, September 1-3, 2004, pp. 469-476, ARCOM.
36. Dainty, A. R. J., Bagilhole, B. M. and Neale, R. H. (2000); *A grounded theory of women's career under-achievement in large UK construction companies*, *Construction Management and Economics*, Vol. 18, Issue 2, pp. 239-250.

References

37. Dainty, A. (2007); *A Call for Methodological Pluralism in Built Environment Research*, Proceedings of the Third Scottish Conference for Postgraduate Researchers of the Built and Natural Environment, Glasgow Caledonian University, November 20-22, pp. 1-10, PRoBE.
38. Dainty, A. R., Qin, J. and Carrillo, P. (2005); *HRM Strategies for Promoting Knowledge Sharing within Construction Project Organisations: A Case Study*, In: Kazi, A. S. (ed.), *Knowledge Management in the Construction Industry: A Socio-Technical Perspective*, 18-33, London: Idea Group Publishing.
39. Davenport, T. (2003); *Knowledge Management: Where It's Going, Where It's Been*, Proceedings of the Knowledge Management International Conference, Quebec Convention Centre, Canada, November 18th – 19th, 2003.
40. Davenport, T. and Prusak, L. (1998); *Working Knowledge: How Organizations Manage What They Know*, Harvard Business School Press
41. Davenport, T. and Volpel, S. (2001); *The rise of knowledge towards attention management*, *Journal of Knowledge Management*, Vol. 5, No. 3, pp. 212-221.
42. Davidson, J. (2006) *Finding the value in lessons learned*. *Knowledge Management Review*, Vol. 9, Issue 3, pp. 6-7.
43. Davis Langdon PKS (2006) *Irish Construction Annual Review 2006*, Available at: <http://www.dlpks.ie> [Accessed April 2007]
44. Davis, V.D., & Kleiner, B.H. (2001). *How to orient employees into new positions successfully*, *Management Research News*, Vol. 24, No. 1/2, pp. 43-49.
45. Denscombe, M. (2003); *The Good Research Guide: For Small-Scale Research Projects*, Second Edition. Buckingham: Open University Press.
46. Denzin, N. K. and Lincoln, Y. S. (2005); *Introduction: The Discipline and Practice of Qualitative Research*, In Denzin, N. K. and Lincoln, Y. S. (Eds.), *The SAGE Handbook of Qualitative Research*, Third Edition, Thousand Oaks: Sage Publications, pp. 1-42
47. Disterer, G. (2002); *Management of project knowledge and experiences*, *Journal of Knowledge Management*, Vol. 6, Issue 5, pp. 512-520.
48. Dixon, N. M. (2004) *Does Your Organization Have An Asking Problem?* *Knowledge Management Review*, Vol. 7, No. 2, pp. 18-23.
49. DKM (2006); *Review of the Construction Industry 2005 and Outlook 2006-2008*. Dublin: DKM Economic Consultants
50. DKM (2007); *Construction Industry Review 2006 and Outlook 2007-2009*, Dublin: DKM Economic Consultants

References

51. DKM (2009); *Construction Industry Review 2008 and Outlook 2009-2011*, Dublin: DKM Economic Consultants
52. DoETE (2009); *Science, Technology and Innovation: Delivering the Smart Economy*, Dublin: Department of Enterprise, Trade and Employment, August 2009.
53. Edvardsson, I. (2008) *HRM and knowledge management*, *Employee Relations*, Vol. 30, No. 5, pp. 553-561.
54. Egbu, C. (2004); *Managing knowledge and intellectual capital for improved organisational innovations in the construction industry: an examination of critical success factors*, *Engineering, Construction and Architectural Management*, Vol. 11, Issue 5, pp. 301-315.
55. Egbu, C. and Botterill, C. (2002); *Information technologies for knowledge management: their usage and effectiveness*, *ITcon*, Vol. 7, Special Issue ICT for Knowledge Management in Construction, pp. 125-137.
56. Egbu, C. and Robinson, H. (2005); *Construction as a Knowledge-Based Industry*. In: Anumba, C., Egbu, C. and Carrillo, P. (Eds.) *Knowledge Management in Construction*. Oxford: Blackwell Publishing.
57. Egbu, C. O., Hari, S., and Renukappa, S. H. (2005); *Knowledge management for sustainable competitiveness in small and medium surveying practices*, *Structural Survey*, Vol. 23, Issue, 1, pp. 7-22.
58. Eisenhardt, K. M. (1989); *Building Theories from Case Study Research*, *The Academy of Management Review*, Vol. 14, Issue 4, pp. 532-550
59. Ellis, R. C. T., Wood, G. D. and Thorpe, T. (2004); *Technology-based learning and the project manager*, *Engineering, Construction and Architectural Management*, Vol. 11, No. 5, pp. 358-365.
60. Engineers Ireland (2005); *Engineering a Knowledge Island 2020*, Dublin: Joint Report by the Irish Academy of Engineering and Engineers Ireland, October 2005.
61. Engineers Ireland (2007); *Engineers Ireland Website* [Internet], Dublin, Ireland. Available from: <http://www.engineersireland.ie> [Accessed 23rd July, 2007].
62. FCI (2003); *Forum for the Construction Industry Fifth Annual Progress Report – 2002*, Published 7th February 2003, Dublin: Department of Environment & Local Government.
63. Fern, F.E. (2001); *Advanced Focus Group Research*, London Sage Publications.

References

64. Fellows, R. and Liu, A. (2008); *Research Methods for Construction*, Third Edition, Oxford: Blackwell Science.
65. Fisher, D., Deshpande, S. and Livingston, J. (1998); *Modelling the Lessons Learned Process: A Report to the Construction Industry Institute*, The University of New Mexico, Albuquerque, New Mexico, Research Report 123-11, January 1998.
66. Fitzpatrick Associates (2003); *Business Case for an Applied Construction Innovation Centre*, Forum for the Construction Industry, The Department of the Environment, Heritage and Local Government, May 2003.
67. Fong, P. S. W. (2005); *Building a Knowledge-Sharing Culture in Construction Project Teams*, In: Anumba, C., Egbu, C. and Carrillo, P. (eds.), *Knowledge Management in Construction*, Oxford: Blackwell Publishing.
68. Fong, P. S. W. and Wong, K. (2005); *Capturing and Reusing Building Maintenance Knowledge: A Socio-Technical Perspective*. In: Kazi, A. S. (ed.), "Knowledge Management in the Construction Industry: A Socio-Technical Perspective". London: Idea Group Publishing.
69. Fong, P. S. W. and Yip, J. C. H. (2006); *An Investigative Study of the Application of Lessons Learned Systems in Construction Projects*, *Journal for Education in the Built Environment*, Vol. 1, Issue 2, pp. 27-38.
70. Fowler, A. (1990); *A Good Start: Effective Employee Induction*, Second Edition, Institute of Personnel Management.
71. Gary, L. (2005); *Build Your Company's Deep Smarts: Ensure that the deeply embedded know-how of your most valuable employees is transferred to the next generation*, *Harvard Management Update*, August 2005, pp. 3-5.
72. Gay (1994); *What is mentoring?* *Education and Training*, Vol. 36, Issue 5, pp. 4-7.
73. Gibbs, G. (2002) *Qualitative Data Analysis: Explorations with NVivo*, Understanding Social Research Series, Berkshire: Open University Press.
74. Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M. (1994); *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*, London: Sage Publications
75. Gillham, B. (2000); *Case Study Research Methods*. London: Continuum Books.
76. Glaser, B. G & Strauss, A. L. (1967); *The Discovery of Grounded Theory: Strategies for Qualitative Research*, Chicago, Aldine Publishing Company.

References

77. Gloet, M. (2006) *Knowledge management and the links to HRM: Developing leadership and management capabilities to support sustainability*, Management Research News, Vol. 29, Issue 7, pp. 402-413.
78. Goulding, C. (1998); *Grounded theory: the missing methodology on the interpretivist agenda*, Qualitative Market Research: An International Journal, Vol. 1, No. 1, pp. 50-57
79. Goulding, C. (2002); *Grounded Theory: A Practical Guide for Management, Business and Market Researchers*, London: Sage Publications.
80. Goulding, C. (2005); *Grounded theory, ethnography and phenomenology: A comparative analysis of three qualitative strategies for marketing research*, European Journal of Marketing, Vol. 39, No. 3/4, pp. 294-309.
81. Gourlay, S. (2001); *Knowledge management and HRD*, Human Resource Development International, Vol. 4, No. 1, pp. 27 – 46.
82. Gregson, K. (1994); *Mentoring*, Employee Counselling Today, Vol. 6 No.4, pp.26-27.
83. Grisham, T. and Walker, D. (2005); *Communities of Practice: Techniques for the International Construction Industry*, Proceedings of CIB W102 Meeting and International Conference, Instituto Superior Tecnico, Lisbon, May 19-20, 2005, pp. 545-556, CIB.
84. Guba, E. G. and Lincoln, Y. S. (1994); *Competing Paradigms in Qualitative Research*, In Denzin, N. K. and Lincoln, Y. S. (Eds.), *The SAGE Handbook of Qualitative Research*, Thousand Oaks: Sage Publications, pp. 105-117.
85. Guest, G. (2007); *CPD: What exactly is it? Why should I bother? And am I actually doing it already?* Downloaded from www.cpdinstitute.org/articles/2007 [Accessed: 13th May 2008].
86. Guo, Z. and Sheffield, J. (2008); *A paradigmatic and methodological examination of knowledge management research: 2000 to 2004*, Decision Support Systems, Vol. 44, Issue 3, pp. 673-688.
87. Haesli, A. and Boxall, P. (2005); *When knowledge management meets HR strategy: an exploration of personalization-retention and codification-recruitment configurations*, International Journal of Human Resource Management, Vol. 16, No. 11, pp.1955-1975.
88. Hari, S., Egbu, C. and Kumar, B. (2004); *Knowledge Capture in Small and Medium Enterprises in the Construction Industry: Challenges and Opportunities*, Proceedings of the Twentieth Annual Conference, Association of Researchers in Construction Management, Heriot Watt University, September 1-3, 2004, pp. 847-855, ARCOM.

References

89. Hari, S., Egbu, C., and Kumar, B. (2005); *A knowledge capture awareness tool: an empirical study on small and medium enterprises in the construction industry*, Engineering, Construction and Architectural Management, Vol. 12, No. 6, pp. 533-567.
90. Harrison, R. and Kessels, J. (2004); *Human Resource Development in a Knowledge Economy: An Organisational View*, Palgrave Macmillan.
91. Hayes, M. (2005); *Irish Construction Industry Magazine*, April 2005, Commercial Publications Ltd.
92. Hayles, C. and Egbu, C., (2004); *Will the Knowledge Management Specialist Please Stand Up! Experiences from the UK Construction Industry and Beyond*, Proceedings of the Twentieth Annual Conference, Association of Researchers in Construction Management, Heriot Watt University, September 1-3, 2004, pp. 805-814, ARCOM.
93. Hislop, D. (2002); *Linking human resource management and knowledge management via commitment: a review and research agenda*, Employee Relations, Vol. 25, No. 2, pp.182-202.
94. Hunter, K., Hari, S., Egbu, C. and Kelly, J. (2005); *Grounded Theory: Its Diversification and Application Through Two Examples from Research Studies on Knowledge and Value Management*, The Electronic Journal of Business Research Methodology Vol. 3, No. 1, pp. 57-68.
95. Hussain, F. and Lucas, C. (2004); *Managing Knowledge Effectively*, Journal of Knowledge Management Practice, Available at: <http://www.tlinc.com/articl66.htm> [Accessed October 2004].
96. ICPD (2006); *Regulating Competencies: Is CPD Working? Research Report*, London: The Institute of Continuing Professional Development, Available at <http://www.cpdinstitute.org/articles/2006/> [Accessed: 19th April 2008].
97. Jack, E. P. and Raturi, A. S. (2006); Lessons learned from methodological triangulation in management research, Management Research News, Vol. 29, No. 6, pp. 345-357.
98. Jashapara, A. (2004); *Knowledge Management: An Integrated Approach*, London: Prentice Hall.
99. Jewell, M. and Walker, D. (2005); *Community of Practice Perspective Software Management Tools: A UK Construction Company Case Study*, In: Kazi, A (ed.), Knowledge Management in the Construction Industry: A Socio-Technical Perspective, pp. 111-128, London: Idea Group Publishing.
100. Jones, N. B., Herschel, R. T. and Moesel, D. D. (2003); *Using 'knowledge champions' to facilitate knowledge management*, Vol. 7, No. 1, pp. 49-63.

References

101. Jones, R. and Noble, G. (2007); *Grounded Theory and Management Research: a Lack of Integrity?* Qualitative Research in Organizations and Management, Vol. 2, No. 2, 84-96.
102. Kamara, J. M., Anumba, C. J. and Carrillo, P. M., (2002a); *A CLEVER approach to selecting a knowledge management strategy*, International Journal of Project Management, Vol. 20, Issue 3, pp. 205-211.
103. Kamara, J. M., Augenbroe, G., Anumba, C. J. and Carrillo, P. M. (2002b); *Knowledge Management in the Architecture, Engineering and Construction Industry*, Construction Innovation, Vol. 2, No. 1, pp. 53-67.
104. Karami, A., Rowley, J. and Analoui, F. (2006); *Research and Knowledge Building in Management Studies: An Analysis of Methodological Preferences*, International Journal of Management, Mar 2006; Vol. 23, No. 1, pp. 43-52.
105. Kartam, N. A. (1996); *Making Effective Use of Construction Lessons Learned in Project Life Cycle*, Journal of Construction Engineering and Management, Vol. 122, No. 1, pp. 14-21.
106. Kaski, T., Lappalainen, E., Novikova, E., vonTroil, S. (2004); *Knowledge Management*, Department of Engineering and Management, Helsinki University of Technology, Available at: http://www.tuta.hut.fi/studies/Courses_and_schedules/Tps/TU-53.301/3.pdf [Accessed: 17th October 2005].
107. Kazi, A. S. and Hannus, M. (2002); *Editorial: ICT Support for Knowledge Management in Construction*, Journal of Information Technology in Construction, Vol. 7, pp. 57-61.
108. Kazi, A., Koivuniemi, A. and Moksen, P. (2005); *Use of Social Processes for Good Practice in Project Based Business: The Case of YIT Construction*, Proceedings of CIB W102 Meeting and International Conference, Instituto Superior Tecnico, Lisbon, May 19-20, 2005, pp. 45-54, CIB.
109. Kelly, K. (2005) Innovation in the Building Industry. *The Engineers Journal: Journal of the Institution of Engineers of Ireland*, 59(2), 83-85.
110. Kleiner, A. and Roth, G. (1997); *How to Make Experience Your Company's Best Teacher*, Harvard Business Review, Vol. 75, No. 5, pp. 172-177.
111. KLICON (1999); *The Role Of Information Technology In Knowledge Management Within The Construction Industry*, Project Report of Knowledge Learning In Construction Group at The Centre For Research In The Management Of Projects, University of Manchester Institute of Science and Technology.

References

112. KMfSCC (2004); *Knowledge Management for Sustainable Construction Competitiveness Final Report*, July 2004, Available at: <http://www.knowledgemanagement.uk.net>, [Accessed February 2005].
113. Knauseder, I., Josephson, P. and Styhre, A. (2005); *Sharing Experiences Between Construction Project Organisations*, Proceedings of CIB W102 Meeting and International Conference, Instituto Superior Tecnico, Lisbon, May 19-20, 2005, pp. 609-617, CIB.
114. Koch, C. (2003); *Knowledge management in consulting engineering – joint IT and human resources to support the production of knowledge*, Engineering, Construction and Architectural Management, Vol. 10, Issue 6, pp. 391-402.
115. Kurul, E., Egbu, C., Hari, S., Vines, M., Olomolaiye, A., and Liyanage, C. (2004); *Appropriateness of Research Methodologies for Knowledge Management Research in the UK Construction Industry*, Salford Centre for Research and Innovation (SCRI) International Symposium, March 2004.
116. Lemons, D. (2005); *Integrating KM and Learning at Turner*, Knowledge Management Review, Vol. 8, No. 2, pp. 20-24.
117. Lengnick-Hall, M. L. and Lengnick-Hall, C. A. (2005); *HR's Role in Building Relationship Networks*, In: Little, S. and Ray, T. (eds.), *Managing Knowledge: An Essential Reader*, Second Edition, London: Sage Publications, pp. 299-315.
118. Leonard, D. and McAdam, R. (2001); *Grounded theory methodology and practitioner reflexivity in TQM research*, International Journal of Quality & Reliability management, Vol. 18, No. 2, pp. 180-194.
119. Leonard, D. and Swap, W. (2005); *Deep Smarts*, in Little, S. and Ray, T. (eds.); *Managing Knowledge: An Essential Reader*, Second Edition, London: Sage, pp. 157-169.
120. Litosseliti, L. (2003); *Using Focus Groups in Research*, Continuum Research Methods Series, Continuum Books.
121. Locke, K. (2001); *Grounded Theory in Management Research*, London: Sage Publications.
122. Longenecker, C. O. (1997) *Why managerial performance appraisals are ineffective: causes and lessons*, Career Development International, Vol. 2, No. 5, pp. 212-218.
123. Loosemore, M. (1999); *A grounded theory of construction crisis management*, Construction Management and Economics, 1999, 17, pp. 9-19.

References

124. Malhotra, Y. (2000); *From Information Management to Knowledge Management: Beyond the 'Hi-Tech Hidebound' Systems*, Knowledge Management for the Information Professional.
125. Malhotra, Y. (2003); *Is knowledge the ultimate competitive advantage?* Business Management Asia, September 2003, pp. 66-69.
126. Mansourian, Y. (2006); *Adoption of grounded theory in LIS research*, New Library World, Vol. 107, No. 9/10, pp. 386-399.
127. Maqsood, T. (2006); *The Role of Knowledge Management in Supporting Innovation and Learning in Construction*, Unpublished Doctoral Thesis, School of Business Information Technology, RMIT University.
128. Mason, J. (2002); *Qualitative Researching*, Second Edition, Sage Publications.
129. Matsumoto, I. T., Stapleton, J., Glass, J. and Thorpe, T. (2005) *Developing a framework to measure organizational employee skills development in a professional engineering design consultancy*, Construction Innovation, 2005(5), pp. 53-66.
130. Maxwell-Hart, G. and Marsh, G. (2001); *Management Development in the Construction Industry: Guidelines for the construction professional*, The Institution of Civil Engineers, Thomas Telford, Second Edition.
131. Mayo, A. (2006); *Supporting knowledge management*, CIPD Factsheet, Available at <http://www.cipd.co.uk/> [Accessed: 30th April 2008].
132. McCallin, A. M. (2003); *Designing a grounded theory study: some practicalities*, Nursing in Critical Care, Vol. 8, No. 5, pp. 203-208.
133. McDougall, M. and Beattie, R.S. (1998); *The missing link? Understanding the relationship between individual and organizational learning*, International Journal of Training and Development, Vol. 2, No. 4, pp. 288-299.
134. Mills, J., Bonner, A. and Francis, K. (2006); *Adopting a constructivist approach to grounded theory: Implications for research design*, International Journal of Nursing Practice, 2006 (12), pp. 8-13.
135. Mohamed, M., Stankosky, M. and Murray, A. (2004); *Applying knowledge management principles to enhance cross-functional team performance*, Journal of Knowledge Management, Vol. 8, No. 3, pp. 127-142.
136. Mohamed, S. F. and Anumba, C., (2004); *Towards a Framework for Integrating Knowledge Management Processes into Site Management Practices*, Proceedings of the Twentieth Annual Conference, Association of Researchers in Construction Management, Heriot Watt University, September 1-3, 2004, pp. 45-54, ARCOM.

References

137. Mohamed, S. and Anumba, C. (2005); *Opportunities for Improving Site Management Practices Through Knowledge Management*, Proceedings of CIB W102 Meeting and International Conference, Instituto Superior Tecnico, Lisbon, May 19-20, 2005, pp. 465-474, CIB.
138. Mondy, R. and Noe, R. (1996); *Human Resource Management*, Sixth Edition, Prentice Hall.
139. Morgan, D. (1997); *Focus Groups as Qualitative Research*, Second Edition, Qualitative Research Methods Series, Sage Publications.
140. Morris, T. (2006); *Social Work Research Methods: Four Alternative Paradigms*, Thousand Oaks: Sage.
141. Newell, S. Robertson, M., Scarbrough, H. and Swan, J. (2002); *Managing Knowledge Work*, Hampshire: Palgrave Macmillan.
142. NFQ (2010); *National Framework of Qualifications Website*, Available at www.nfq.ie, Accessed: 13th May 2010.
143. Ng, F. (2005); *Knowledge Management in Higher Education and Professional Development in the Construction Industry*, In: Kazi, A. S. (ed.), *Knowledge Management in the Construction Industry: A Socio-Technical Perspective*, pp. 150-165, London: Idea Group Publishing.
144. Nonaka, I. (1994); *A dynamic theory of organizational knowledge creation*, *Organization Science*, Vol. 5, No. 1, pp. 14-37.
145. Nonaka, I. and Takeuchi, H. (1995) *The Knowledge- Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press.
146. OECD (1996); *The Knowledge-Based Economy*, Paris: Organisation for Economic Co-Operation and Development, Available at: <http://www.oecd.org/dataoecd/51/8/1913021.pdf>, [Accessed September 2006].
147. Offsey, S. (1997); *Knowledge Management: Linking People to Knowledge for Bottom Line Results*, *Journal of Knowledge Management*, Vol. 1, No. 2, pp. 113-122.
148. Olomolaiye, A. and Egbu, C. (2004); *The Significance of Human Resource Issues in Knowledge Management Within The Construction Industry – People, Problems and Possibilities*, Proceedings of the Twentieth Annual Conference, Association of Researchers in Construction Management, Heriot Watt University, September 1-3, 2004, pp. 533-540, ARCOM.
149. Olomolaiye, A. and Egbu, C. (2005); *Training Needs in the Management of Human Resources for Knowledge Management*, ARCOM Doctoral Workshop on Skills,

References

- Training and Development in the Construction Industry, School of the Built Environment, Northumbria University, 30 November 2005, pp. 12-17.
150. Olomolaiye, A and Egbu, C. O. (2006); *Linking Human Resource Management and Knowledge Management for Performance Improvements: A Case Study Approach*, Proceedings of the COBRA Conference, 7-8 September, University College London, London, UK, pp. 507-516.
151. Orange, G., Onions, P., Burke, A., Colledge, B. (2003); *Knowledge Management: Facilitating Organisational Learning Within the Construction Industry*, Leeds Metropolitan University, School of Information Management Discussion Paper Series.
152. OED (2008); *Oxford English Dictionary*, Eleventh Edition, Oxford: Oxford University Press.
153. Palmer, J. and Platt, S. (2005); *Business case for knowledge management in construction*, Construction Industry Research and Information Association
154. Paltridge, B. (2002); *Thesis and dissertation writing: an examination of published advice and actual practice*, English for Specific Purposes, Vol. 21, Issue 2, pp. 125-143.
155. Payne, J. (2003); *Knowledge Management in Construction Toolkit (CD-ROM)*; Knowledge Management in Construction Project Partners.
156. Payne, J. and Sheehan, T. (2004); *Demystifying Knowledge Management: A Best Practice Guide for the Construction Industry*, Constructing Excellence, <http://www.constructingexcellence.org.uk>
157. Pettijohn, L. S., Parker, R. S., Pettijohn, C. E. and Kent, J. K. (2001); *Performance appraisals: usage, criteria and observations*, Journal of Management Development, 20(9), pp. 754-771.
158. Phillips, E. M. and Pugh, D. S. (2005); *How to get a PhD: A handbook for students and their supervisors*, Fourth Edition, Berkshire: Open University Press.
159. Proverbs, D. and Gameson, R. (2008); *Case Study Research*, In: Knight, A. and Ruddock, L. (eds.), *Advanced Research Methods in the Built Environment*, West Sussex: Wiley-Blackwell
160. Prusak, L. (2005); *The Four Names for Knowledge* [Online], Babson Knowledge. Available from: [\[http://www.babsonknowledge.org/2005/12/the_four_names_for_Knowledge.htm\]](http://www.babsonknowledge.org/2005/12/the_four_names_for_Knowledge.htm), Accessed 12th December 2006.
161. Prusak, L. (2006); *What have we learned about managing knowledge over the past decade?* Knowledge Management Seminar Series, Centre for Information & Knowledge Management, University of Limerick, 20th June 2006.

References

162. Quintas, P. (2005); *The Nature and Dimensions of Knowledge Management*, In: Anumba, C., Egbu, C. and Carrillo, P. (eds.), *Knowledge Management in Construction*, Oxford: Blackwell Publishing.
163. Rabelo, L. (2004); *Analysis Of Knowledge Management Initiatives: A Perspective From Two Companies*, *Journal of Knowledge Management Practice*, October 2004.
164. Raidén, A.B. and Dainty, A.R.J. (2006); *Human resource development (HRD) in construction organisations: an example of a 'chaordic' learning organisation?* *The Learning Organization*, Vol. 13, No. 1, pp. 63-79.
165. Remenyi, D., Williams, B., Money, A. and Swartz, E. (1998); *Doing Research in Business and Management: An Introduction to Process and Method*, London: SAGE.
166. Ribeiro, F., Love, P., Davidson, C., Egbu, C. and Dimitrijevic, B. Eds. (2005); *Information and Knowledge Management in a Global Economy*, Proceedings of CIB W102 Meeting and International Conference, Instituto Superior Tecnico, Lisbon, May 19-20, 2005.
167. Robey, D., Boudreau, M. and Rose, G. (2000); *Information technology and organizational learning: a review and assessment of research*, *Accounting, Management and Information Technologies*, Vol. 10, Issue 2, pp. 125-155.
168. Robinson, H. S., Carrillo, P. M., Anumba, C. J. and Al-Ghassani, A. M., (2004); *Developing a business case for knowledge management: the IMPakT approach*, *Construction Management and Economics*, Vol. 22, No. 7, pp. 733-743.
169. Robinson, H. S., Carrillo, P. M., Anumba, C. J. and Al-Ghassani, A. M. (2005); *Knowledge management practices in large construction organisations*, *Engineering, Construction and Architectural Management*, Vol. 12, No. 5, pp. 431-445.
170. Robson, C. (1993); *Real World Research: A Resource for Social Scientists and Practitioner-Researchers*, Blackwell.
171. Roscoe, J. (2002); *Continuing professional development in higher education*, *Human Resource Development International*, Vol. 5, No. 1, pp. 3-9.
172. Rothwell, A. and Arnold, J. (2005); *How HR professionals rate 'continuing professional development,'* *Human Resource Management Journal*, Vol. 15, No. 3, pp.18-32.
173. Sadler-Smith, E. and Badger, B. (1998); *The HR practitioner's perspective on continuing professional development*, *Human Resource Management Journal*, Vol. 8, No. 4, pp. 66-75.

References

174. SAIC (2004); *Knowledge Management*, Science Applications International Corporation Web Site, Available at: <http://www.saic.com/km/> [Accessed: November 2004].
175. Salisbury, M. (2003); *Putting theory into practice to build knowledge management systems*, Journal of Knowledge Management, Vol. 7, No. 2, pp. 128-141.
176. Scandura, T., Tejada, M., Werther, W., Lankau, M. (1996); *Perspectives on mentoring*, Leadership & Organization Development Journal, Vol. 17 No.3, pp.50-58.
177. Schwandt, T. (1994); *Constructivist, Interpretivist Approaches to Human Inquiry*, In Denzin, N. K. and Lincoln, Y. S. (Eds.), Handbook of Qualitative Research, Thousand Oaks: Sage Publications, pp. 118-137.
178. Schwandt, T. A. (2001); *Dictionary of Qualitative Inquiry*, Second Edition, London: Sage Publications.
179. SCS (1996); *Guidance Notes for Continuing Professional Development*, First Edition, Dublin: The Society of Chartered Surveyors.
180. SCS (2007); Society of Chartered Surveyors Website [Internet], Dublin, Ireland. Available from < <http://www.scs.ie> > [Accessed 23rd July, 2007].
181. Selden, L. (2005); *On Grounded Theory – with some malice*, Journal of Documentation, Vol. 61, No. 1, pp. 114-130.
182. Senge, P. (1990); *The Fifth Discipline: The Art and Practice of the Learning Organization*, Random House
183. Seymour, D. and Rooke, J. A. (1995); *The culture of the industry and the culture of research*, Construction Management and Economics, Vol. 13, No. 6, pp. 511-523.
184. Shipton, H. and Shackleton, V. (1998); *Management development within the construction industry: building on success?* International Journal of Training and Development, Vol. 2, No. 4, pp. 276-287.
185. Sheehan, T., Poole, D., Lyttle, I. and Egbu, C. O. (2005); *Strategies and Business Case for Knowledge Management*. In: Anumba, C., Egbu, C. and Carrillo, P. (Eds.) Knowledge Management in Construction. Oxford: Blackwell Publishing, pp. 50-64.
186. Siemieniuch, C. E. and Sinclair, M. A. (2005); *Organisational Readiness for Knowledge Management*. In: Anumba, C., Egbu, C. and Carrillo, P. (Eds.) Knowledge Management in Construction. Oxford: Blackwell Publishing, pp. 65-82.
187. Smith, P. A. C. (1999); *The learning organization ten years on: a case study*, The Learning Organization, Vol. 6, No. 5, pp. 217-224.

References

188. Smith, A. D. and Rupp, W. T. (2003); *Knowledge workers: exploring the link among performance rating, pay and motivational aspects*, Journal of Knowledge Management, Vol. 7, No. 1, pp. 107-124.
189. Smith, A. D. and Rupp, W. T. (2004); *Knowledge workers' perceptions of performance ratings*, The Journal of Workplace Learning, Vol. 16, No. 3, pp. 146-166.
190. Snider, K. F., Barrett, F. J. and Tenkasi, R. (2002); *Considerations in acquisition lessons-learned system design – Lesson Learned*, Acquisition Review Quarterly, Winter 2002, pp. 67-84.
191. Sousa, C. A. A. and Hendriks, P. H. J. (2006); *The Diving Bell and the Butterfly: The Need for Grounded Theory in Developing a Knowledge-Based View of Organizations*, Organizational Research Methods, Vol. 9, No. 3, pp. 315-339.
192. Stewart, J. and McGoldrick, J., Eds. (1996); *Human Resource Development: Perspectives, Strategies and Practice*, Pitman Publishing.
193. Storey, J. (2005); *Human Resource Policies for Knowledge Work*, In: Little, S. and Ray, T. (eds.), *Managing Knowledge: An Essential Reader*, Second Edition, London: Sage Publications, pp. 199-219.
194. Strauss, A. and Corbin, J. (1994); *Grounded Theory Methodology: An Overview*, In Denzin, N. K. and Lincoln, Y. S. (Eds.), *Handbook of Qualitative Research*, Thousand Oaks: Sage Publications, 273-285.
195. Strauss, A. and Corbin, J. (1998); *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*, Second Edition, Thousand Oaks: Sage Publications
196. Styhre, A. (2003); *Knowledge management beyond codification: knowing as practice/concept*, Journal of Knowledge Management, Vol. 7, No. 5, pp. 32-40.
197. Styhre, A. and Josephson, P. (2006); *Revisiting site manager work: stuck in the middle?* Construction Management and Economics, Vol. 24, April-June, pp. 521-528.
198. Suresh, S. (2006); *Knowledge Capture in Small and Medium Enterprises in the UK Construction Industry*, Unpublished Doctoral Thesis, Glasgow Caledonian University
199. Svetlik, I. and Stavrou-Costea, E. (2007); *Connecting human resources management and knowledge management*, International Journal of Manpower, Vol. 28, No. 3/4, pp. 197-206.
200. Tan, H. C., Carrillo, P. M., Anumba, C. J., Kamara, J. M., Bouchlaghem, N. M., and Udeja, C. E. (2005); *Approaches to the Capture of Reusable Project Knowledge in Construction*, Proceedings of CIB W102 Meeting and International Conference, Instituto Superior Tecnico, Lisbon, May 19-20, 2005, pp. 577-586, CIB.

References

201. Teare, R. and Neil, J. (2002); *Fast-forward to accredited corporate learning?* International Journal of Contemporary Hospitality Management, Vol. 14, No. 7, pp. 342-348.
202. Tennant, S. and Field, R. (2004); *Continuing professional development: does it make a difference?* Nursing in Critical Care, Vol. 9, No. 4, pp. 167-172.
203. Terrell, M. S. (2000); *Implement a lessons learned process that works*, Hydrocarbon Processing, Vol. 79, No. 1, pp. 97-100.
204. Theriou, G. N. and Chatzoglou, P. D. (2007); *Enhancing performance through best HRM practices, organizational learning and knowledge management: A conceptual framework*, European Business Review, Vol. 20, No. 3, pp. 185-207.
205. Thomas, K. (1999); *A study of the use of information technology in the Republic of Ireland construction sector*, International Journal of Construction Information Technology, Vol. 7, No. 1, pp. 21-34.
206. Thomas, K., Graham, B. and Wall, J. (2007); *Learning About IT and Learning Using IT – A Review of Current Practice on Higher Education AEC Programmes in Ireland*, Proceedings of Bringing ITC Knowledge to Work: 24th W78 Conference Maribor & 5th ITCEDU Workshop & 14th EG-ICE Workshop, University of Maribor, Slovenia, 26-29 June.
207. Thomas, D. C., Johnston, B., Dunn, K., Sullivan, G. M., Brett, B., Matzko, M. and Levine, S. A. (2006); *Continuing Medical Education, Continuing Professional Development, and Knowledge Translation: Improving Care of Older Patients by Practicing Physicians*, Journal of the American Geriatric Society, Vol. 54, No. 10, pp. 1610-1618.
208. Tiwana, A. (2000); *The Knowledge Management Toolkit: Practical Techniques for Building a Knowledge Management System*, Prentice Hall.
209. Voit, J. R. and Drury, C. G. (2006); *Supporting Vicarious Learning With Collaborative Lessons Learned Programs*, IEEE Transactions on Systems, Man and Cybernetics, Vol. 36, No. 6, pp. 1054-1062.
210. Walker, D. H. T. (2004); *The Knowledge Advantage (K-Adv) for Unleashing Creativity & Innovation in the Construction Industry*, Research Project No. 2001-004-A, Knowledge Management and Innovation Diffusion, CRC for Construction Innovation Publication, July 2004.
211. Walker, D. and Wilson, A. (2004); *The Knowledge Advantage (K-Adv) Concept*, Proceedings of the Twentieth Annual Conference, Association of Researchers in Construction Management, Heriot Watt University, September 1-3, 2004, pp. 767-775, ARCOM.

References

212. Walker, D., Wilson, A. and Srikanthan, G. (2004); *The Knowledge Advantage (K-Adv) for Unleashing Creativity & Innovation in the Construction Industry*, Knowledge Management and Innovation Diffusion Project Report, <http://www.construction-innovation.info> [Accessed 27th October 2005].
213. Walker, D. (2005); *Having a Knowledge Competitive Advantage (K-ADV): A Social Capital Perspective*, Proceedings of CIB W102 Meeting and International Conference, Instituto Superior Tecnico, Lisbon, May 19-20, 2005, pp. 13-31, CIB.
214. Wall, J. and Ahmed, V. (2005) *Issues in Developing a Blended Learning Initiative to Meet Continuing Professional Development Needs of Construction Professionals in Ireland*. In: Khosrowshahi, F. (ed.), 21st Annual ARCOM Conference, 7-9 September 2005, School of Oriental and African Studies. Association of Researchers in Construction Management, Vol. 2, 1289-1298.
215. Walliman, N. (2001); *Your Research Project: A Step-by-Step Guide for the First-Time Researcher*, Sage Publications.
216. Walsh, K. and Fisher, D. (2005); *Action inquiry and performance appraisals: tools for organizational learning and development*, The Learning Organization, Vol. 12, No. 1, pp. 26-41.
217. Weber, R. O. and Aha, D. W. (2002); *Intelligent delivery of military lessons learned*, Decision Support Systems, 34(3), 287-304.
218. Wenger, E., McDermott, R. and Snyder, W. M. (2002); *Cultivating Communities of Practice*, Boston: Harvard Business School Press.
219. Wiese, D. S. and Buckley, M. R. (1998); *The evolution of the performance appraisal process*, Journal of Management History, Vol. 4, No. 3, pp. 233-249.
220. Wiig, K. (1997); *Knowledge Management: Where Did It Come From and Where Will It Go?* Expert Systems with Application, Vol. 13, Issue 1, pp. 1-14.
221. Wiig, K. (1999); *Comprehensive Knowledge Management*, Working Paper KRI #1999-4 Revision 2, Texas: Knowledge Research Institute Inc.
222. Wiig, K. (2008); *Enterprise Knowledge Management*, White Paper, Texas: Knowledge Research Institute Inc.
223. Yin, R. K. (2003); *Case Study Research: Design and Methods*, Third Edition, Thousand Oaks: Sage Publications.

Appendices

Appendix A

PhD Transfer Application External Reviewers Report

School of the Built and
Natural Environment
Glasgow Caledonian University
Cowcaddens Road
Glasgow G4 0BA, Scotland, UK
Tel: +44 (0) 141 331 8968
Fax: +44 (0) 141 331 3696
Email: c.egbu@gcal.ac.uk

Waterford Institute of Technology
Waterford, Ireland

19th November 2006

Dear Sir, madam

External Review: MSc to PhD Transfer Application

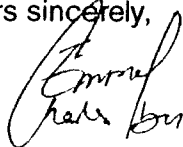
Candidate: Mr. Brian Graham

Title: Knowledge management in Construction

Firstly, I write to acknowledge the receipt of the relevant documentation (i.e. The candidate's written transfer proposal, WIT Postgraduate Research Degree – April 2006 Revised Strategy, Regulations and Procedures, and the Irish National Framework of Qualifications) sent to me with regard to Mr. Brian Graham's Proposal for Transfer from MSc to PhD.

In accordance with your University Regulations, please find my independent Report on the above named candidate

Yours sincerely,



Professor Charles Egbu
External Reviewer

Candidate: Mr. Brian Graham

Title: Knowledge management in Construction

External Reviewer's Comments

- An in-depth and thorough Transfer Report has been presented. The candidate has shown a thorough understanding of the general areas of knowledge management and the knowledge management needs of the Irish Construction Industry.
- In the main, the review of literature on knowledge management is robust and comprehensive.
- The objectives of the proposed PhD study have been well formulated and presented. This has helped to effectively scope the study. These objectives are sound, pragmatic and achievable.
- There is a well-established link between the work that is done at the Master's level and how this is to be built up to a PhD programme. The proposed PhD also builds on authoritative works in relevant areas of study. This provides a sound basis to carry out a study in a relatively new area of research in the Irish Construction Industry. The accumulation of knowledge and learning from the master's level into the proposed PhD programme would very much enrich the final PhD output. PhD is also a 'learning process' and an academic journey. There is strong evidence that the journey which the candidate has embarked upon in the area of Knowledge management would enrich him as a person, and benefit the targeted beneficiaries (Irish Construction Industry, Academe, Engineers Ireland and construction organisations) of the PhD study.
- Most of the issues under study in the area of knowledge management are socially embedded in complex contexts. Any meaning research approach needs to accommodate this complexity. The research methodology and research techniques proposed to be adopted for the PhD study are appropriate. The use of qualitative research approaches would be useful for in-depth investigation and exploration of subtle issues (such as organisational culture, motivational constructs, and the organisational dynamics that often exist in the alignment of a knowledge strategy with the wider organisational strategy).
- The student has shown a very good grasp of different research methods, and their potential usefulness in the proposed PhD study. The use of case studies and focus groups would be useful for an in-depth understanding and verification of complex phenomena in the proposed study. In addition, there is some evidence that there will be the use of a triangulation approach in the research methodology for the study. This should lead to a rich data set as well as help improve the consistency and validity of the study data.
- Given what has been submitted as part of the Transfer Proposal, there is substantial evidence of rigour, critical thought and reflection in the proposed PhD programme. There is also a high level of originality designed into the PhD Programme (for example –

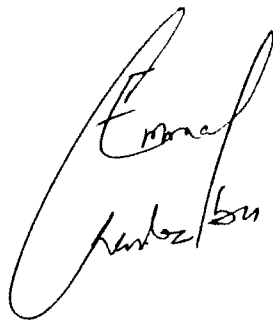
the proposed development of a CPD/Educational Programme for the benefit of Construction professionals, and the development of an appropriate KM Model, which would help improve awareness and understanding of the complexities, importance and benefits of KM to construction – and showing the link to performance and productivity improvements. Every PhD work is expected to show evidence of rigour, critical thought and some level of originality. This is also in line with the National Framework of Qualifications (Award-Type Descriptor 'O') and Level 10 of HETAC.

- Given what has been proposed to be investigated as part of the PhD, there is strong evidence that the PhD output will add to the body of knowledge in an area where there is a paucity of empirical research (i.e. Knowledge Management in the Irish Construction Industry). The outputs will also be significant, and will inform both practice and academia. Another area of strength is the logic in the research methodology. If the research methodology is effectively executed, then up and coming researcher would benefit from this too.
- The Transfer Report from MSC to PhD is well written. The English Language (including grammar and syntax) is very satisfactory. The report is also an enjoyable read.

In the final analysis, the transfer report submitted is robust. What has been proposed is at a PhD standard. My recommendation is that the candidate be allowed to transfer onto a PhD programme.

Prof. Charles Egbu

External Reviewer

A handwritten signature in black ink, appearing to read 'Charles Egbu', written in a cursive style.

Other Comments which the candidate may wish to consider as he progresses with his study

There are always some refinements in a PhD programme. This is often inevitable as a candidate makes progress with his/her study.

The following are some comments, which the candidate may wish to consider:

- The aim of the study, as articulated and documented, does not fully capture or reflect the areas proposed to be investigated. As it stands, the aim of the study narrowly considers the "Development of a KM Model". This is only one aspect of the study. A closer look at the objectives and the other issues that are proposed, suggest that they are more interesting and richer than just the development of the model. The study, in addition to developing a model, also posits to investigate some of the cultural and strategic issues associated with developing and implementing KM initiatives. It also proposed to develop a CPD programme in the area of KM. In addition, it also intends to make a comparative assessment of KM in other sectors. The aim should be reconsidered to accommodate the wider aspects of the study.
- The study proposes to look into other sectors, perhaps, to ascertain if there are certain issues to be learned for the benefit of the construction industry. A little more clarity is needed here. For example, what are these sectors (e.g. Aerospace, Pharmaceutical, Manufacturing, Agriculture, Shipping industry, IT sector)? Also, a framework may be needed to indicate what aspects of KM would be investigated in these sectors (and in what depth), and what framework allows for better comparative exercises.
- The candidate proposes to develop a KM Model. At present, it is not very obvious the lines which the model is likely to take. Would it take a KM process approach (i.e. accommodate all the areas of K-creation, k-capture, k-sharing, k-transfer, k-storage, k-benefit measurement)? An early focus would be useful.
- There is a view that the study would also reflect on the IT aspect of Knowledge management. The extent to which this is to be lined to a proposed model may need to be considered.

The intention of the External Reviewer is to raise a few of these issues during the candidate's presentation on 23rd November 2006

Date: 19th November 2006



Professor Charles Egbu
External Reviewer.

School of the Built and Natural Environment, Glasgow Caledonian University
Cowcaddens Road, Glasgow G4 0BA, Scotland, United Kingdom
Tel: +44 (0) 141 331 8968, Fax: +44 (0) 141 331 3696, Email: C.egbu@gcal.ac.uk

Appendix B

Senior Manager Interview Questions

1.0 THE IRISH CONSTRUCTION INDUSTRY

- 1.1 The Irish construction industry has, in recent years, encountered phenomenal growth and sustained success. What are the main issues that will govern the direction of the industry over the next 3 to 5 years?

2.0 INDIVIDUAL KNOWLEDGE

- 2.1 What happens when a new employee joins your company?
- 2.2 How is CPD managed within your organization?
- 2.3 How is staff's performance appraised?
- 2.4 Apart from financial incentive, how else do you motivate\encourage your staff's performance?
- 2.5 "*Knowledge is power*" – people tend to be guarded about their experience, skills, and what they know, particularly in an organizational setting. How do you think people could be encouraged to share their knowledge within a construction organisation?
- 2.6 How effectively do you think your organization manages knowledge at an individual level?

3.0 PROJECT KNOWLEDGE

- 3.1 During the course of a project, how often does your project team (both site and office-based) meet, and what is discussed?
- 3.2 How do you review projects upon their completion?

4.0 ORGANISATIONAL KNOWLEDGE

4.1 In terms of KM, what position do you think your company is currently at?

4.2 How does your company manage R&D?

4.3 How does your organization innovate and continuously improve?

4.4 Does your company have an electronic people finder?

4.5 In terms of knowledge-sharing activities, does your company use any of the following??

- Workshops & Seminars
- Project Presentations & Summary Reports
- Project Award Schemes
- Departmental Meetings & Annual Company Conference
- Site Visits
- Company Newsletter

If yes:

- How beneficial are they?
- Who is involved in them?

4.6 Do you have any Communities of Practice set up within your company?

4.7 How effectively do you think that knowledge is managed within your organisation?

5.0 ROLE OF INFORMATION & COMMUNICATIONS TECHNOLOGIES

5.1 In relation to ICT what are your opinions on:

6.0 KNOWLEDGE MANAGEMENT

6.1 Do you think that KM is worth considering in your company?

Appendix C

IT Manager Survey Questions

1.0 ROLE OF ICT DEPARTMENT

1.1 Please state the number of people in the ICT Department:

Number:

1.2 What are the main functions of the ICT Department? (Please tick all that are relevant)

- | | |
|---------------------------------|--------------------------|
| No ICT Department | <input type="checkbox"/> |
| Network administration | <input type="checkbox"/> |
| Computer maintenance | <input type="checkbox"/> |
| Technical support | <input type="checkbox"/> |
| Information systems development | <input type="checkbox"/> |
| Software development | <input type="checkbox"/> |
| Web site development | <input type="checkbox"/> |
| ICT strategy formulation | <input type="checkbox"/> |
| Other | <input type="checkbox"/> |

If Other, please state: _____

1.3 Which of the following do you feel best describes your company's current use of ICT?

- | | |
|---|--------------------------|
| Basic with little or no value added | <input type="checkbox"/> |
| Supportive of your business processes and functions | <input type="checkbox"/> |
| An integral part of your company' operations | <input type="checkbox"/> |

1.4 What is your background?

- | | |
|----------------------------|--------------------------|
| Construction & Engineering | <input type="checkbox"/> |
| ICT | <input type="checkbox"/> |
| Business & Accounting | <input type="checkbox"/> |
| Other | <input type="checkbox"/> |

If Other, please state: _____

2.0 COMMUNICATIONS TECHNOLOGY

2.1 Do you have a company Intranet?

Yes No

If Yes, what is the Intranet used for?

Company Directory Policy & Procedure
 News & Information File Management
 Appointments Other

If Other, please state: _____

2.2 Does your organization use any of the following communications technologies?

E-mail
 Groupware
 Virtual meeting\project spaces
 Instant messaging\chat rooms
 Video conferencing
 Voice over Internet Protocol (VoIP) Phone System
 Other

If Other, please state: _____

2.3 Do you use\plan to use any of the following collaboration tools?

	Plan to Use	Use Already	No Plan to Use
COINS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SAP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lotus Notes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sarcophagus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Build Online	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4Projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If Other, please state: _____

2.4 What percentage of project staff use the following?

	Office-Based	Site-Based
Laptop Computer	%	%
PDA\Handheld Computer	%	%
Desktop Computer	%	%

3.0 NETWORK INFRASTRUCTURE

3.1 Which of the following best describes the overall ICT setup in your company's head office?

- Stand alone PC's (No network)
- Local Area Network
- Wireless network
- Other

If Other, please state: _____

3.2 Which of the following best describes a typical ICT setup on site?

- Stand alone PC's (No network)
- Local Area Network (with on-site server)
- Local Area Network (with link to Head Office server)
- Wireless network
- Other

If Other, please state: _____

3.3 How is data transfer facilitated between head office and site? (Please tick all that are relevant)

- No data transfer
- Back-Up Tape\CD
- Dial-Up
- Broadband
- ISDN Leased Line
- VPN
- Wireless
- Other

If Other, please state: _____

3.4 Of the following servers, which ones do you host on your network? (Please tick all that apply)

- | | | | |
|-------------|--------------------------|-------|--------------------------|
| E-mail | <input type="checkbox"/> | FTP | <input type="checkbox"/> |
| Database | <input type="checkbox"/> | Web | <input type="checkbox"/> |
| Application | <input type="checkbox"/> | Other | <input type="checkbox"/> |

If Other, please state: _____

4.0 THE FUTURE

4.1 In considering investment in ICT over the next 3 years, in your opinion, which of the following factors are important?

	Very important	Important	Not important
Maintain & upgrade existing ICT	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Introduction of new ICT	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Keeping up with clients	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Keeping up with consultants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Keeping up with suppliers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Keeping ahead of the competition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If Other, please state: _____

4.2 What percentage of turnover is dedicated to ICT investment at present?

None	<input type="checkbox"/>	Less than 1%	<input type="checkbox"/>
1 - 2%	<input type="checkbox"/>	Greater than 2%	<input type="checkbox"/>

4.3 How much will you invest in ICT in the next 3 years, compared to the last 3 years?

Much more	More	Same	Less	Much less
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4.4 To what extent do you think that ICT has the potential to enhance the overall effectiveness of your company?

No Potential	Little Potential	Potential	Great Potential
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4.5 Please list 5 ICT initiatives that your company plan to implement over the next 3 to 5 years

1. _____
2. _____
3. _____
4. _____
5. _____

Many thanks for taking the time to complete this questionnaire. I would be very grateful if you could return it in the envelope provided.

Appendix D

Case Study A

Staff Survey Questions



Knowledge Management in the Irish Construction Industry



Brian Graham
Masters by Research in Construction Management
Waterford Institute of Technology

The Development and Sharing of Knowledge within a Leading Irish Construction Company

My name is Brian Graham and I am currently undertaking a Masters by Research in Waterford Institute of Technology. Case Study A have agreed to assist me in my research and I would be very grateful if you could take the time to complete this questionnaire. All responses shall remain anonymous and confidential.

This questionnaire can be completed and returned in a number of ways:

1. **By email:** Complete the questionnaire in Microsoft Word, save the file, and **return as an email attachment** to bgraham@wit.ie
 2. **By fax:** Print this document, complete the questionnaire, and **return by fax** to xxxxxxxxxxxx.
 3. **By post:** Print this document, complete the questionnaire, and **return by internal post** to xxxxxxxxxxxx.
-

Should you have any further queries, please don't hesitate to contact me by email at bgraham@wit.ie or by phone at 086-3842032.

1.0 GENERAL INFORMATION

1.1 Job Title: _____

1.2 In your work, are you generally based:

On-site In head office Between both

1.3 What is your age range?

18 - 25 36 - 45 56 - 65
26 - 35 46 - 55 65+

1.4 How many years have you been working:

For PJ Hegarty _____ yrs In Construction _____ yrs

1.5 What educational qualifications do you hold?

None Secondary Level
Trade Qualification Certificate
Diploma Degree
Post Graduate Other

If Other, please state: _____

1.6 Which of the following professional organizations are you a member of?

None IEI CIOB
SCS RICS IPMI
ICE Other

If Other, please state: _____

2.0 COMPANY SEMINARS

2.1 On average, how many in-house seminars would you attend in a year (i.e. those run and presented by staff)?

None 1 - 4
5 - 9 10+

2.2 What factors do you think make these seminars worth attending? Please rank in order of importance from 1 to 5, with 1 being the most important, 5 being the least important.

It's a good way to meet colleagues
You get to see the experiences of others
There's always good discussion and interaction
The content is always interesting
They allow me to improve in my own work

3.0 PERSONAL DEVELOPMENT

3.1 Upon joining the company, did you attend a company induction?

Yes No

3.2 Do you have a mentor within the company?

Yes No

If yes, what is your mentor's position? _____

3.3 Are you a mentor to anyone within the company?

Yes No

If yes, what is their position? _____

3.4 Please indicate the areas you have received training in, and whether the training was in-house (by the company) or external (e.g. FAS, college, training company, supplier, etc.). Please tick all that apply.

	In-House	External
Health & Safety	<input type="checkbox"/>	<input type="checkbox"/>
First Aid	<input type="checkbox"/>	<input type="checkbox"/>
Quality Management	<input type="checkbox"/>	<input type="checkbox"/>
Environmental Management	<input type="checkbox"/>	<input type="checkbox"/>
Communication Skills	<input type="checkbox"/>	<input type="checkbox"/>
Project Management	<input type="checkbox"/>	<input type="checkbox"/>
Materials Management	<input type="checkbox"/>	<input type="checkbox"/>
Surveying\Setting Out	<input type="checkbox"/>	<input type="checkbox"/>
Computer Skills	<input type="checkbox"/>	<input type="checkbox"/>
Technical Training	<input type="checkbox"/>	<input type="checkbox"/>
People Skills	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>

If Other, please state: _____

3.5 Other than financial incentive, how important are the following in motivating you in your work?

(Tick the box under the initial that applies. VI = Very Important; I = Important; NI = Not Important).

	VI	I	NI
Job security	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Good training and development programme	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Personal contact with Directors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Responsibility to work on your own initiative	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Being part of a team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recognition of your skills and talents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If Other, please state: _____

4.0 COMMUNICATIONS

- 4.1 Please rank the following communication tools in order of effectiveness in the various situations (i.e. your workplace, other sites and head and regional offices), with 1 being most effective and 5 being least effective.**

	Phone	Chat	Email	Fax	Meeting
<i>Example</i>	2	5	1	4	3
Your workplace					
Other sites					
Head office					
Regional offices					

- 4.2 In relation to computers and technology, do you think that:**

	Yes	No
Too much information is being sent by email?	<input type="checkbox"/>	<input type="checkbox"/>
Computers are used effectively in the company?	<input type="checkbox"/>	<input type="checkbox"/>
You are sufficiently trained to use computers?	<input type="checkbox"/>	<input type="checkbox"/>
Computers are an integral part of your job?	<input type="checkbox"/>	<input type="checkbox"/>
Systems are developed without your input?	<input type="checkbox"/>	<input type="checkbox"/>

5.0 LESSONS LEARNED

- 5.1 Do you think that the lessons learned database is of benefit to you in your current position?**

Yes No

- 5.2 How often do you refer to the lessons learned database? Please tick all that apply.**

Never	<input type="checkbox"/>
Very rarely	<input type="checkbox"/>
When a new subcontract package starts	<input type="checkbox"/>
When I have a problem	<input type="checkbox"/>
When I have a specific question	<input type="checkbox"/>
Quite often, I like to keep up to date	<input type="checkbox"/>
Other	<input type="checkbox"/>

If Other, please state: _____

- 5.3 Do you think that the lessons learned database:**

	Yes	No
Is up to date	<input type="checkbox"/>	<input type="checkbox"/>
Is easy to access	<input type="checkbox"/>	<input type="checkbox"/>
Contains relevant information	<input type="checkbox"/>	<input type="checkbox"/>
Identifies the key people	<input type="checkbox"/>	<input type="checkbox"/>
Is easy to understand	<input type="checkbox"/>	<input type="checkbox"/>
Well organised and laid out	<input type="checkbox"/>	<input type="checkbox"/>
Can be searched quickly	<input type="checkbox"/>	<input type="checkbox"/>
Is overloaded with information	<input type="checkbox"/>	<input type="checkbox"/>

6.0 COMPANY KNOWLEDGE

6.1 Do you meet with others in similar positions in the company, to discuss issues, problems, solutions etc.?

Yes If Yes, complete parts A to C
No If No, complete part D

A) If yes, how often do you meet?

Monthly	<input type="checkbox"/>	3 -4 times a year	<input type="checkbox"/>
Twice a year	<input type="checkbox"/>	Once a year	<input type="checkbox"/>
Other	<input type="checkbox"/>		

If Other, please state: _____

B) If yes, what is discussed?

New work methods	<input type="checkbox"/>	New technologies	<input type="checkbox"/>
Technical issues	<input type="checkbox"/>	Recurring problems	<input type="checkbox"/>
Company news	<input type="checkbox"/>	Other	<input type="checkbox"/>

If Other, please state: _____

C) If yes, do you find it of benefit to you in your day to day work?

Yes No

D) If no, would you like to have a forum to meet other people in similar positions?

Yes No

6.2 If you are having a particular problem that requires the expertise of another employee, do you think that it is easy to identify these people?

	Yes	No
In your own workplace	<input type="checkbox"/>	<input type="checkbox"/>
On other sites	<input type="checkbox"/>	<input type="checkbox"/>
In head office	<input type="checkbox"/>	<input type="checkbox"/>
In the other regions	<input type="checkbox"/>	<input type="checkbox"/>

6.3 Have you ever visited another site to look at specific construction methods, new systems etc.?

Yes No

Many thanks for taking the time to complete this questionnaire. I would be very grateful if you could return it either by email, fax or post, as outlined on the cover page.

Appendix E

Case Study A

Project Team Interview Questions

1.0 GENERAL INFORMATION

- 1.1 Maybe you could tell me about yourself, your experience in the construction industry, and some background to your current role?
- 1.2 In general terms, what do you think of Case Study A as a company, what are they like to work for?

2.0 PERSONAL DEVELOPMENT

- 2.1 Do you think that there is adequate training provided to support you in your current position?
 - Are there any areas where you feel you could get more\better training?
 - Do you think that you're training, experience and skills are fully utilised in your current role?
- 2.2 In meeting with one of the company directors, do you think that the annual appraisals are a worthwhile exercise?
 - Is there a need to meet with a Director?
 - How does the appraisal help you in your work?
 - Do you feel that you can have an honest and open discussion with a Director or do you find it one-sided\intimidating?

3.0 INFORMATION & COMMUNICATIONS TECHNOLOGIES

- 3.1 How do use computers in your day to day work?
 - What works well, what doesn't, how could it be improved?
 - How much experience do you have of using computers?
 - What software packages can you use? (Office, IE, CAD, Project)
 - What type of training have you received in the use of computers?
- 3.2 Can you describe what you use email for, how often etc.?

4.0 LESSONS LEARNED DATABASE (LLDB)

- 4.1 Can you describe the LLDB?
 - Layout, use of photos, contact information etc.
 - Give an example of a time when you used it?
- 4.2 What do you think of the LLDB?
 - Could it be improved?
 - Does it accurately reflect projects that you worked on?
- 4.3 How effective do you think the lessons learned seminars are?
- 4.4 Have you ever followed up on a lesson learned by contacting someone that was involved in a particular project?
- 4.5 Do you think that the LLDB actually prevents people from repeating the same mistakes?

5.0 KNOWLEDGE SHARING ACTIVITIES

- 5.1 In terms of sharing knowledge and experiences, how effective do you think the following are utilised within the company?
- Weekly site meetings
 - Project reviews
 - PJH\External seminars
 - Project reports
 - Site visits
 - Mentoring
 - Company induction
 - Other informal activities
- 5.2 Do you think that there's enough time given to activities like the above?
- Would you like more?
 - When would be the best time to have them?
- 5.3 How much do you know about what is going on in other projects throughout the company? How do you find out about it?
- 5.4 Would you like to see an online tool to identify others within the company (other regions), based on their experience, qualifications and interests?
- 5.5 Do you think that others within the company are willing to share their knowledge with you?
- 5.6 Do you meet with others in similar positions within the company?
- Yes, how often, where, what is discussed, who organises it?
 - No, would you like to? How often? To discuss what?

6.0 PROJECT KNOWLEDGE

- 6.1 In your current position, do you think that you are well informed as to how your job is progressing, in terms of cost, programme and any other relevant issues?
- 6.2 Are there enough mechanisms in place for effective communications within the project team?
- 6.3 Do you think that there's enough communication with head office departments?
- 6.4 If you see something as being inefficient on site, are you encouraged to change the way you're doing something?
- Is there a platform or mechanism there to do that?
 - Getting the job done vs. time to reflect\explore\be creative?
- 6.5 Do you think that there's enough time given at the end of a project to reflect upon what happened, what went well, what didn't?
- 6.6 Are there any areas where the company could improve?

7.0 WRAP-UP

- 7.1 Based on our conversation, is there anything else that you would like to add?

Appendix F

Case Study A

Management Team Presentation



Case Study A

Continuing Professional Development & Knowledge Management



Overview of Presentation

- **Introduction**
- **PhD Study**
 - Progress To-Date
 - Future Research Activities
- **Case Study A Research**
 - CPD Practices
 - Knowledge Management
 - Conclusions
 - Recommendations





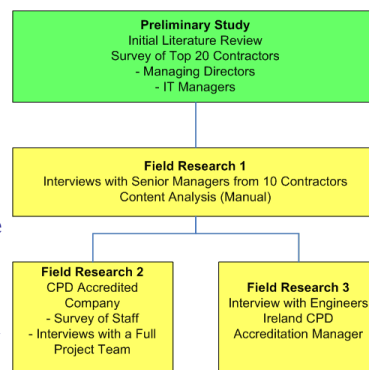
Introduction

- **Purpose of Presentation**
- **Academic Experience**
 - BSc (Hons) Construction Management
 - Grad. Dip. Information Technology
- **Background to the Research**
 - Undergraduate Dissertation
 - Masters by Research
 - KM as an “IT system”
 - Role of Case Study A
 - Move to PhD study



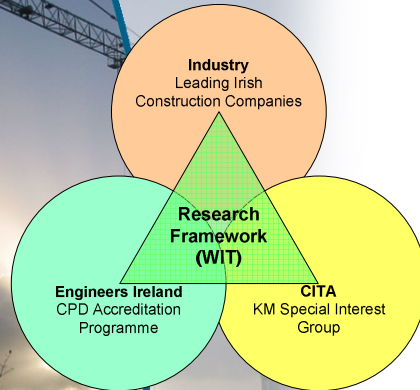
Progress To-Date

- **Body of primary research undertaken**
- **Formal approach to KM has potential to improve performance**
- **Both CITA and Engineers Ireland have agreed to participate**
- **Leading contractors have expressed interest in further research**
- **Personal development over past 2 years**





Future Research Activities



- **Develop KM Model**
- **Formulate Strategic Framework for KM & CPD**
 - Leading Companies
 - Engineers Ireland
 - CITA
- **Further Primary Research**
- **Develop CPD Resources**
- **Evaluate CPD & Model**



Case Study A Research

- **Interview with Director**
- **Survey of professional and management staff**
- **Interviews with project team**
- **Exploring:**
 - CPD practices
 - Approaches to managing knowledge





Performance Appraisals

- *“An essential exercise”*
- **Differences between QS and Engineer?**
- **Young vs. older employees**
- **Good to get feedback**
- **Beneficial to motivated, career-oriented individuals**
- **Overall quite positive**



CPD & Training

- **Excellent feedback on opportunities provided by Case Study A**
- **Important motivator to join and stay with company**
- **Recognition of senior management support**
- **Difficulty with experienced recruits?**





Induction

- **Centred around computer systems**
- **83% surveyed had completed**
- **Problems with cancelled inductions/tracking new starts?**
- **Relevance of IT focus to certain roles?**



Mentoring

- **Training provided for mentors**
 - **What about mentees?**
- **Shouldn't be involved in day to day job**
- **Differences between QS and Engineer?**
- **Too much paperwork!**





Professional Institutions

- Staff felt supported by the company in their involvement with professional institutions
- Engineers Ireland ranked highest!
- Involvement with other institutions?



Lessons Learned Database

- Over 50% use “very rarely” or “never”
 - Lack of time
 - Relevance to their role?
 - Difficult user interface
 - Not required to use/contribute
 - Can’t be searched by date (i.e. most recent)
 - Site-based personnel





Internal Seminars

- **Good level of attendance**
- **Number of problems:**
 - **Timing (i.e. after day's work)**
 - **Delivered by people not involved in actual lessons learned?**
 - **Relevance to their role?**
 - **Experience of recent graduates**
 - **Pitched at similar levels**



Knowledge Sharing

- **50% of survey respondents meet peers on a regular basis**
 - **97% of these found it beneficial to their own work**
- **Majority (83%) of respondents who don't meet with peers, would like to do so**





Identifying Internal Expertise

- **Easy to identify expertise of other employees:**
 - 88% in own workplace
 - 65% in head office
 - 45% on other sites
 - 15% in other regions
- **Wealth of knowledge in other sites and regions to explore and share?**



Summary

“Overall, they’re quite good, they’re quite loyal to their employees as long as you make an honest effort to do your work to the best of your ability and be loyal to them. You’re not expected to pull rabbits out of the hat or perform miracles, but just perform to the best of your ability.”





Conclusions

- **Good CPD & KM practices in place**
- **Staff are very positive about CPD, training etc.**
- **However...**
 - **Difficult to get away from day job!**
 - **Differences between professions?**
 - **More focus on experienced recruits?**



Recommendations

- **Format of induction?**
- **Expand mentoring to others**
- **Use of lessons learned database**
- **Site-based seminars**
- **Knowledge sharing forums**
- **Interaction with other regions**
- **Site visit programme**
- **Streamline CPD practices**



Appendix G

Case Study A

Research Report

Review of Continuing Professional Development and Knowledge Management Practices in Case Study A



**Brian Graham BSc(Hons) GradDip AMIEI
Dr. Ken Thomas BE MA PhD CEng MIEI EurIng**

**Department of Construction & Civil Engineering
Waterford Institute of Technology**

January 2007

Table of Contents

1.0	Introduction	1
2.0	Continuing Professional Development	2
2.1	Performance Appraisals	2
2.2	CPD and Training	3
2.3	Induction	4
2.4	Mentoring	5
2.5	Professional Institutions	6
3.0	Knowledge Management	7
3.1	Lessons Learned Database	7
3.2	Internal Knowledge Sharing Seminars	9
3.3	Knowledge Sharing Forum	11
3.4	Identification of Expertise within Case Study A	12
3.5	Site Visits	13
4.0	Conclusions	14
5.0	Recommendations	16

1.0 Introduction

The contents of this report are based on on-going research into Knowledge Management (KM) and Continuing Professional Development (CPD) as part of a wider study within the Irish Construction industry, being undertaken in Waterford Institute of Technology. This research is specifically exploring the potential for a more formal approach to managing knowledge, within the leading Irish construction companies.

In-depth research was conducted with staff in Case Study A, over a five month period between January and May 2006. This research consisted of three elements:

1. Interview with Company Director: an initial semi-structured interview was conducted with a company director in order to get an overview of relevant issues upon which to base further research. Conducted in January 2006, the findings of the interview allowed for the identification of key issues and the development of questions for a survey.
2. Staff Survey: distributed via email to 180 professional and management staff based in Case Study A's Dublin office, in February 2006, 65 completed questionnaires were returned, giving a satisfactory 36% response rate. The survey explored the experience of individuals, participation in identified CPD activities and knowledge sharing issues.
3. Interviews with Project Team: in order to provide more depth to the study, semi-structured interviews were conducted with a full site team, based on a development in Waterford city. Twelve individuals were interviewed, comprising; the contracts manager, site manager, three engineers, three quantity surveyors, three foremen and a safety advisor. Issues discussed were based on those included in the survey, allowing for more detailed and subjective responses.

This report presents the findings of this research in a number of key areas related to Engineers Ireland (EI) CPD Accreditation Scheme including performance appraisals, CPD and training, induction and mentoring, involvement in professional institutions and knowledge management. Overall conclusions and recommendations are made for the continued success and improvement of these practices with Case Study A.

2.0 Continuing Professional Development

The company's approach to CPD is explored from a number of perspectives as follows: performance appraisals, CPD and training, induction, mentoring and professional institutions.

2.1 Performance Appraisals

The use of an appraisal allows individuals to both assess and review performance and training and development needs for the previous and coming year. Case Study A try to encourage a proactive approach to appraisals, once a year each staff member is appraised by their immediate supervisor, followed by a review meeting with a company director.

"That's one thing we've said, each person should have access to a director as part of their performance review."

Areas where training is required are identified, which is reviewed at the appraisal the following year to ensure that goals have been achieved. The annual appraisals were discussed in-depth during interviews with staff, the following being the main findings:

- Viewed as very useful and *"an essential exercise"*
- There are some differences between how Quantity Surveyors and Engineers are appraised
- In meeting with a director, most of the younger employees felt that they couldn't have an open discussion, whereas more experienced staff saw it as a vital opportunity to get feedback
- One interviewee commented: *"I think it's good to hear what other people think of you in your work...and it means they're listening to you [the directors]."*
- They're beneficial to people who are career-oriented: *"If I'm honest the performance appraisals are very good for people that want to move up or gain more knowledge. Someone that doesn't want to...the performance appraisal probably wouldn't be that beneficial."*

Overall, the feedback on the appraisals was quite positive, with most individuals agreeing that the success of them is driven by the employee's attitude and motivation.

2.2 CPD and Training

"I think they're good, they've a good attitude to staff, they support training, they support career development, so I think that overall, they're a good company to work with."

The overwhelming consensus among interviewees was that Case Study A are excellent in their provision of CPD and training. Indeed all respondents to the survey cited that a good training and development programme was either very important or important in motivating them in their work. Senior management support of CPD was recognised as being *"proactive and supportive,"* and viewed as important to the success the success of training. It should also be noted that research undertaken by this author elsewhere, involving many of the leading Irish construction organisations has demonstrated, has placed Case Study A on top in terms of structure and opportunities provided.

Some staff went as far as saying that the focus on CPD and Engineers Ireland Accredited company status was a motivating factor in joining the company, particularly graduates who felt a structured programme is important for development. This however, was viewed negatively by one interviewee who joined the company after a number of years experience elsewhere:

"People who join as graduates tend to move up the ladder quicker than those who come in later."

Some difficulties encountered in accessing CPD events included actually getting away from work to attend, the nature of a construction site being recognised as problematic. In the case of the Railway Square project, staff found it difficult to attend events in the Dublin office, time spent travelling seen as *"over the top."* In response, the company organised for staff to attend CPD events in the Cork office. Indeed, it was noted that CPD events in Cork *"seemed to be more structured/regular than Dublin, which was good, allowing people to plan things better."*

Involvement in CPD activities was viewed by most people as being self-motivated, requiring a proactive approach on the individual's behalf. More experienced employees felt that as they progressed within the company they became more selective of courses taken and increasingly self-directed.

2.3 Induction

An induction is an essential part HR development and has been identified as having three main objectives:

1. Easing the new employee's adjustment to the organisation
2. Providing information concerning tasks and performance expectations
3. Reinforcing a favourable impression

It is vital, therefore, that inductions are organised and executed in a manner which addresses these objectives.

"The induction centres around where to find information on our server, because we have a wealth of information, but with somebody starting off, they don't really know where to look for it."

The survey found that 83% of respondents had attended a company induction upon joining Case Study A. Some problems were encountered with the company induction:

- Focus on the company's computer systems at induction was not beneficial, most felt it was too early and couldn't remember what had been covered
- A number of people had their inductions cancelled at the last minute due to a number of reasons (no computer account set up, person who does inductions was double-booked/not available). In these cases, an alternative time and date was not arranged.
- *"I think the office aren't tracking new people starting, I don't think it's as efficient as it should be."*
- The relevance of the induction was called into question by people who don't work with IT in their day to day role e.g. site engineers

The difficulties with inducting new recruits were highlighted by the director: *"in our experience there's no point in bombarding someone with tons of information on their first day, because it just goes straight over their heads, so we concentrate on telling them where to find it, so in their own time, they can go back and dig it out."*

2.4 Mentoring

"It took us a while to get the mentoring going, because people didn't really understand what mentoring was all about, but we actually did some training of the senior people on mentoring through Engineers Ireland, and that helped, so it's actually working a lot better now."

In relation to mentoring, 43% of people surveyed cited having a mentor within the company, with 17% identifying themselves as being mentors. During the course of the interviews, some of the people who were mentees, were unsure about how the process was to be approached. Differences between how mentoring was conducted were identified between engineers and quantity surveyors, two of the surveyors thought that they had an official mentor but were unsure who it actually was. One surveyor commented *"I think that it's a good scheme, its designed for junior engineers, it probably applies to surveying as well."*

In one instance, the mentor and mentee were on the same site, which resulted in a less than ideal situation, and was viewed as diminishing the value of the mentoring scheme.

Other comments about the mentoring included:

- Good to get encouragement from someone who has been in the same position as you, when you're starting out
- Definitely shouldn't be involved in your day to day work: *"I think its good...there should be someone you can talk to that's separate from your site and you can talk to about anything."*
- One mentor commented that there was too much paperwork involved in the process – *"there's a whole paperwork exercise...I've a bloody big folder...I think it should be a little less structured that way."*

Mentoring is well recognised as an effective method of bedding-in new employees and sharing experience from senior to junior employees. In a broader study of the leading construction companies, it was found that some of Case Study A's competitors operate a mentoring programme for all levels of staff, allowing people to see another side of the business and promoting a sense of ownership within the organisation.

2.5 Professional Institutions

All relevant interviewees indicated that the company was supportive of them in their efforts to gain chartered status with their respective professional institutions, and felt that the company provided more than enough opportunity for them to meet their required CPD hours.

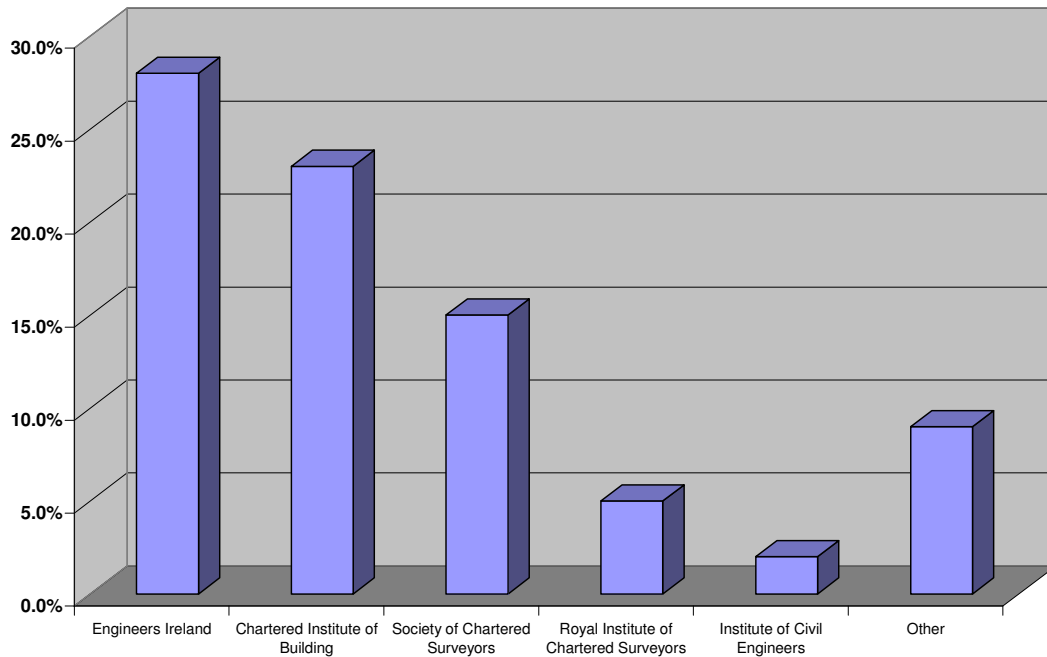


Figure 1 Membership of Professional Institutions

Over a quarter of survey respondents (28%) are members of Engineers Ireland, the country's largest professional institution, followed by the Chartered Institute of Building with 23%. Overall, the results show that a high proportion of the company's employees are either engineers or quantity surveyors as would be expected in such an organisation. It should also be noted that a small number of respondents indicated dual membership (i.e. membership of two institutions).

3.0 Knowledge Management

The company's approach to KM is explored from a number of perspectives as follows: lessons learned database, internal knowledge sharing seminars, knowledge sharing and identification of internal expertise.

3.1 Lessons Learned Database

"The theory is, and I'd be interested in the answer from your survey on this one, is that before you start that package you log onto the database and have a look and say "yeah, I know that one, I know that one, oh, there's a new one, I'll read that" and hope you don't make the same mistake again. So the theory is good but you are depending on people to take the time to look at it."

Staff were queried on their frequency of use of the lessons learned database (LLDB) during the course of their work. Despite nearly three-quarters of the respondents (73.8%) stating that they found it beneficial to them in their work, the use of the database in Table 1 shows that "Very Rarely" ranked highest in terms of usage.

Rank	Use of LLDB
1	Very Rarely
2	When I Have a Problem
3	When I Have a Specific Query
4	Never
5	Quite Often
6	When a subcontract package commences

Table 1 Frequency of Use of Lessons Learned Database

During the interviews, the use of the database was discussed from a number of perspectives, the following being the most pertinent points made:

- **Lack of time:** many respondents stated that they just didn't have the time to look through the database every time a new package started. *"I haven't checked it in about a year...you don't get time to, unless you're sitting here twiddling your thumbs...it's extremely difficult."*
- **Relevance to their current role:** some people questioned the actual relevance of the lessons learned to them in their current position. One respondent stated *"a lot of the things on the lessons learned are relevant to foreman level...they're the guys out there dealing with those issues. For example there's a lessons learned on the difference between WBP and marine plywood, and what happens if the stamp is wrong...that's where the breakdown is, the people who really need to know are not accessible to a computer, its not in their job description."* Another individual identified a similar issue contributing: *"you don't want them in front of a computer all day."*

- **User interface:** *"it's not something that's overly user-friendly."* One individual while demonstrating the database, clicked on a link which led them to an incorrect page.
- **No requirement to contribute:** many people felt that there was no requirement on them to contribute to the LLDB, and as a result, didn't bother. One individual suggested *"perhaps contributing to the lessons learned should be part of your work...the company I worked for in England did that, when you did your monthly report for the directors, you had to do your lessons learned."*
- **Difficulty finding the most recent lessons:** *"you have to sift through the older lessons as well."*
- **Refresher on using LLDB:** it was suggested that the company should run refresher courses in the use of the database to jog people's memory and improve awareness

The survey asked respondents to identify whether or not the database fulfilled a number of factors related to using the database. Figure 2 illustrates their responses, which overall indicate that they are quite happy with the LLDB, rating relevance and amount of information, easy to understand, easy to access, well organised, and easy to access quite highly. Similar to the interviews, the question of whether lessons were up-to-date was brought into question.

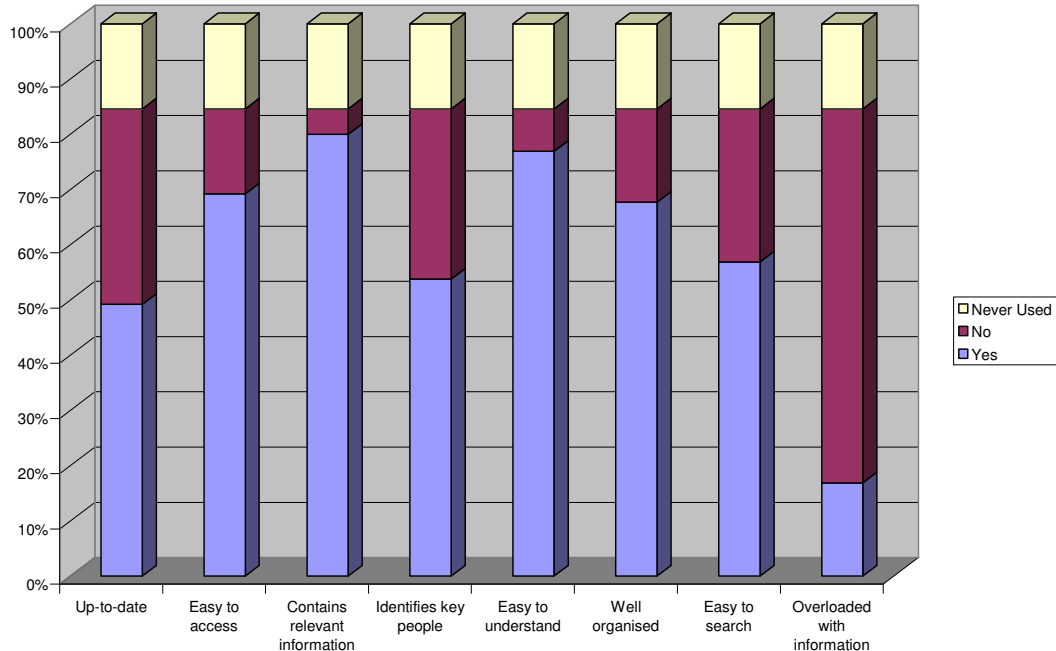


Figure 2 Factors Influencing Use of Lessons Learned Database

3.2 Internal Knowledge Sharing Seminars

Case Study A organise staff seminars quite frequently covering a wide range of topics, *"particularly technical, we find it's actually quite hard to get good technical courses, so we do a lot of that in-house, with our own senior managers."* Seminars are also held on lessons learned.

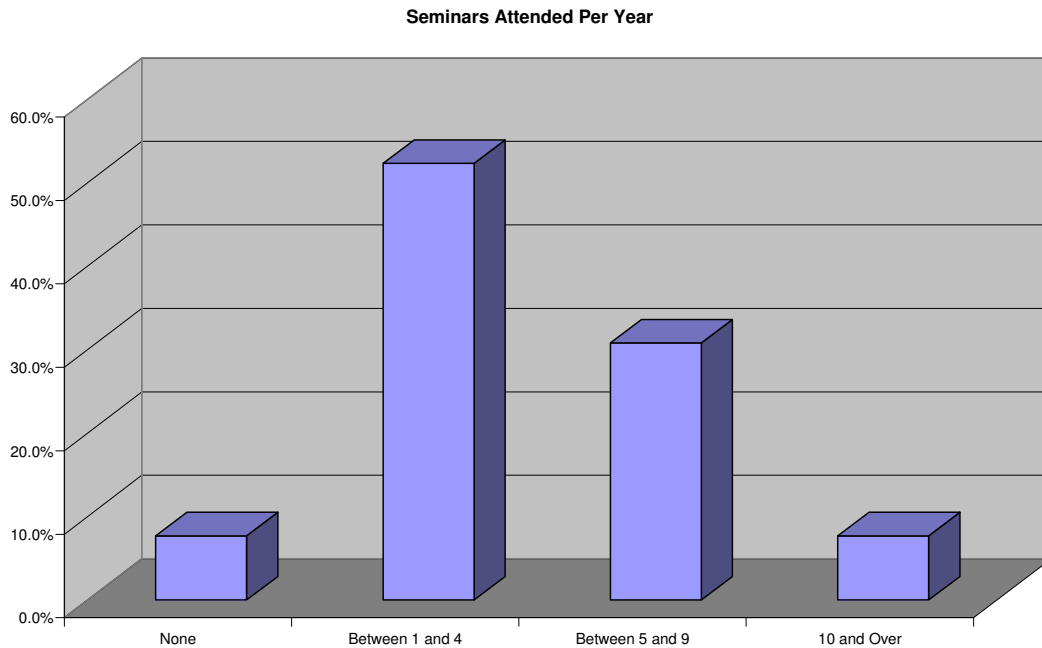


Figure 3 Average Number of Seminars Attended Per Year

The survey found that over half of the respondents (53.1%) attend between 1 and 4 seminars on average per year, with a further 31.3% attending between 5 and 9 over the same period. All interviewees spoke of how they were actively encouraged to attend relevant seminars, attendance being driven by self-motivation.

Rank	Reasons for attending seminars
1	Helps improve own work
2	See experience of others
3	Interesting content
4	Good discussion and interaction
5	Good way to meet colleagues

Table 2 Reasons for Attending Seminars

Both the survey and the interviews revealed that discussion and interaction at the seminars is somewhat limited. A number of other problems with the seminars were identified as:

- **Timing of seminars:** the seminars are generally run in the evening, after a *"hard day's work on-site."* Many of the interviewees cited fatigue and long travelling times as being counter-productive to getting any value out of the seminars.
- **Delivery:** in some instances the experience of the individual in a particular area was brought into question *"the likes of the office people would be giving a seminar on lessons learned...they talk about them, but because they're not involved on site, they don't come up with any solutions."*
- **Relevance:** it is important that seminars are pitched at the right level to the audience *"if it's not relevant or you know it already, you're going to switch off."* If a person attends a seminar which isn't relevant or of interest to them, then it may put them off attending again.
- **Experience of recent graduates:** timing of seminars in relation to graduates is particularly important: *"once you've seen it been done [formwork, concrete etc.] I find it's easier to go to a seminar and talk about it...it's hard to visualise something that you've never seen or experienced when you go into a room and listen to someone talk about it for an hour."*

It should be noted that the interview participants were based in Waterford and had to travel to either Cork or Dublin in order to attend seminars. However, staff who had worked with the company in Dublin felt that at times it was difficult to get any benefit from a seminar in the evening: *"even jobs in Dublin that are an hour from the office...that can be difficult."*

"We were out working in the rain one day, pouring concrete, slogging away, and then I'm into this thing at 5.30...and I mean the heat and all, I'd been out in the fresh air all day, out in the wind, and I come into this nice, cosy, comfortable room to a guy in a shirt and tie...and I'm gone!"

"The seminars are effective if they get people at similar levels together, when they wouldn't normally get together and they give people a chance to learn from the experience of others."

In relation to seminars, one interviewee suggested that *"there should be more done on-site, particularly on a big site like this where you have a lot of staff...it's not a thing that has to happen in head office."*

3.3 Knowledge Sharing Forum

The opportunity to meet with peers and share experiences is an important part of managing knowledge in organisations. Unfortunately, the geographical dispersion and intensity of construction projects can inhibit the potential for such activities in busy construction organisations - *"it's difficult to get away from sites, and you can't really have more than one or two people from a site going to something, that's difficult."*

With this in mind, the survey asked *"do you meet with others in similar positions?"* Just over half of the respondents (51%) indicated that they meet with their peers on a regular basis, in fact 40% of such responses stated that they meet with others in similar positions on a monthly basis.

Rank	Frequency of meeting peers
1	Monthly
2	3 to 4 times a year
3	Twice a year
4	Once a year

Table 3 Frequency of Meetings with Peers

Of the 51% of respondents who stated that meet with others in similar positions, 97% of them found such interaction of benefit to them in their work, particularly in discussing recurring problems, new construction methods and other issues. These views were confirmed during the course of the interviews, in particular, a bi-annual quantity surveyors meeting was viewed as *"extremely beneficial."*

Of the survey respondents who didn't get to interact with others outside of their day-to-day roles, 83% indicated that they would like to do so.

In general, the idea of annual meetings for the various disciplines was viewed as potentially be useful but would have to be very structured – *"once a year would be enough, if there were any new people they would get a chance to meet with everybody else."*

3.4 Identification of Expertise within Case Study A

Throughout the course of working, people may encounter issues that they haven't dealt with previously. In these instances there is often someone within the organisation who can offer assistance, having encountered such issues themselves. An important aspect of KM is the identification of "know-who," that is, knowing the people in the organisation with certain domain expertise. In this regard, the survey asked respondents to identify the ease with which they were able to identify such people within the company. Both "in own workplace" and "in head office" ranked quite highly (89% and 67% respectively) indicating the ease with which they could identify people in these instances. Interestingly, only 46% of respondents indicated that they could easily identify expertise on other sites within the company, which may be influenced by the amount of time they are with the company. Only 16% of respondents felt that they could locate expertise in the company's other regional offices in Cork, Limerick and Galway.

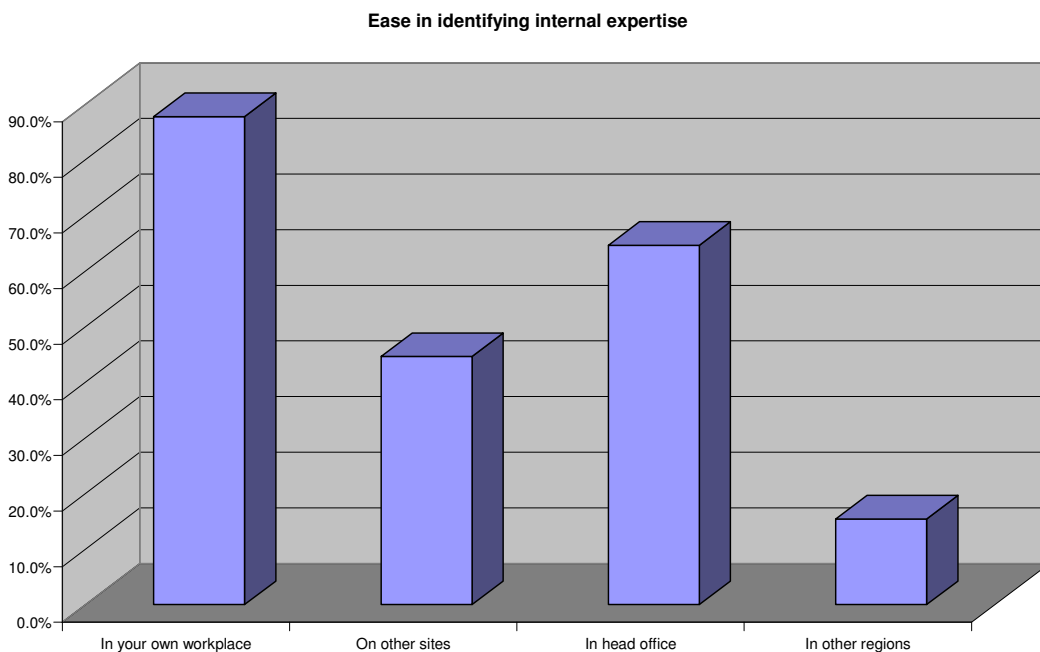


Figure 4 Ease in Identifying Expertise within Case Study A

These figures were reinforced by interviewees, with many individuals having little or no knowledge of other construction sites or regions.

3.5 Site Visits

Visiting other construction sites are seen as an important part of knowledge management, allowing participants to share knowledge and experience, whilst viewing it first hand. The company encourages staff to visit sites on an ad-hoc basis, particularly if site managers are “between projects” they are given time to visit other Case Study A sites. The survey found that 49% of respondents had visited another Case Study A site to look at a specific construction method.

During the interviews, it emerged that a number of participants had visited another site to look at bathroom pods and a new twin wall system, both of which were used on the Railway Square project. One interviewee described it as follows: *“we visited a site to look at pods and a twin wall system...we got to know how they worked, how to go about setting out for them, it’s helped shorten the learning curve.”* Another person commented: *“someone walked us around and showed us what was involved in the process and pitfalls to look out for...it was extremely beneficial.”*

Other comments on site visits included:

“I think that site visits could be a good thing and there’s not much done on that...particularly if it would benefit the project that you’re on.”

“You see it first hand, rather than being told it’s a great system, you can talk to the lads on site and they’ll tell you the problems or issues.”

“I think they’re a great idea for graduates, just even to see what’s going on and get a feel for it. You could be stuck on a job as a young engineer...there’s so many different aspects to construction, just to see different things.”

“Site visits are of benefit...I’ve done them before, but there’s probably not enough of that done, but if the company promoted it more it might be of better use to us all.”

“I think it would be quite beneficial to go from Dublin to Cork to view sites, sooner than going from site to site in Dublin, because they’re channelled into doing things the same in Dublin, whereas Cork might have a different slant on things.”

4.0 Conclusions

This study set out to explore the current approaches to CPD and KM within Case Study A. *"We work very hard to give people careers...while it can't be guaranteed in this business, our track record is pretty good."*

"Overall, they're quite good, they're quite loyal to their employees as long as you make an honest effort to do your work to the best of your ability and be loyal to them. You're not expected to pull rabbits out of the hat or perform miracles, but just perform to the best of your ability."

Based on the research undertaken the following conclusions can be drawn:

1. Regular **performance appraisals** are a worthwhile and beneficial undertaking for both the individual and the organisation.
2. There is excellent provision of **CPD and training** opportunities from the company for all employees, with visible support from senior management further reinforcing the importance placed on employee development.
3. Staff **inductions** focus primarily on the company's computer systems, the relevance and timing of which was called into question.
4. **Mentoring** is recognised as an important programme within Case Study A, although mentees understanding of their role appears unclear.
5. Staff value membership of **professional institutions** quite highly and the company provide ample opportunity to gain chartered status.
6. The use of a **lessons learned database** is a relatively new occurrence in the construction industry, and the company should be applauded for their efforts in this regard. However, use of this tool was found to be quite low, due to a number of factors; lack of time, not relevant to role, poor user interface, no requirement to contribute, and difficulty finding most recent lessons.
7. Staff were generally positive about **internal knowledge sharing seminars**, seeing them as an opportunity to help them improve in their work. The timing, delivery and relevance of the seminars were brought into question.
8. The opportunity to engage with peers in a **knowledge sharing forum** was found to be extremely beneficial by those who had the opportunity to do so. Those who didn't attend such events, felt that the opportunity to do so would have a positive effect on their work.
9. The accumulated knowledge and expertise of the entire organisation is not visible or readily accessible to employees. The **identification of expertise within Case Study A** is difficult to do on other sites and regions where staff may possess knowledge of use to fellow employees
10. The opportunity to participate in **site visits** is encouraged by the company, and is beneficial to those who partake.

In general, staff were very happy with the range of such activities provided, however a number of recurring themes emerged throughout the research which are applicable to all of the above:

- The difference in certain aspects of CPD and KM were noticeable between engineering and surveying staff, and were referred to in a negative "*us and them*" manner on a number of occasions.
- The level of engagement with some tools (e.g. lessons learned database) by project-based staff differed between those who were predominantly working in the site office as opposed to those who were out on site most of the time.
- While the company have a comprehensive graduate training programme, those people who enter the company at a later stage, and with more experience tend to feel *left out* in relation to training and opportunities to progress.
- There is a possibility that the regional division of the company inhibits the maximum effectiveness for knowledge sharing throughout the entire organisation.

5.0 Recommendations

Taking the findings, company structure and the dynamics of the construction industry into account, a number of recommendations are made in key areas as follows:

1. Re-evaluate the company **induction** – is it necessary to cover IT systems on first day?
2. Build on early success of **mentoring** programme, keep mentors and mentees separate in their day-to-day work, provide training for mentees, consider mentoring for experienced recruits
3. Incorporate the use of, and contribution to the **lessons learned database** into company policy, performance appraisals, subcontract awards, monthly reports etc.
4. Provide refresher courses in the use of the **lessons learned database** (could be run on-site, during the day)
5. Re-consider the format for **internal knowledge sharing seminars**, perhaps some should be targeted at specific projects at particular stages e.g. lessons learned on ground works when the project team is dealing with ground works.
6. Organise structured **knowledge sharing forums** for various disciplines (e.g. junior engineers, site managers, foremen etc.) allowing for the identification of recurring problems, potential solutions, feedback etc.
7. Explore opportunities for more structured **interaction and collaboration with other regions** within the organisation (identification of expertise, site visits, seminars, knowledge sharing forum)
8. Develop a structured **site visit programme** for all staff, at all levels
9. Streamline **CPD practices** for both engineers and quantity surveyors (mentoring, appraisals, knowledge sharing etc.)

Appendix H

Case Study B

Focus Group Agenda

Pharma Division Focus Group Agenda

1.0 CLEANROOMS

1.1 There is a need to have the cleanroom contractor appointed and involved in the process from an early stage especially with the different types of systems that are out there. However what do you think is "early" and what suggestions would you give, bearing in mind the steel structure could be up and floors poured before room layouts are agreed?

1.2 It is apparent that there are many unique design and quality issues on cleanroom / pharma projects. Some of these issues have reoccurred on other projects. What recommendations could be offered to minimize these from happening on future projects?

1.3 On some of our cleanroom projects the issuing and approval of commissioning and validation documentation has caused major programme issues. What suggestions could be offered in minimizing this in future projects?

2.0 COMMISSIONING & VALIDATION

2.1 This research has shown to be issues in commissioning HVAC systems with various problems with setting pressures, relative humidity and temperatures. The process is starting in Centocor and so far there are no issues. With our experience to date what can be done to prevent these issues from arising?

2.2 The process of commissioning and validation meetings with the client is very important especially with the extent of documentation involved. At what stage is it best to start these meetings and is there a critical list that should form the agenda, based on our experience to date?

3.0 MANAGEMENT CONTRACTING

3.1 Management contract projects are usually large scale and are suitable for facilitating changes. However this is often taken for granted with clients making late changes and expecting to maintain programme. Is there any way that Case Study B can play a more active role with the design team and client on layout approvals or pre emptying change?

3.2 Management contracting allows for an overlap in design and construction. This research has shown that a lack of scope at design stage has major implications during the project. From our experience to date should there be a certain amount of information / scope agreed before the management contractor gets involved or before construction starts?

3.3 Our experience is important so interaction and consultation with the design team is essential at the design stage. At what time prior to construction start do you feel the management contractor should be appointed?

4.0 KNOWLEDGE MANAGEMENT

4.1 At present Case Study B are poor at sharing knowledge within the pharma division. Sharing knowledge and experiences is thought to be invaluable especially when cleanroom construction is so specialized. Is there a consensus on what are the best methods or forum to share knowledge?

4.2 It is hoped that by sharing information, knowledge and lessons learned that we will all derive a benefit and advantage for ourselves and our projects. Is this a view that is shared and that it would motivate people to participate in a knowledge management forum?

Appendix I

Case Study B

Project Team Interview Questions

1.0 GENERAL INFORMATION

- 1.1 Tell me about your experience in construction and with Case Study B?
- Educational qualifications and professional bodies
 - Previous experience companies and/or (cleanroom) projects
- 1.2 What do you think of Case Study B as a company, what are they like to work for?
- Training, development, career opportunities and job security
- 1.3 How do you use computers in your day to day work?
- How much experience do you have of using computers?
 - Use of email and intranet?
 - What software packages can you use? (Office, IE, CAD, Project)

2.0 CLEANROOM PROJECT

- 2.1 Can you give me some background to your role on the project?
- Duration of involvement with project
 - Responsibilities
 - Previous experience of working with other staff on site
- 2.2 What were the biggest issues involved in building the cleanrooms?
- Quality of finishes (floors, ceiling, walls, lights, silicone)
 - Mechanical and electrical (pressures, leaks, AHU design, alarms)
 - Commissioning, protocols, documentation and validation
 - Procurement route i.e. management contracting
 - Design issues
 - Information and documentation
 - Subcontractor performance

3.0 KNOWLEDGE SHARING ACTIVITIES

- 3.1 How effectively do you think knowledge and experience is shared within the pharma division/wider organisation?
- Site meetings
 - Site visits
 - Seminars
 - Project reviews
 - Mentoring
 - Other activities
- 3.2 Do you think that there's enough time given to activities like the above?
- Would you like more (project reviews), how often?
- 3.3 How much do you know about what is going on in other (pharma) projects throughout the company? How do you find out about it?
- 3.4 Would you like to see an online tool to identify others within the company (other regions), based on their experience, qualifications and interests?
- 3.5 Are others within the company willing to share their knowledge with you?
- 3.6 Do you meet with others in similar positions within the company?
- Yes, how often, where, what is discussed, who organises it?
 - No, would you like to? How often? To discuss what?

4.0 WRAP-UP

- 4.1 Is there anything else that you would like to add?

Appendix J

Case Study B

Post-Project Review Agenda

LESSONS LEARNED AGENDA

INTRODUCTION

- Discuss the purpose of the focus group and the importance of lessons learned.
- Explain my role in the process.
- Mention that it will be recorded and confidentiality will be observed.
- Will now go through a number of the main issues associated with the cleanrooms and aim for consensus on the lessons learned.

CLEANROOM FINISHES

Floor Finishes

- Selection of good flooring subcontractor is essential
- Give flooring subcontractor full cleanroom for floor installation
- Ensure adequate protection of wall panels when spraying adhesive for vinyl floor covering

Wall Finishes

- Ensure adequate protection of wall panels at all times
- Cut-outs and drilling for sockets and light boxes can cause significant damage
- Order spare single skins to replace damaged wall panels
- Costly repairs to damaged wall panels were not always accepted by the client

Ceiling Finishes

- Numerous problems encountered with "walk-on" ceiling, ensure that heavy duty work like steel platforms is completed before ceiling installation
- 1200 x 600 grid system was identified as the best solution
- Compatibility issues for light fittings, HEPA filters and sprinkler heads with both ceiling types, list of recommended fittings should be drawn up

Silicone Sealing

- The client had high standards and required all joints (floor, ceiling, wall, coving, grilles, sockets etc.) to be sealed with silicone. Need to consider extent of silicone when pricing the job
- Check silicone seal between floor covering and wall panel
- In hindsight, sealing of the lights and HEPA boxes should have been looked at earlier. This could not have been foreseen during the mock up. It only became apparent during construction, with the volume of work done on the ceiling

CLEANROOM SERVICES

Lighting

- Maintenance and replacement of lights needs to be considered i.e. from above or from within cleanroom?
- Get a sample light fitting and test it within the ceiling grid.

Sprinkler Heads

- Traffic above the ceiling caused the sprinkler caps to pop off, ended up having to retrofit a lot of the sprinklers with brackets at our own cost.

Services Integration

- Ensure that break glass units, temperature sensors etc. are fit for use in a cleanroom. Water ingress occurred when washing cleanroom, led to problems with temperature, humidity and fire alarms requiring units to be replaced.
- There's merit in one contractor coordinating the services in the cleanroom, and doing everything except for the flooring. For example Ardmac should supply and install the walls, ceilings, fixtures and fittings, that is everything inside the room, then there's one point of responsibility.

HVAC and AHU

- Insect mesh was used at the air intake, which froze over during cold weather causing the AHUs to shut down. Recommend using bird mesh at intake, as panel filter will catch finer particles further along the line.
- There were problems with the humidifiers and humidifier bottles on the AHUs, in controlling the humidity as there were issues with taking over the working and maintenance of them.

Alarms and BMS

- Problems with the BMS and alarms due to the phased nature of the project with construction work in close proximity to live production, meaning that BMS strategies were changed throughout construction.
- Had a live, validated BMS for the production areas, and nuisance alarms from the construction area that were both being relayed to the maintenance department, causing considerable confusion. Need to agree a clear protocol with the client for testing the BMS and alarms.
- For the validation process, if the pressure dropped in a room, we had to prove that we got it registered on the BMS, that it was relayed to a printer and that it was relayed to the pager, and all that had to be witnessed as well, and that was for every alarm also.
- Working in areas with live fire alarms, break glasses and smoke heads was problematic. There were a number of nuisance evacuations due to both ongoing construction work and maliciousness, leading to the client's staff having to leave the cleanrooms and the production processes, having a big effect on their manufacturing processes.

COMMISSIONING & VALIDATION

- Appoint commissioning contractor as early as possible to reduce conflicting positioning of equipment and less changes during construction.
- Have clearly defined access walkways at an early stage to allow for improved duct and services layout.
- Early consideration of location of commissioning sets is very important.
- Need for system design to be checked as there were a lot of problems with pressure drops, more than had been anticipated in the design.
- There should be a defined window left in the programme for testing, and this has to be communicated to the client from the start, based on our experiences.
- Walk-downs were difficult to manage due to the phased nature of the project, adding onto systems that were already demonstrated to the client.
- Have agreed procedure in place with client to sign off on demonstrations
- Get client to issue URS as early as possible and make them aware of potential problems if delays occur
- Identify client's staff involved in signing off on documentation
- Staff to receive training in the area of commissioning and validation

HANDOVER OF PHASED WORK

- Need for more/better procedures for people working in areas that have already been handed over. There were a number of cases where people had to work over live cleanrooms in order to make connections to the new phase and there were problems with items falling into the existing cleanroom and leaks. There was also a problem with the mechanical contractor and the overflow effluent tank leaking, ended up bringing in an independent guy in to issue permits and we spent a lot of money on that.

SNAGGING

- A lot of fine tuning involved in getting the door interlocks and closers to work due to the pressure differentials between rooms.
- Need for an agreed process for snagging the cleanrooms with the client and the design team that is workable and achievable. Look to develop a strategy for snagging early on where all subcontractors, the client and design team are in agreement about a combined approach.
- Had an engineer whose role was to focus on quality and snagging, he came up with an innovative idea, where if he saw a snag he would put a sticky beside it.

SUBCONTRACTOR PERFORMANCE

- Ordering of materials for cleanroom needs to be agreed with subcontractor. There was a delay in getting the doors and windows, resulting in delays to finishing and sealing the cleanroom.
- In general, subcontractor performance was good; however there were problems with the flooring subcontractor on the first phase and the lift contractor.

Appendix K

Case Study B

Lessons Learned Report

Pharmaceutical Expansion Project

Cleanroom Lessons Learned



Project Details	
Client:	Major Pharmaceutical Company
Procurement:	Management Contracting
Value:	€100 million
Programme:	August 2004 – November 2007 (on a phased basis)
Scope:	Expansion of existing medical devices production facility, including: class 7 and 8 cleanrooms; offices and canteen; laboratories and CUB; civil works and car parks; warehouse and 38 KV sub station; and modifications to existing building.

Case Study B's Team			
Contracts Manager	AN Other	info@build.com	086-1234567
Site Agent	AN Other	info@build.com	086-1234567
Site Foreman	AN Other	info@build.com	086-1234567
Services Engineer	AN Other	info@build.com	086-1234567

Project Team			
Architect	AN Other	Services Consultant	AN Other
Structural Engineer	AN Other	Quantity Surveyor	AN Other

Specialist Subcontractors			
Cleanroom	AN Other	Electrical	AN Other
Flooring	AN Other	Mechanical	AN Other

Vinyl Flooring: On phase 1, a flooring contractor was nominated who subsequently subcontracted much of their work to others; this led to numerous problems with coordination of work and resulted in some quality and programme issues. Prior to spraying adhesive to form the coving between the wall and floor, it is important to **ensure that the wall panels are fully protected**, especially at the edges with masking tape. Adhesive that was left on the wall panels when coving the vinyl resulted in dust and dirt sticking to the panels, which turned out to be costly and time-consuming to rectify.

Walls: Considerable damage was caused to the cleanroom walls when cutouts were being made for socket and light boxes, leading to considerable time and money being spent on repairs, with many being rejected. It was suggested that **a template should be made for cutouts** and that spare single skins be ordered to replace badly damaged wall panels

Ceilings: The ceiling was designed as a "walk-on" ceiling, with two different ceiling types (3m x 1m panel and 1200mm x 600mm grid) used on the project. The **1200 x 600 grid system was identified as the best solution**. There were numerous problems with the 3m x 1m "walk-on" ceiling as it deflected due to cut-outs, high volume of traffic, and heavy work above. It is recommended that as much work as possible be completed before the ceiling is installed.

Use of Silicone: The client had high standards and required all joints (floor, ceiling, wall, coving, grilles, sockets etc.) to be sealed with silicone. On future projects, **Case Study B need to consider extent of silicone when pricing the job**. Cutting too many opes in the ceiling caused distortion in the panels, preventing lights and grilles from fitting properly. This was on the 3000 x 1000 type and resulted in all lights and HEPA's being siliconed to the ceiling.

Lighting: Need to **consider access to lights for maintenance and replacement purposes** at an early stage i.e. from within or above cleanroom. Traffic above ceiling caused light fittings to deflect and lights and diffusers popped out due to people standing on them

Sprinkler Heads: Again, due to traffic above the ceiling put the sprinkler cap underneath under pressure, and over time the sprinkler caps popped off. **The sprinkler contractor ended up having to retrofit a lot of the sprinklers with brackets**. The use of a flexible connection between sprinkler and piping is also recommended. This type of sprinkler cap was an FM Global requirement.

HVAC: There were a lot of problems with pressure drops, more than had been anticipated in the design. A lot of fans and motors were undersized which had to be changed and upgraded. There is a **need to build redundancy into the system** to ensure that system pressure is achieved. Humidifiers were "cut too close to the bone" and hadn't allowed for inefficiencies in the system design. **Case Study B need to ask questions early on about capacity** and efficiency of systems and should **get an independent check on the system design** pressures on coordination drawings; the issue here is getting the client to pay.

Alarms & BMS: Working in areas with live fire alarms, break glasses and smoke heads was problematic. There were a number of nuisance evacuations due to both ongoing construction work and maliciousness, leading to the client's staff having to leave the cleanrooms and the production processes, having a big effect on their manufacturing processes. Abbott fitted plastic cover over break glass units to limit "accidental" alarms and signs were posted regarding criminal prosecution for malicious setting of alarms. **Case Study B need to agree a clear protocol with the client for commissioning and testing of the BMS and alarms**. These issues arose particularly due to the multi-phased nature of the handovers.

Services Integration: There were compatibility issues for light fittings, HEPA filters and sprinkler heads with both ceiling types. Fittings such as break glass units, sensors, screws etc. should be fit for purpose in cleanroom, particularly due to wet cleaning of rooms. **A list of recommended fittings for cleanrooms should be drawn up.**

Commissioning & Validation: Have clearly defined walkways at an early stage to allow for access to commissioning sets and improved duct and services layout. There should be a **defined window left in the programme for getting system up and running and testing it.** This has to be communicated to the client from the start, based on our experiences. **Appoint commissioning contractor as early as possible** to reduce conflicting positioning of equipment prior to installation, and less changes during construction. Need to have agreed procedure in place with client for their staff to sign off on demonstrations. Get client to issue URS as early as possible and make them aware of potential problems if delays occur. Need for Case Study B staff to receive training in the area of commissioning and validation

Handover of Phased Work: There were a number of cases where people had to work over live cleanrooms in order to make connections to the new phase and there were problems with items falling and leaks. There is a **need for more/better procedures for people working in areas that have already been handed over.** Permits and/or SPA (safe plan of action) should be used to identify and control work and reduce such problems in so far as possible.

Snagging: Need for an agreed process for snagging the cleanrooms with the client and the design team that is workable and achievable. Look to **develop a strategy for snagging** early on where all subcontractors, the client and design team are in agreement about a combined approach. The level of snagging; i.e. by who and when, needs agreement from day one. Case Study B had an engineer whose role was to focus on quality and snagging, he came up with an innovative idea, where if he saw a snag he would put a sticky beside it. This worked extremely well as it identified a snag much better than trying to document the location.

Appendix L

Case Study B

Director Presentation

Knowledge Management in Construction Organisations



Brian Graham
Waterford Institute of Technology
Friday 14th December 2007

Presentation Overview



- Introduction
 - What is knowledge?
 - Knowledge Management (KM)
 - Implementation
 - Activities
 - Benefits of KM
-

What is KM?

*"The creation and subsequent management of an environment which encourages knowledge to be created, shared, learnt, enhanced, organised and utilised **for the benefit of the organisation and its customers.**"*

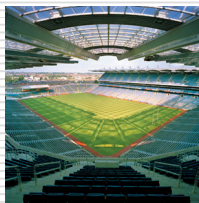


Learning from Experience



"IF WE REALLY DID LEARN FROM OUR MISTAKES YOU WOULD BE AS SMART AS EINSTEIN BY NOW!"

Past



Knowledge Management

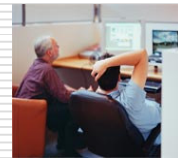
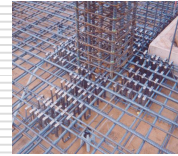


Future



KM Implementation

- Develop a KM strategy
- Identify knowledge to be managed
- Understand characteristics of knowledge
- Develop a knowledge-sharing culture
- Link to existing initiatives
- Provide support from IT and non-IT tools
- Benchmark KM implementation efforts



KM Activities



- **Regular Meetings**
- **Workshops & Seminars**
- **Task Groups**
- **Project Reviews**
- **Lessons Learned**
- **Site Visit Programme**
- **CPD & Training**
- **Performance Appraisals**
- **Mentoring**
- **Intranet & Databases**

Benefits of KM

- Improved project delivery
- Better service to clients
- Cost and time reduction
- Less repeated mistakes and rework
- Improved problem solving and innovation
- Increased awareness, accessibility and availability of knowledge
- Already doing it – room for improvement!



Appendix M

Engineers Ireland HRM/CPD Interview Questions

1.0 GENERAL INFORMATION

- 1.1 Can you tell me about your organisation and the type of work it undertakes?
- Sector characteristics (nature of work, competition etc.)
 - Organisational characteristics (size, no. of employees etc.)
 - Location of staff (central vs. geographically dispersed)
- 1.2 What is your role within the organisation?
- Day-to-day duties
 - Involvement in CPD and KM activities

2.0 ENGINEERS IRELAND CPD ACCREDITATION SCHEME

- 2.1 How and why did your organisation become involved in the CPD scheme?
- Recruitment and retention of staff
 - Prestige of being involved with Engineers Ireland
- 2.2 Is the CPD scheme in your organisation specifically designed for engineering staff only or is it applicable to all staff?
- 2.3 How has the CPD accreditation scheme impacted on your organisation?
- 2.4 Is your organisation engaged in similar schemes with other professional bodies?

3.0 KNOWLEDGE MANAGEMENT

- 3.1 What is your understanding of knowledge and knowledge management?
- 3.2 How was the KM System criteria addressed and implemented within your organisation?
- Integration with other initiatives & pilot projects
 - Support from senior management
 - Providing resources for KM system (people, money, ICT etc.)
 - In place prior to becoming involved in the CPD scheme?
- 3.3 How long has the KM system been in place?
- 3.4 Does ICT form part of your KM system?
- If yes, what role does it play? (Intranet, Yellow Pages, LLDB)
 - If no, why is it not used for KM?
- 3.5 What is the role (if any) of the HR function in the KM system?
- 3.6 How do you get staff to buy into and use the KM system?
- Incentives to motivate staff to use system
 - Linked with training and CPD activities
 - Ensure that use of KM system doesn't lapse over time
 - Provide training on KM system
- 3.7 Is use of the KM system monitored, measured or recorded?

- 3.8 Does the KM system differentiate between professions and levels of experience?
- Example 1: the knowledge a senior member of staff seeks may be entirely different to that of a recent graduate
 - Example 2: differences between technical and management staff
- 3.9 Does your organisation measure the benefit of the KM system to the organisation?
- If yes, how? (Links to financial performance?)
 - If no, why not?
- 3.10 In your view what are/have been the biggest challenges of KM?
- Delivering knowledge to the right person at the right time
 - Knowledge is power, friction between staff, organisational politics
 - Overloading people with too much information/knowledge
 - Making KM beneficial to staff
 - Sharing sensitive knowledge
 - Loss of context through documentation and time lapse
 - Sharing knowledge between project teams and functions
- 3.11 Do you think that education and training resources on KM would be of benefit to you/your organisation in improving your understanding of knowledge/KM?

4.0 LEARNING ENVIRONMENT

- 4.1 How are employees encouraged to share their knowledge and experiences with others in the organisation?
- 4.2 Are there opportunities for staff to reflect upon their practice and learn from past mistakes?
- Project reviews and lessons learned
 - Open discussion, lack of blame culture
- 4.3 Are staff supported in becoming chartered members of professional bodies?
- Payment of fees
 - Provision of CPD\training hours
 - Study leave
- 4.4 How do you find the time to provide opportunities for CPD & KM within the constraints of a demanding business environment?

5.0 WRAP-UP

- 5.1 Based on our conversation, is there anything else that you would like to add?

Appendix N

Case Study C

Model Evaluation Presentation



Building Knowledge

The Development of Knowledge Management in Case Study C

Brian Graham
Waterford Institute of Technology
5th May 2010

Overview

- ▶ Background & Purpose
- ▶ What is Knowledge?
- ▶ Why Manage Knowledge?
- ▶ What is Knowledge Management (KM)?
- ▶ Developing a KM Strategy
- ▶ Important Role of HRM & IT
- ▶ Important Role of Middle Managers
- ▶ Potential Benefits of KM
- ▶ KM in Construction Organisations
 - ▶ Professional Knowledge
 - ▶ Project Knowledge
 - ▶ Organisational Knowledge



Background

- ▶ *Knowledge Management within the Leading Irish Construction Organisations*
 - ▶ PhD study – commenced in 2004
 - ▶ Develop a KM model that is useful to industry
- ▶ Significant volume of research
 - ▶ Survey of top 20 contractors
 - ▶ Interviews with 10 senior managers
 - ▶ Two in-depth case studies
 - ▶ Interviews with 14 CPD/KM champions
- ▶ Publications
 - ▶ 14 conference papers
 - ▶ 2 industry publications
 - ▶ 1 academic journal paper



Purpose of Workshop

- ▶ **Present and evaluate proposed KM model**
 - ▶ Does it improve understanding of knowledge and KM?
 - ▶ Is KM important to Case Study C?
 - ▶ Does the model reflect reality?
 - ▶ Could model be adopted by Case Study C?
- ▶ **Get feedback to improve/refine model**
- ▶ **Finish PhD!**



What is Knowledge?



*Experientially-based, continuously modified,
socially-constructed & context-specific*

Explicit

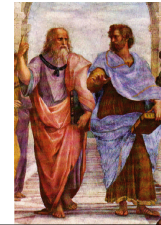
Formal Training
Readily Codified
Actionable
Information



Tacit

Problem-Solving
Context-Specific
Highly
Individualised

Is this definition meaningful?



Why Manage Knowledge?



- ▶ Critical organisational resource
 - ▶ Strategic business need for KM?
 - ▶ Current economic climate & increased competition
 - ▶ Demands from clients and society
- ▶ Inability to retain project knowledge
 - ▶ Loss of specialist knowledge
 - ▶ Reinventing the wheel & repeated mistakes
- ▶ Develop & maintain highly skilled staff
 - ▶ Improved project delivery & client satisfaction
 - ▶ Increased profitability
- ▶ Engineers Ireland CPD Accreditation Scheme

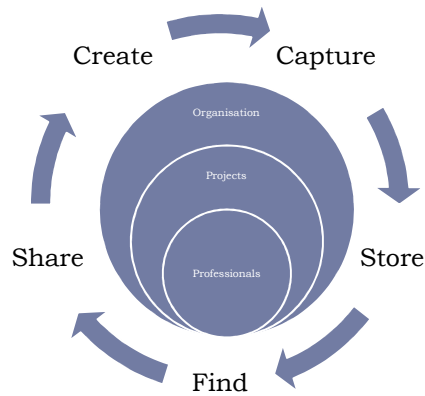
Are these sufficient reasons for KM?



What is Knowledge Management?



“The effective learning processes associated with knowledge to enhance both the performance of the individual and the organisation.”



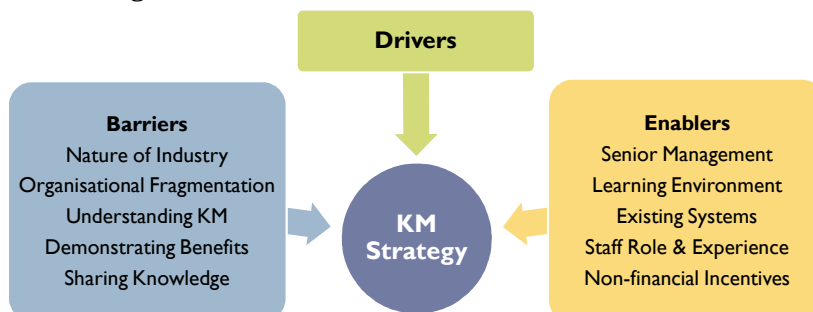
Is this a clear definition of KM?



Developing a KM Strategy



- ▶ Appoint KM champion/team
- ▶ Involve middle management
- ▶ Align with existing business strategy
- ▶ Set goals and allocate resources
- ▶ Get feedback from staff
- ▶ Recognise barriers to and enablers of KM



Is it feasible to develop a KM strategy for Case Study C?



Important Role of HRM & IT



Human Resource Mgt.

- ▶ Staff Inductions
- ▶ Manage CVs
- ▶ Mentoring
- ▶ Training & Development
- ▶ Develop Relationships & Informal Networks
- ▶ Performance Management
- ▶ Support IT Systems
- ▶ Provide Incentives
- ▶ Develop KM Activities

Information Technology

- ▶ Intranet
- ▶ Staff Skills Database
- ▶ Lessons Learned Database
- ▶ Ensure systems are:
 - ▶ Available
 - ▶ Accessible
 - ▶ User-Friendly
 - ▶ Up-to-Date
 - ▶ Secure

Can HRM & IT fulfil all of these roles?



Important Roles of Middle Managers



- ▶ Champion KM initiative
- ▶ Organisational 'knowledge hubs'
- ▶ Undertake R&D for projects
- ▶ Conduct performance appraisals
- ▶ Deliver CPD seminars to staff
- ▶ Oversee Lessons Learned practices
- ▶ Participate in knowledge-sharing activities
 - ▶ Identify recurring problems and develop solutions
 - ▶ Share high-value, context-specific knowledge

Is it feasible for Contracts Managers & Department Heads to fulfil all of these roles?





Potential Benefits Of KM

▶ Organisations

- ▶ Reduce mistakes & reinventing of wheel
- ▶ Innovation culture
- ▶ Cost & time reduction
- ▶ Improved performance
- ▶ Re-use of knowledge
- ▶ Learning & development
- ▶ CPD accreditation

▶ Professionals

- ▶ Up-to-date knowledge
- ▶ Skills conversion
- ▶ Career development
- ▶ Credibility with colleagues & employers
- ▶ Professional recognition
- ▶ Awareness of learning
- ▶ Alignment with business

Are there other potential benefits?



Managing Professional Knowledge



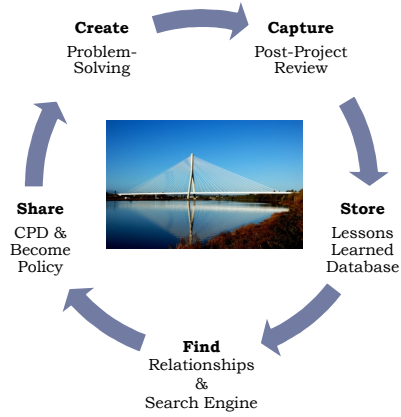
▶ Contextual Factors

- ▶ Experience
- ▶ Role
- ▶ Management level
- ▶ Education
- ▶ IT Literacy
- ▶ Absorptive Capacity
- ▶ Motivation
- ▶ Professional Bodies
- ▶ Align KM with CPD?

Could this process be adopted by Case Study C?

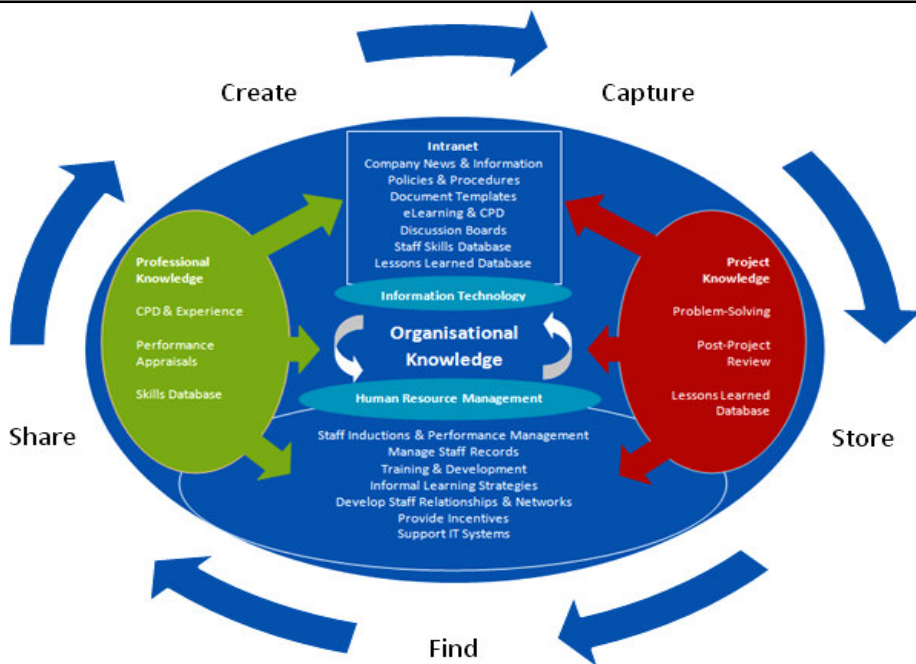


Managing Project Knowledge



- ▶ Contextual Factors
 - ▶ Type of Project
 - ▶ Client
 - ▶ Project Team
 - ▶ Location
 - ▶ Value
 - ▶ Procurement Route
 - ▶ Technical Features
 - ▶ Performance

Could this process be adopted by Case Study C?



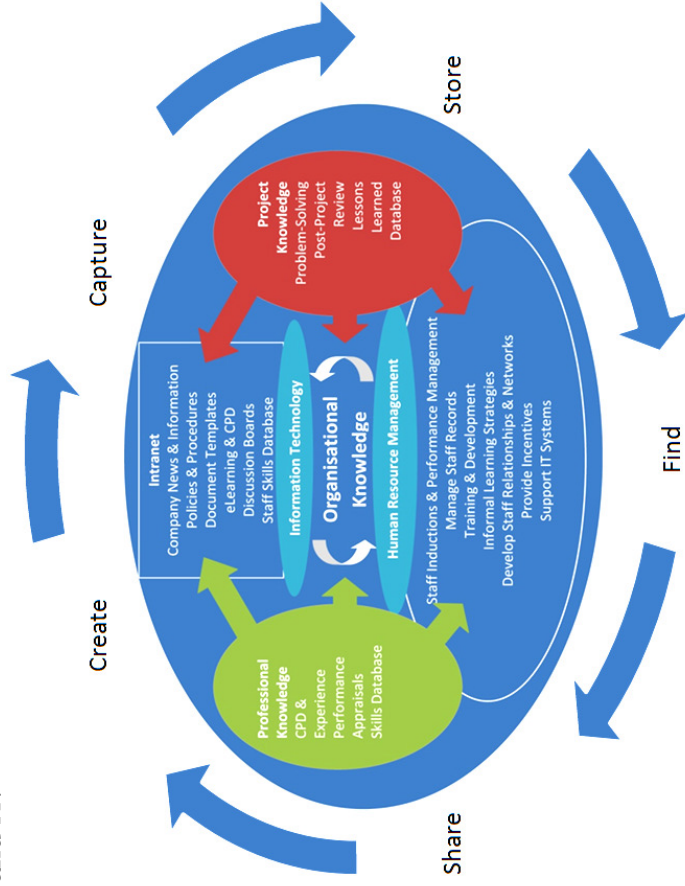
Could this process be adopted by Case Study C?

Appendix O

KM Model Handbook

Organisational Knowledge

In terms of KM, organisations are recognised as the best place for learning, allowing for consideration of issues that are relevant to the business. Organisational knowledge can be viewed as an aggregation of the knowledge of its people and projects, the management of which can be facilitated by HRM and IT.



Q2

Potential Benefits of KM

Individual Benefits

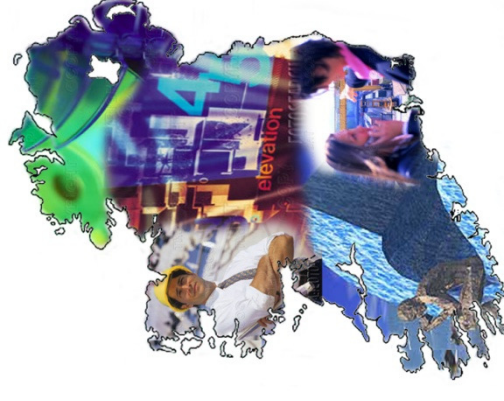
- Up-to-date knowledge, skills conversion and career development
- Ensure credibility with their colleagues and employer
- Gain recognition from professional bodies
- Improved understanding of knowledge and learning

Organisational Benefits

- Less repeated mistakes and reinventing of the wheel
- Cost and time reductions
- Continuous improvement in performance, innovation and client satisfaction
- Alignment of professional development with business goals
- Improved recruitment and retention
- CPD accreditation with Engineers Ireland
- Raised organisational profile for marketing and tendering purposes

www.wit.ie/construction

Building Knowledge



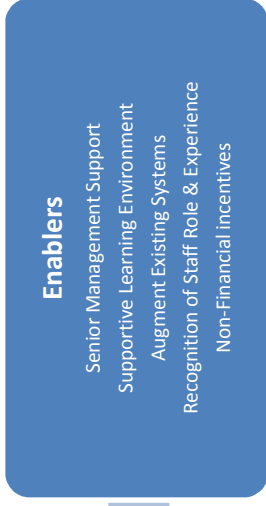
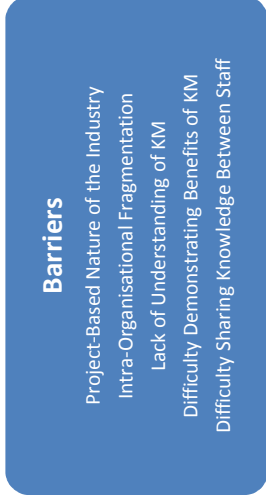
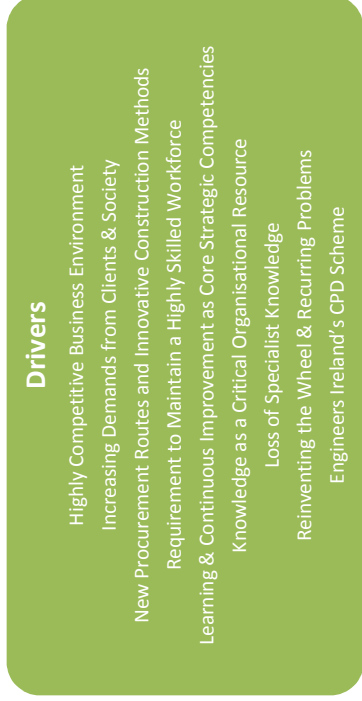
Knowledge Management (KM):

The effective learning processes associated with knowledge of people, projects, the organisation and external business environment; which enhances both the construction professional's and the construction organisation's performance.

The Development of Knowledge Management in the leading Irish Construction Organisations

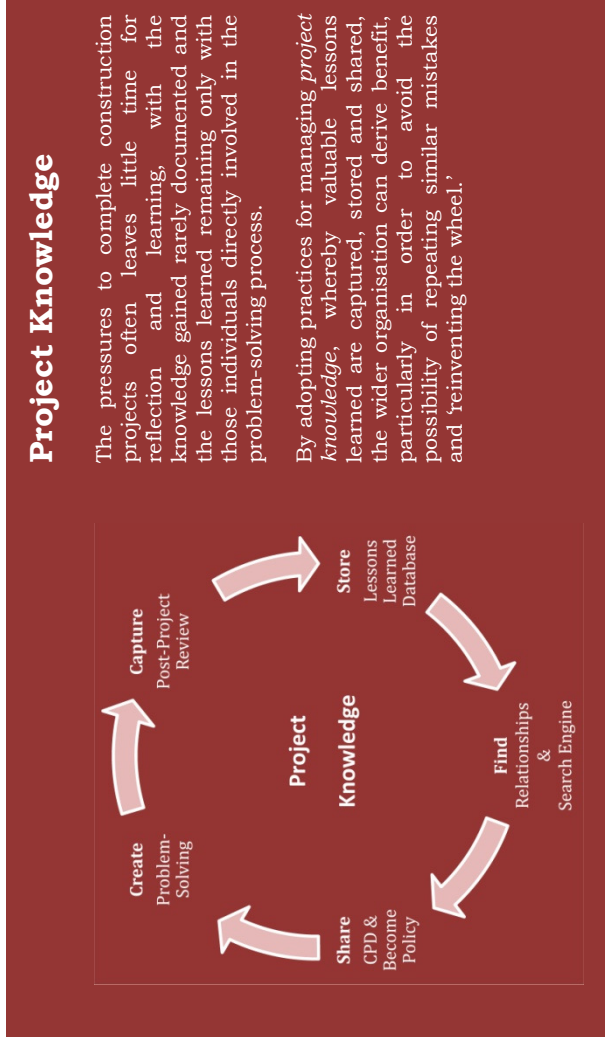
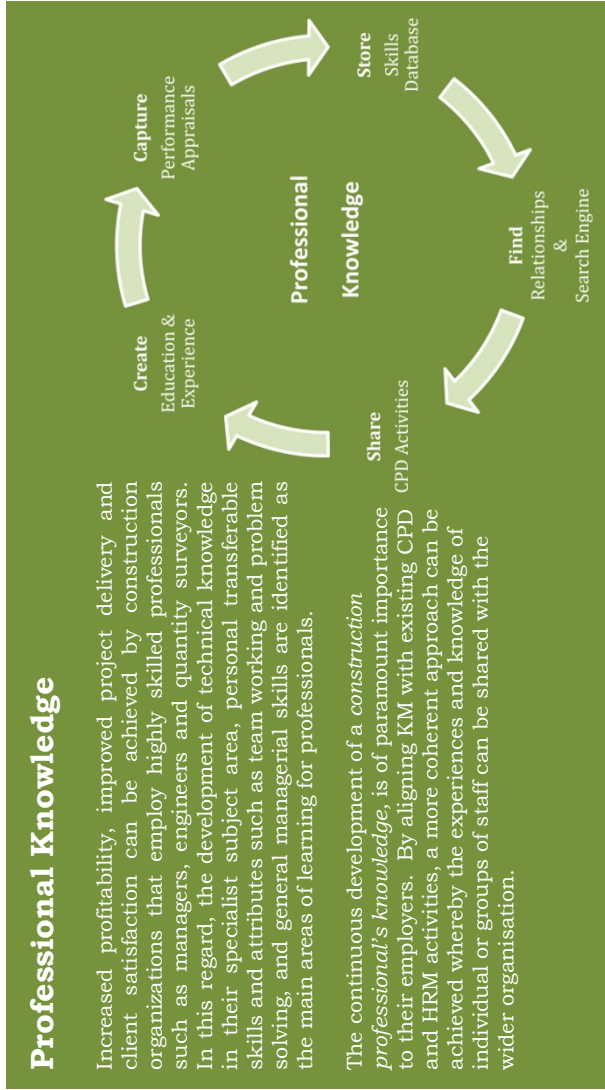
The **Human Resource Management** function has an important role to play in developing people and their knowledge, particularly in providing CPD and KM opportunities for staff. These can include: site visits, focus groups, workshops & seminars, mentoring, an annual conference and social activities. Such activities should contribute to a learning and development culture where knowledge is readily shared throughout the organisation.

Information Technology can facilitate the centralisation of explicit knowledge within dispersed construction organisations, connecting people with both useful knowledge and other people. The development of an up-to-date company intranet, which includes both Staff Skills and Lessons Learned databases, should act as a focal point for KM activities. The IT infrastructure employed needs to be available, accessible, user-friendly and secure, in both offices and on site.



Developing a Knowledge Management Strategy

In developing and implementing a KM initiative, it is important that an organisational strategy is formulated. Existing systems, such as HR, IT & CPD should be used and developed, as employees will engage in KM if it is perceived to be part of their normal working practices



Professional Knowledge

Increased profitability, improved project delivery and client satisfaction can be achieved by construction organizations that employ highly skilled professionals such as managers, engineers and quantity surveyors. In this regard, the development of technical knowledge in their specialist subject area, personal transferable skills and attributes such as team working and problem solving, and general managerial skills are identified as the main areas of learning for professionals.

The continuous development of a *construction professional's knowledge*, is of paramount importance to their employers. By aligning KM with existing CPD and HRM activities, a more coherent approach can be achieved whereby the experiences and knowledge of individual or groups of staff can be shared with the wider organisation.

Project Knowledge

The pressures to complete construction projects often leaves little time for reflection and learning, with the knowledge gained rarely documented and the lessons learned remaining only with those individuals directly involved in the problem-solving process.

By adopting practices for managing *project knowledge*, whereby valuable lessons learned are captured, stored and shared, the wider organisation can derive benefit, particularly in order to avoid the possibility of repeating similar mistakes and 'reinventing the wheel.'

Appendix P

KM Module Descriptor

Number	Semester	Subject	Element
Knowledge Management			
<p><i>On successful completion of this module the student will be able to:</i></p> <ul style="list-style-type: none"> • Appreciate the complexities of knowledge in an organisational setting • Reflect on the effectiveness of current approaches to managing knowledge in the construction sector • Critically appraise the importance of KM for construction/project-based organisations • Evaluate the KM needs of individuals, groups and organisations • Critique the suitability of a variety of tools and techniques for managing knowledge 			
<p><i>Indicative Syllabus</i></p> <p>The nature of the construction industry makes managing knowledge a difficult task for organisations; time and cost constraints leave little room for reflection and learning in an intensely competitive industry. The capability of an organisation to innovate and continuously improve depends upon the effective sharing and exploitation of its knowledge. Knowledge management (KM) has been promoted as a means of harnessing and utilising intellectual resources to address these challenges. Therefore, this module seeks to improve the student's ability to understand, select, develop and apply appropriate strategies for KM in the construction industry. The context for the delivery of this module will be influenced by the group of participants (e.g. background disciplines, from one or more employers) but the topics that are likely to be covered in order to achieve the learning outcomes include:</p> <ul style="list-style-type: none"> • Understanding knowledge: definitions, types and domains • The need to manage knowledge in an organisational setting • The potential benefits of KM • Learning from experience and innovation • The challenges of managing knowledge in a project-based environment • Learning processes associated with KM (e.g. creating, capturing, storing, finding, sharing) • Tools and techniques for managing knowledge (e.g. HRM, CPD & IT) • Implementing a formal KM initiative • Case studies of KM best practice 			
<p><i>Assessment Approach</i></p> <p>Using an appropriate Learning Management System, students will be required to engage in an online discussion about KM with peers (25%). Students will be also be required to develop a strategy for implementing KM within their respective organisations. This will comprise a report (50%) outlining current approaches to managing knowledge, the proposed KM strategy and an action plan for implementation and will be supplemented by an oral presentation (25%).</p>			
<p><i>Recommended Reading and Other Learning Media</i></p> <ol style="list-style-type: none"> 1. Jashapara, A. (2004); <i>Knowledge Management: An Integrated Approach</i>, Essex: Pearson Education 2. Anumba, C., Egbu, C. and Carrillo, P. (2005); <i>Knowledge Management in Construction</i>, Oxford: Blackwell Publishing 3. Kazi, A. S. (2004); <i>Knowledge Management in Construction: A Socio-Technical Perspective</i>, London: Idea Group 4. Dent, R. J. and Montague, K. N. (2004); <i>Benchmarking Knowledge Management Practice in Construction C620</i>, London: CIRIA 5. Little, S., Quintas, P. and Ray, T. (2005); <i>Managing Knowledge: An Essential Reader</i>, Second Edition, London: Sage Publications 			
Pre-requisite Modules: n/a		Co-requisite Modules: -n/a	
Credits: NQF Level 9		Exams: Number -0 Duration -n/a	
Number 5			
Mark Allocation:	Written Report 50	Oral Presentation 25	Online Discussion 25 Max 100
Allocated Time (Hrs): Classroom: 18 Online Support: 6 Directed & Independent Learning (Indicative):111			Total: 135

Appendix Q

National Framework of Qualifications Grid Level Indicators

National Framework of Qualifications

GRID OF LEVEL INDICATORS

LEVEL 1

LEVEL 2

LEVEL 3

LEVEL 4

LEVEL 5

LEVEL 6

LEVEL 7

LEVEL 8

LEVEL 9

LEVEL 10

Knowledge Breadth	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	LEVEL 6	LEVEL 7	LEVEL 8	LEVEL 9	LEVEL 10
Knowledge Breadth	Elementary knowledge.	Knowledge that is narrow in range.	Knowledge moderately broad in range.	Broad range of knowledge.	Broad range of knowledge.	Specialised knowledge of a broad area.	Specialised knowledge across a variety of areas.	An understanding of theory, concepts and methods pertaining to a field (or fields) of learning.	A systematic understanding of knowledge, its origin, its use, or its application, as informed by the forefront of a field of learning.	A systematic acquisition and understanding of a substantial body of knowledge which is at the forefront of a field of learning.
Knowledge Kind	Demonstrate basic practical skills and carry out directed activity using basic tools.	Concrete in reference and basic in comprehension.	Mainly concrete in reference and with some comprehension of relationship between knowledge elements.	Mainly concrete in reference and with some elements of abstraction or theory.	Some theoretical concepts and abstract thinking, with significant depth in some areas.	Some theoretical concepts and abstract thinking, with significant underpinning theory.	Recognition of limitations of current knowledge and familiarity with sources of new knowledge; integration of concepts across a variety of areas.	Detailed knowledge and understanding in one or more specialised areas, some of fit at the current boundaries of the field(s).	A critical awareness of current problems and/or new insights, generally informed by the forefront of a field of learning.	The creation and interpretation of new knowledge, through original research, or other advanced scholarship, of a quality to satisfy review by peers.
Know-How & Skill Range	Demonstrate basic practical skills and carry out directed activity using basic tools.	Demonstrate limited range of basic practical skills, including the use of relevant tools.	Demonstrate a limited range of practical and cognitive skills and tools.	Demonstrate a moderate range of practical and cognitive skills and tools.	Demonstrate a broad range of specialised skills and tools.	Demonstrate comprehensive range of specialised skills and tools.	Demonstrate specialised technical, creative or conceptual skills and tools across an area of study.	Demonstrate mastery of a complex and specialised area of skills and tools use and modify advanced skills and tools to conduct closely guided research, professional or advanced technical activity.	Demonstrate a range of complex and specialised research or equivalent tools and techniques of enquiry.	Demonstrate a significant range of the principal skills, techniques, tools, practices and/or materials which are associated with a field of learning; develop new skills, techniques, tools, practices and/or materials.
Know-How & Skill Selectivity	Perform processes that are repetitive and predictable.	Perform a sequence of routine tasks given clear direction.	Select from a limited range of varied procedures, and apply known solutions to a limited range of predictable problems.	Select from a range of procedures, and apply known solutions to a variety of predictable problems.	Evaluate and use information to plan and develop investigative strategies and to determine solutions to varied unfamiliar problems.	Formulate responses to well-defined abstract problems.	Exercise appropriate judgement in a number of complex planning, design, technical and/or management functions related to products, services, operations or processes.	Exercise appropriate judgement in a number of complex planning, design, technical and/or management functions related to products, services, operations or processes, including resourcing.	Select from complex and advanced skills across a field of learning; develop new skills to a high level including novel and emerging techniques.	Respond to abstract problems that expand and redefine existing procedural knowledge.
Competence Context	Act in a closely defined and highly structured contexts.	Act in a limited range of predictable and structured contexts.	Act within a limited range of contexts.	Act in familiar and unfamiliar contexts.	Act in a range of varied and specific contexts, taking responsibility for the nature and quality of outputs.	Act in a range of varied and specific contexts involving creative and non-routine activities; transfer and apply technical concepts and/or knowledge to a wide variety of contexts.	Utilise diagnostic and creative skills in a range of functions in a wide variety of contexts.	Use advanced skills to conduct research on advanced technical or professional activity, accepting accountability for all related decision making, transfer and apply diagnostic and creative skills in a range of contexts.	Act in a wide and often unpredictable variety of professional levels and ill-defined contexts.	Exercise personal responsibility and largely autonomous initiative in complex and unpredictable situations. In professional or equivalent contexts.
Competence Role	Act in a limited range of roles.	Act in a range of roles under direction.	Act under direction within familiar, homogenous groups.	Act with considerable amount of responsibility and autonomy.	Exercise some initiative and independence in carrying out defined activities, join and function within multiple complex and heterogeneous groups.	Exercise substantial personal autonomy and often take responsibility for the work of others under allocation of resources; assume responsibility for multiple complex and heterogeneous groups.	Accept accountability for determining and achieving personal and/or group outcomes; take significant or supervisory responsibility for the work of others in defined areas of work.	Act effectively under guidance in a peer relationship with qualified practitioners; lead multiple, complex and heterogeneous groups.	Take significant responsibility for the work of individuals and groups; lead and initiate activity.	Communicate results of research and innovation to peers; engage in critical dialogue; lead and originate complex social processes.
Competence Learning to Learn	Learn to sequence learning tasks; learn to access and use a range of learning resources.	Learn to learn in a disciplined manner in a well-structured and supervised environment.	Learn to learn within a managed environment.	Learn to take responsibility for own learning within a supervised environment.	Learn to take responsibility for own learning within a managed environment.	Learn to evaluate own learning and identify needs within a structured learning environment; assist others in identifying learning needs.	Take initiative to identify and address learning needs and interact effectively in a learning group.	Learn to act in variable and unfamiliar learning contexts; learn to manage learning tasks independently, professionally and ethically.	Learn to self-evaluate and take responsibility for continuing academic/professional development.	Learn to critique the broader implications of applying knowledge to particular contexts.
Competence Insight	Begin to demonstrate awareness of independent role for self.	Demonstrate awareness of independent role for self.	Assume limited responsibility for consistency of self-understanding and behaviour.	Assume partial responsibility for consistency of self-understanding and behaviour.	Assume full responsibility for consistency of self-understanding and behaviour.	Express an internalised, personal world view, reflecting engagement with others.	Express an internalised, personal world view, manifesting solidarity with others.	Express a comprehensive, internalised, personal world view, manifesting solidarity with others.	Scrutinise and reflect on social norms and relationships and act to change them.	Scrutinise and reflect on social norms and relationships and lead action to change them.

Note: The outcomes at each level include those of all the lower levels in the same sub-strand.

This 10-Level grid of Level Indicators forms part of the determination of the National Framework of Qualifications under Section 7(a) of the Qualifications (Education and Training) Act, 1999



Appendix R

Research Publications

The following publications were completed throughout the course of the study:

1. Graham, B and Thomas, K (2005) An Investigation into the Development of Knowledge Management Systems within the Leading Irish Construction Companies. *In: Khosrowshahi, F (Ed.), 21st Annual ARCOM Conference, 7-9 September 2005, SOAS, University of London. Association of Researchers in Construction Management, Vol. 1, 499-508.*
2. Graham, B and Thomas, K (2006) Knowledge Management in Irish construction: the role of CPD accreditation. *In: Boyd, D (Ed.), 22nd Annual ARCOM Conference, 4-6 September 2006, Birmingham, UK. Association of Researchers in Construction Management, Vol. 2, 1015-24.*
3. Graham, B. and Thomas, K. (2007); Lessons Learned Practices: Case Study of a Leading Irish Construction Organisation, *In: Hughes, W. (ed.) Construction Management and Economics 25th Anniversary Conference, 16-18 July 2007, University of Reading.*
4. Graham, B. & Thomas, K. (2007) 'The Alignment of Continuing Professional Development with Knowledge Management in Construction Organisations' *Proceedings of the 3rd Scottish Conference for Postgraduate Researchers of the Built and Natural Environment, 20-22 November 2007, Glasgow, UK, pp. 179-189.*
5. Duffy, K., Graham, B. & Thomas, K (2007) 'Assessing the potential for Construction Collaboration Technologies (CCT) in small to medium enterprises in the Irish Construction Industry.' *Proceedings of the 23rd Annual ARCOM Conference, 3-5 September 2007, University of Ulster, Belfast. 978-09552390-1-X*
6. Graham, B., Gahan, D. & and Thomas, K. (2007) 'The application of Knowledge Management practices in the procurement and construction of cleanroom projects' *Proceedings of the 23rd Annual ARCOM Conference, 3-5 September 2007, University of Ulster. 978-09552390-1-X*
7. Graham, B. & Thomas, K. (2007) 'The development of an integrated Knowledge Management model for construction' *Proceedings of the 23rd Annual ARCOM Conference, 3-5 September 2007, University of Ulster, Belfast. 978-09552390-1-X*
8. Graham, B. & Thomas, K. (2007) 'The development and implementation of Knowledge Management for Irish construction organisations through grounded theory' *Connecting Theory & Practice, Irish Academy of Management, 10th Annual Conference, 3-5 September 2007, Queen's University, Belfast.*

9. Graham, B. & Thomas, K. (2007) 'Knowledge Management Within a Leading Irish Construction Organisation' Proceedings of the 8th European Conference on Knowledge Management, 6-7 September 2007, Consorci Escola Industrial de Barcelona, Spain.
10. Graham, B, Gahan, D and Thomas, K (2008) An action research approach to sharing specialist construction knowledge. *In: Dainty, A (Ed.), 24th Annual ARCOM Conference*, 1-3 September 2008, Cardiff, UK. Association of Researchers in Construction Management, Vol. 1, 289-98.
11. Graham, B and Thomas, K (2008) Learning from experience: aligning continuing professional development with knowledge management. *In: Dainty, A (Ed.), 24th Annual ARCOM Conference*, 1-3 September 2008, Cardiff, UK. Association of Researchers in Construction Management, Vol. 1, 319-28.
12. Graham, B. and Thomas, K. (2008); An Emerging Grounded Theory of Knowledge Management in the Leading Irish Construction Organisations, *In: Harorimana, D and Watkins, D. (eds.) Proceedings of the 9th European Conference on Knowledge Management*, 4-5 September 2008, Southampton Solent University, Southampton, UK, 225-232.
13. Graham, B. and Thomas, K. (2008); Developing professional knowledge – individual learning for organisational benefit, *In: COBRA 2008: The Construction and Building Research Conference of the RICS*, 4-5 September 2008, Dublin Institute of Technology.
14. Graham, B. and Thomas, K. (2008); Building Knowledge – Developing a Grounded Theory of Knowledge Management for Construction, *The Electronic Journal of Business Research Methods*, Vol. 6, No. 2, 115-122, available online at www.ejbrm.com
15. Graham, B., Thomas, K. and Gahan, D. (2008); Towards a framework for capturing and sharing construction project knowledge, *In: Zarli, A. and Scherer, R. (eds.), eWork and eBusiness in Architecture, Engineering and Construction, Proceedings of the 7th European Conference on Product and Process Modelling*, 10-12 September, Sophia Antipolis, France, 589-604.
16. Graham, B. (2008); Building knowledge in the construction industry – WIT and Sisk collaborate, *Research Matters*, Waterford Institute of Technology, Issue 9, p.9.
17. Gahan, D. and Graham, B. (2008); Building Knowledge, *Construction Information Quarterly*, Vol. 10, Issue 4, CIOB, pp. 179-180