Title: “THE OPERATIONALISATION OF A KNOWLEDGE ASSESSMENT FRAMEWORK ADOPTING A CASE BASED APPROACH”

Submitted to the Kemmy Business School, University of Limerick, in Fulfilment of the Requirements for the Degree of

Doctor of Philosophy
By
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Submitted to the University of Limerick, September 2012
DECLARATION

I hereby declare that this thesis is entirely my own work, except where otherwise acknowledged. It has not been submitted as an exercise for a degree at any other university or institution.

This thesis may not be lent or copied by the library for reasons of its sensitive nature and confidentiality agreements made with the participants of the research, for a minimum of three years.
ABSTRACT

The primary aim of this dissertation is to operationalise a Knowledge Assessment Framework (KAF) using two exploratory case studies. The development of a KAF is important for organisations for three reasons. Firstly, the use of knowledge assessment allows firms to pinpoint knowledge gaps. Secondly, it allows firms to manage knowledge more effectively. Thirdly, it gives organisations a diagnostic tool with which to gauge their knowledge base. The effective management of knowledge can be considered a competency that enables a greater level of service to be extracted from other resources within the organisation.

The literature in this dissertation highlights the shortcomings of the Organisation for Economic Co-operation and Development (OECD) in dealing with knowledge assessment at firm level. In addition to this, a combination of Knowledge Management and Endogenous Growth Theory are used to build a KAF for use within the case studies. The thesis itself uses an interpretivist theoretical perspective in dealing with the research question. Employing a research strategy that uses two in-depth cases, this dissertation builds a working KAF. Through methods of observation, interview and document analysis this is achieved. The results of this study highlight several points for organisations interested in understanding their knowledge base. The analysis moves beyond simply looking at the framework itself and offers some interesting insights. Within the organisations it was observed that across groups, cross-functional sharing is siloed, which leads to a lack of knowledge sharing. Some of the reasons for this, as highlighted by the framework, are that several instances of knowledge hoarding were observed. Furthermore, the knowledge networks in both organisations are informal in nature. As a result of this, coupled with the complexity of navigating the knowledge network, and instances of knowledge hoarding, employees new to the organisation find it difficult to locate knowledge. The external knowledge network is also shown to be secondary to the internal knowledge network. The results also show that the implementation of several KM initiatives is hindered because the staff do not have sufficient time. Employees regularly spend their day navigating their informal network only to complete their “actual” work at home. Furthermore, lessons learned and knowledge re-use is not given attention when project targets have to be met. Training at both organisations is very formal in nature. Due to time issues and informal network dependence, there is a lack of formal systems use, however; a problematic learning cycle is being fostered because of a reliance on formal systems training. In many instances formal training is not entirely sufficient for complex knowledge work.

This thesis makes important contributions by addressing the need for an assessment framework that deals specifically with knowledge at the organisational level. Knowledge indicators in the past have proven too broad on scope and methods have proven unsuccessful in trying to understand the complex activities that make up an organisations knowledge base. This study attempts to understand these indicators in a more in-depth way. Furthermore, it is imperative that firms in the high-technology sector encourage knowledge assessment because it is an important part of understanding the fabric of the organisation. To achieve this, however, a better understanding of the indicators of knowledge is needed. This is an area for further research.
ACKNOWLEDGEMENTS

This thesis is the product of many years of hard work and has been a rich experience for me. Without the contributions of others it may not have been possible. I would like to acknowledge the support of those who have been instrumental to the completion of my thesis.

I would like to especially thank my supervisors, Dr. Fergal McGrath and Dr. Philip O’Regan, who generously contributed their time and energy throughout the evolution of the thesis. A special thanks to Fergal who has been both a mentor and a friend.

I would like to remember Dr. Geoff Mallory, from the Open University, may he rest in peace.

I would also like to thank all my friends and colleagues in the Centre for Information and Knowledge Management and of course the Kemmy Business School itself for all the advice and support I received. I would like to thank the research participants who gave their time and energy to this study.

I would like to thank my friends over the last eight years during my undergraduate and postgraduate experience. Your support and friendship got me through more than just my thesis.

I would like to thank Sue and Royce for being there for me. Making a home in the United States would not have been possible without them. I consider myself very lucky to have met them, as you do not meet people like them just every day. The world would be a better place with more Sues and more Royces, of that, I am certain. I love them very much.

I would like to thank my wife, Hannah, for her love and support throughout this project. I would be lost without her. She’s my number one.

Last, but by no means least, I would like to thank my family, Mom and Dad, and my sister Marie for giving me a good work ethic, advice, support and probably a few euro if I ever needed it. I would like to dedicate this thesis to them.
DEDICATION

To Mom and Dad, and to Hannah
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Word count  
95,865

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<tr>
<td>AMT</td>
<td>Advanced Manufacturing Technology</td>
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<td>ASR</td>
<td>Acetabular System Replacement</td>
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<tr>
<td>CAD</td>
<td>Computer Aided Design</td>
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<td>CAM</td>
<td>Computer Aided Manufacturing</td>
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<td>CAE</td>
<td>Computer Aided Engineering</td>
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<tr>
<td>CCO</td>
<td>Configuration Change Order</td>
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<td>CPD</td>
<td>Continual Professional Development</td>
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<tr>
<td>DCOM</td>
<td>Direction, Competence, Opportunity and Motivation</td>
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<td>EGT</td>
<td>Endogenous Growth Theory</td>
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<td>E.U.</td>
<td>European Union</td>
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<td>FTE</td>
<td>Full-Time Equivalent</td>
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<td>GSC</td>
<td>Global Supply Chain</td>
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<td>HR</td>
<td>Human Resources</td>
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<td>IC</td>
<td>Intellectual Capital</td>
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<td>IDA</td>
<td>Industrial Development Authority</td>
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<td>IM</td>
<td>Information Management</td>
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<td>IMP</td>
<td>Inventory Management Project</td>
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<td>IMPA</td>
<td>International Project Management Association</td>
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<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>J&amp;J</td>
<td>Johnson &amp; Johnson (Health products &amp; pharmaceutical company)</td>
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<td>JEC</td>
<td>Job Evaluation Classification</td>
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<tr>
<td>KAF</td>
<td>Knowledge Assessment Framework</td>
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<td>KPI</td>
<td>Key Performance Indicators</td>
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<td>KM</td>
<td>Knowledge Management</td>
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<td>KMS</td>
<td>Knowledge Management System</td>
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<td>LMS</td>
<td>Learning Management System</td>
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<tr>
<td>NPD</td>
<td>New Product Development</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic and Co-operation and Development</td>
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<td>PLM</td>
<td>Product Lifecycle Management</td>
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<td>R&amp;D</td>
<td>Research and Development</td>
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<td>RAD</td>
<td>Research Audit Document</td>
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<tr>
<td>SEAI</td>
<td>Sustainable Energy Authority Ireland</td>
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<tr>
<td>TBP</td>
<td>Technology Balance of Payment</td>
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<td>TPP</td>
<td>Technological Product and Process</td>
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<td>UPK</td>
<td>User Productivity Kit</td>
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The purpose of the RAD file is to provide the complete set of data gathered during the research. This works in tangent with this thesis for the purpose of integrity, best practice and auditing and transparency. The RAD includes:

- Pilot interview transcripts
- Case interview transcripts of Creganna
- Case interview transcripts of DePuy
- Organisational documents
- Interview consent forms
CHAPTER 1: INTRODUCTION

1.0 INTRODUCTION

“Most OECD countries are increasing their investment in the knowledge base. For all reporting countries except Ireland, the ratio of investment in knowledge to GDP was higher in 2004 than in 1997” (OECD 2007a: A-1)

“Although the pace may differ all OECD economies are moving towards a knowledge-based economy” (Brinkley 2006:4)

“The term “knowledge-based economy” results from a fuller recognition of the role of knowledge...in economic growth” (OECD 1996a:9)

This dissertation aims to operationalise a Knowledge Assessment Framework (KAF) for use at the organisational level. This will be achieved by using two exploratory case studies.

As we begin the second decade of the new century, Ireland faces many challenges economically, socially and politically. One of these challenges is the ability to extract more from the knowledge economy and manage this successfully. Even with the recent launch of the E.U. research fund for industry, worth €6.4 billion (€600 million that Ireland may receive by 2013) (Examiner 2012), more needs to be done now to improve knowledge intensity. More importantly, Ireland needs to manage knowledge more effectively.

In an economy that needs to find more efficient ways of operating, a more effective way of highlighting knowledge gaps, through the development of a Knowledge Assessment Framework may prove useful. Indeed the “softer” innovations may be key; a distinctive feature of the knowledge economy, especially around the introduction of knowledge management practices (Forfás 2011a, Brinkley 2006). Before the discussion of the motivation for the research and the structure of the thesis, an explanation of the importance of assessing knowledge more effectively will be offered.
Derived from Neo-Classical Growth Theory (Marshall 1920; Domar 1947; Harrod 1948; Solow 1956), economic indicators are measures that summarise the performance of an economic system. Traditionally, the OECD has used Gross Domestic Product (GDP) as a standard measure (OECD 2006). However, traditional economic indicators have never been completely satisfactory. For example, feminists, among others, challenge GDP because it does not take into account household work; environmentalists maintain that traditional indicators do not take into account pollution or destruction of natural habitat (OECD 2006). Measuring the performance of a knowledge-based economy or a knowledge-based organisation poses a more difficult challenge. According to the OECD (2006), at the heart of the knowledge economy is knowledge itself, which may be particularly hard to quantify. However, it is possible to scrutinise certain indicators for the purpose of a knowledge assessment (OECD 2009: 1996a).

Expenditure on research and development (R&D) can be considered an investment in knowledge that translates into growth (OECD 2001a). It has been identified that Ireland needs to increase its commitment to R&D (Forfás 2011b: 52) however, Ireland’s level of R&D intensity is hindered by foundering investment in the three main macroeconomic measures: the business, higher education and government sectors (Forfás 2011a, 2006). In the private sector Ireland performed slightly better with 44.9% of enterprises involved in some form of technological innovation (Forfás 2011a: 8).

Ireland showed growth of 3.8% GDP per annum (Mankiw et al 1992) between 1960 and 1985, before the Celtic Tiger era. As Table 1.1 demonstrates on average R&D performance, which has been linked with long-term growth (Romer 1986, 1990; Aghion & Howitt 1992; Jones 1995), Ireland remains well below the average where it has been for the last two decades (Forfás 2006; OECD 2006; OECD 2001b). As a percentage of GNP, gross expenditure on R&D has improved from 1.32% in 2000 to 1.56% in 2006. A recent study in the Netherlands showed spending on R&D or intangible capital in the United States was 13% of GDP, the Netherlands was 8% of GDP, and the United Kingdom was 10% of GDP (Van Rooijen-Horsten et al 2008). Ireland also lags behind the E.U. and OECD as they show 1.77% and 2.26% of GNP respectively.
The OECD (2006) states that this lag during the past decade is due to Ireland’s over-reliance on foreign corporations as the main generator of innovation and knowledge. Indigenous research remains underdeveloped, and public funding in R&D, although having grown quickly, has not kept pace with economic output (OECD 2006). The OECD (2001b) report on growth recommends fostering innovation by increasing public R&D funding to aid our indigenous knowledge base. Van Rooijen-Horsten et al (2008) found that the realisation of the importance of assessing knowledge in the Netherlands aimed to benchmark spending on intangibles.

Though R&D performance by businesses is the largest sector of research in the economy (1.05% of Gross National Product (GNP)), we still lag behind the E.U. and OECD benchmark of 1.12% and 1.54% respectively (Forfás 2006). Only in higher education expenditure on R&D is Ireland, in line with its E.U. and OECD counterparts (Forfás 2006). This has been greatly aided by the Programme for Research in Third Level Institutions (OECD 2006). Taken as a whole, R&D intensity is too low for Ireland to be a competitive, growing knowledge economy. In 2006 we are ranked 14th of 17 in an OECD survey on economic indicators with regard to R&D intensity as a percentage of GDP (OECD 2006). In 2009 we ranked slightly better; two places higher at 12th of 17 (Forfás 2011b). Concerning R&D in indigenous local firms, we rank 15th of 17 in the same study, just ahead of Portugal and Hungary with only minor improvements in 2009. (Forfás 2011a, 2011b; OECD 2006).

Table 1.1: Ireland’s R&D Performance: E.U. and OECD Comparison

<table>
<thead>
<tr>
<th></th>
<th>% of GNP ‘00</th>
<th>% of GNP ‘06</th>
<th>‘09 Ireland</th>
<th>E.U. ‘06/09</th>
<th>OECD ‘06</th>
<th>OECD ‘09</th>
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<tr>
<td>Gross Expenditure on R&amp;D</td>
<td>1.32%</td>
<td>1.56%</td>
<td>1.77%</td>
<td>1.77%/1.9%</td>
<td>2.26%</td>
<td>2.33%</td>
</tr>
<tr>
<td>Business Sector Performed R&amp;D</td>
<td>0.94%</td>
<td>1.05%</td>
<td>1.17%</td>
<td>1.12%/1.16%</td>
<td>1.54%</td>
<td>1.62%</td>
</tr>
<tr>
<td>Higher Education Expenditure on R&amp;D</td>
<td>0.27%</td>
<td>0.40%</td>
<td>0.52%</td>
<td>In line with E.U.</td>
<td>In line with OECD</td>
<td>0.4%</td>
</tr>
<tr>
<td>Government Sector Performed R&amp;D</td>
<td>0.11%</td>
<td>0.11%</td>
<td>0.08%</td>
<td>0.24%/-</td>
<td>0.27%</td>
<td>0.32%</td>
</tr>
<tr>
<td>Total Researchers</td>
<td>4.8 per thousand</td>
<td>5.9 per thousand</td>
<td>7.7 per thousand</td>
<td>–</td>
<td>6.9 per thousand</td>
<td>8.28 per thousand</td>
</tr>
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Source: Adapted from Forfás (2011b, 2006)
For countries like Ireland that claim to be at the forefront of the smart economy (Motherway & Kennedy 2010), the balance has shifted away from traditional resources to knowledge-intensive resources. This also is true at firm level as the acquisition, sharing and reuse of knowledge is a key challenge for organisations hoping to prosper in the modern economic environment (Ichijo & Nonaka 2007; Earl 1996; Choo 1996; Velben 1898), so the development of an assessment framework for knowledge at firm-level would be very useful in an arena where no current consensus of knowledge exists (OECD 2006).

The innovative capacity of organisations is linked to their ability to combine knowledge from internal and external sources. A key challenge for firms as they grow is to be able to assess their knowledge (OECD 2002c). Firms who are able to achieve innovative transition grow through four levels. According to the OECD (2002c), these are: 1) The static firm; 2) The innovative firm; 3) The learning firm; 4) The self-generating firm. As firms transition through these key stages, key capacities are important. The OECD (2002c) recognises the role of knowledge management and the role of being able to assess ones knowledge base.

According to Allee (1997: 27) knowledge is “that which is known through experience, concepts, beliefs or information that can be communicated”. Romer (1990) states that knowledge is primarily about generating ideas and has an undeniable link with growth. A shift from the manufacturing sector to high technology-based labour that requires knowledge-intensive workers is becoming a more frequent prerequisite in successful knowledge-based organisations and smart economies. It is imperative that Ireland does not fall behind its OECD and E.U. counterparts in this shift. To fully understand why knowledge is important for Irish firms, the thesis will do two things: First, it will attempt to understand the meaning of knowledge within the context of the research. Second, it will look at knowledge and its relationship with growth as posited by Endogenous Growth Theory (EGT).

This study emphasises that our ability to assess knowledge more effectively needs to improve if we are to meet the challenge Ireland faces economically and become a more efficient knowledge economy. There needs to be a greater understanding of the indicators of knowledge at organisational level and in the economy as a whole. These
indicators can help quantify knowledge intensity and focus on developing beneficial strategies to counteract gaps in knowledge at firm and national levels.

1.1 MOTIVATION FOR STUDY

The debate persists as to the manageability and measurability of a concept such as knowledge – whether all forms of knowledge (tacit/implicit/explicit) can be managed and of the compatibility of the terms knowledge, measurement and management. In addition, research has predominantly employed case study-based research (Davenport 1998, 1997; Martiny 1998). However, studies seem to focus on general conceptual principles of Knowledge Management (KM) or and KM initiatives (Spender & Scherer 2007; Hahn & Subramani 2000). They offer few insights in the area of knowledge assessment as a means to try and assess knowledge gaps or to explain KM phenomena. A narrow focus on performing outputs deprives inquiry of self-reflection and critical scrutiny (Zining & Sheffield 2006).

Moreover, KM literature has focused on internal sources of knowledge generation and has not sufficiently taken into account the measurement of this stock internally or externally as a way of learning an organisation’s knowledge intensity. The literature, therefore, lacks a holistic view of the concept of organisational knowledge indicators and the management of them. As McAdam and McCreedy (1999: 92) state, “given the change and emergent nature of the field over the past two to three years, it is now an appropriate time to try to have a more in-depth enquiry into KM discourse to attempt to clarify how KM can be more beneficially researched and applied to organisations”.

Endogenous Growth theory (EGT) attempts to explain the link between knowledge and growth. Within this dissertation, EGT acts as support of the existence of technical change/knowledge, which is necessary for an investigation into the assessment of the item. EGT focuses on the nature of knowledge at a macro-level and also refers to national and firm systems of innovation and learning. New EGT has a deliberate organisation-focused view of knowledge where it is referred to as “the way we work”, thus technical change refers to “changes in the way we work” (Romer 1990). It attempts to clarify somewhat the lengthy arguments based on the exact nature of knowledge, as the knowledge studied is in the organisational context only and is linked to organisational performance, not society in general. The motivation for this
study rests on exploring more effective ways of assessing and managing knowledge at organisational level. This will be achieved by using KM and EGT to derive a conceptual framework and operationalise it using exploratory case studies at organisational level.

1.2 OUTLINE OF STUDY

This following section provides a synopsis of the chapters contained in this study.

1.2.1 Chapter One: Introduction

This chapter provides an introduction to the motivation for this thesis. It provides evidence that Ireland is lagging behind its European counterparts with regard to investment in knowledge. It posits that, generally, knowledge assessment at organisational level requires further exploration and posits that a KAF is worthy of investigation. It outlines the research question and presents the possible contributions. An outline of the chapters in the thesis also is presented.

1.2.2 Chapter Two: Literature Review

Chapter two outlines academic literature pertaining to the primary themes covered in this study. It begins by outlining the OECD indicators of knowledge. It then offers some criticisms of the OECD and these indicators. The chapter then discusses what is meant by knowledge in both KM and EGT literature. It then presents the conceptual KAF derived from the literature. The chapter concludes by presenting the conceptual framework itself.

1.2.3 Chapter Three: Research Methodology

This chapter outlines the research method and data collection approach for this study. It begins by describing the research location in which this study is conducted, the medical device sector in Ireland. It then outlines the research paradigms available, namely positivist and interpretivist, before discussing the study’s research methods.

Furthermore, the chapter explains the choice of exploratory case study. The exploratory case study seeks to satisfy curiosity, provide a better understanding for
general interest, examine the feasibility of further study and provide illumination on the process of a problem (Peng et al 2012, Creswell 2007; Hart 1998). The chapter then discusses the data collection methods employed in the research. As in-depth interviews, observation and document analysis were used, these items will be discussed. The limitations of the research also are outlined.

1.2.4 Chapter Four: Case Studies
Chapter Four presents the Creganna case study. This provides in-depth context pertaining scenarios and experiences observed at Creganna.

1.2.5 Chapter Five: Case Studies
Chapter Five presents the DePuy case study. This provides in-depth context pertaining scenarios and experiences observed at DePuy.

1.2.6 Chapter Six: Analysis and Findings
Chapter Six uses the framework to analyse the case studies. The chapter draws on the exploratory case studies to answer the research question and research objectives posed at the beginning of this thesis and to present the research findings.

1.2.7 Chapter Seven: Concluding Remarks
This chapter presents the study’s implications and conclusions. It also develops research recommendations for future work. Theoretical, empirical and practical contributions of the research also are presented. The limitations of the study are discussed while also highlighting the limitations of the KAF.

1.3 RESEARCH QUESTION, AIMS AND CONTRIBUTION
This section will outline the proposed research question. Furthermore, some of the contributions of the research will be discussed.
1.3.1 Research Question, Aims and Objectives

The central research question centres on the following:

What is the usefulness of a Knowledge Assessment Framework derived from OECD macro indicators using KM and EGT?

To answer the above question an exploration of many key areas is needed. In that regard Table 1.2 states the key research aims and highlights in the thesis, where these objectives have been addressed in more detail.

Table 1.2 Research Objectives

<table>
<thead>
<tr>
<th>Research Objectives</th>
<th>Literature to Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>To explore knowledge acquisition activities at organisational level</td>
<td>Chp 2; section 2.2.3.2, Chp 6; section 6.2.2, 6.2.4, 6.2.6</td>
</tr>
<tr>
<td>To explore knowledge sharing activities at organisational level</td>
<td>Chp 2; section 2.2.3.3, Chp 6; section 6.2.1, 6.2.3, 6.2.8</td>
</tr>
<tr>
<td>To explore knowledge learning at organisational level</td>
<td>Chp 2; section 2.3.3.1, Chp 6; section 6.2.5</td>
</tr>
<tr>
<td>To explore knowledge re-use activities at organisational level</td>
<td>Chp 2; section 2.2.3.4, Chp 6; section 6.2.4, 6.2.6</td>
</tr>
<tr>
<td>Develop a knowledge assessment framework with accompanying research probes</td>
<td>Chp 2; section 2.3.5, Chp 6; Figure 6.1, Chp 7; Table 7.2, Figure 7.1</td>
</tr>
<tr>
<td>Explore the nature of knowledge at organisational level</td>
<td>Chp 7; section 7.1</td>
</tr>
<tr>
<td>Unearth avenues for future research opportunities</td>
<td>Chp 7; section 7.4, 7.4.1</td>
</tr>
</tbody>
</table>

1.3.2 Contribution

This section will discuss the expected contributions of the study. This will be broken down into theoretical, methodological and practitioner contributions.

1.3.2.1 Theoretical

The main focus of the research is the operationalisation of a KAF and its exploration at organisational level. The research will make a positive contribution to the disciplinary area at the theoretical level. The study will use the findings from the
framework to best inform areas of EGT and KM while also aiming to offer new ways of looking at knowledge indicators. The combination of both EGT and KM literature is a conceptual departure that is relatively unexplored for the disciplines, despite both areas involving the concept of knowledge (Romer 1986, 1990; Polanyi 1966). In using the theoretical perspective of EGT, the research brings to KM a concrete theoretical base. The research will further our knowledge of KM by extending the understanding of knowledge assessment under that umbrella. The study’s focus is on knowledge assessment at organisational level, and also is an exploratory departure for KM-based research in Ireland (Moffett & Humphreys 2012, OECD 2006, 1996a; Lev & Daum 2003; Wagner & Sternberg 1991), which will progress the understanding of manageable and measurable forms of knowledge. The research will contribute to KM literature as it offers critical analysis of the literature and, in doing so, reveals both ongoing debates within the literature and inconsistencies regarding the definition and conceptualisation of knowledge and the characteristics of manageable knowledge. A critical analysis of the literature confirms inconsistencies relating to the conceptual and definitional issues surrounding knowledge. The research findings will highlight how organisations create and share knowledge and will give the researcher an opportunity to obtain some indicators of knowledge, or at least a better understanding of the indicators. It is proposed that the identification and operationalisation of the indicators of knowledge within the case firms will offer a deeper understanding of assessment at organisational level.

1.3.2.2 Methodological

The methodological contribution of this research is in its adoption of a case study approach. An in-depth interview approach; which dominates qualitative case study-based research found in KM literature (Peng et al 2012, Davenport 1997, 1998; Martiny 1998), will be employed. KM is considered to be a “soft” and often “abstract” discipline (Fitzgerald and Howcroft 1998; Allee 1997). The application of the qualitative approach to answer criticisms of OECD approaches will allow for an in-depth study of knowledge assessment at organisational level. The idea of multi-method or triangulation in KM research is not new (Campbell & Fiske, 1959; Jick 1979; McGrath 1982). Reports of mixed-methods research in literature on management are rare (Scandura & Williams 2000). Multi-Method or triangulation-
based studies, which incorporate quantitative elements, could act as a support to the qualitative-based case studies, which can be offered to organisations as evidence for supporting the implementation of KM initiatives after the knowledge assessment. However, in this research the qualitative approach taken will deepen understanding of the different indicators and activities within the KAF. This, coupled with previous qualitative work, will provide a richer, analytical and empirical base for KM initiatives within companies. Also the development of research probes for future research in this area will prove useful. In future research, quantitative methods, by their nature, could aid in new studies and facilitate replication (Peng et al 2012, Gill & Johnson 1997) among other organisations.

1.3.2.3 Practitioner

The research will contribute at a practitioner level. One of the outputs of the research will be more effective KM insights that can lead to better strategies and practices for organisations. It is important that firms are aware of the importance and significance of knowledge assessment at firm level. In addition, organisations will have an opportunity to improve their understanding of their knowledge base and in turn their best practice when managing knowledge. They will be able to identify where in the organisational structure knowledge is performing poorly and develop strategies to enhance their strengths and counter weaknesses. Reports will be presented to both companies used as case studies following the analysis of the data gathered.

1.4 CONCLUSION

This chapter introduced the importance of investment in knowledge and the creation of a knowledge economy. The chapter also sets the scene in Ireland today, giving the research a sense of urgency as Ireland lags behind the E.U. and OECD with regard to knowledge intensity. The chapter then set out the motivation for this study and described the context within which it was carried out. It also outlined the structure under which the research will be presented and gave an overview of subsequent chapters. Finally, the chapter presented the research question and the potential contributions of the research. The next chapter will provide a comprehensive review of academic literature pertaining to the main theoretical areas covered in this study including KM and EGT. It will also develop the conceptual KAF.
CHAPTER 2: LITERATURE REVIEW

2.0 INTRODUCTION

This chapter presents the knowledge indicators proposed by the OECD. It highlights the need to improve upon these indicators. KM and EGT will be explored, focusing on the knowledge-based indicators that will be used in the KAF. Finally, a KAF, which is derived from the literature, will be presented.

In 2005 the Economic and Social Research Council in the UK defined the knowledge economy as “economic success is increasingly based on the effective utilisation of intangible assets such as knowledge, skills and innovative potential as the key resource for competitive advantage. The term “knowledge economy” is used to describe this emerging economic structure” (Brinkley 2006:4).

Within this review, it is argued that with the emergence of the knowledge economy, paralleled with the increasing importance of KM and innovation strategy (Forfás 2011a, 2011b, Motherway & Kennedy 2010), it is critical that we examine knowledge assessment at organisational level. A sustained attempt to understand the concept of knowledge assessment or to develop strategies to aid in knowledge assessment has not been generally explored at the firm level (Moffett & Hinds 2010, OECD 2006; 1996a; Lev & Daum 2003). Consequently, it has been claimed that many knowledge-intensive firms may be unable to proactively identify, measure and manage their stock of knowledge, or even determine their knowledge base (OECD 2006; 1996a; Nonaka 2007).

In Table 2.1, a map of the literature (layout adapted from Hart 1998) is presented for the purpose of clarity. The theories cited will be presented, with their purposes also shown. Finally, some of the gaps observed within the literature will be highlighted.
Table 2.1: Literature Map and Purpose

<table>
<thead>
<tr>
<th>Literature</th>
<th>Purpose</th>
<th>Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD</td>
<td>1. Provides empirical evidence as to the importance of knowledge as a driver for growth 2. Provides for quantitative metrics/indicators for knowledge for the macro environment 3. Calls for “field study” based enquiry into the phenomenon of at organisation level</td>
<td>1. Does not provide insight/understanding for the many indicators of knowledge 2. Calls for case study-based qualitative work to be carried out 3. Does not provide a clear firm-level methodology for the assessment of knowledge</td>
</tr>
<tr>
<td>1. Managing 2. Measuring 3. Creating</td>
<td>1. Provides the body of work on the core phenomenon under investigation 2. Provides for the distinction between the different types of knowledge (explicit/implicit/tacit) 3. Provides for the different approaches to KM</td>
<td>1. Does not provide strong links between knowledge and growth 2. Lack of consensus about knowledge at organisation level</td>
</tr>
<tr>
<td>KM</td>
<td>1. Invention 2. Learning-By-Doing 3. Hybrid Model 4. Critiques</td>
<td>1. Provides for the existence of knowledge as internal to the system 2. Provides for the study of knowledge in the macro environment 3. Understanding of the links between knowledge and learning-by-doing</td>
</tr>
<tr>
<td>EG</td>
<td>1. Provides for the existence of knowledge as internal to the system 2. Provides for the study of knowledge in the macro environment 3. Understanding of the links between knowledge and learning-by-doing</td>
<td>1. Does not provide insight/understanding for the many indicators of knowledge 2. Calls for case study-based qualitative work to be carried out 3. Does not provide a clear firm-level methodology for the assessment of knowledge</td>
</tr>
</tbody>
</table>

Source: Adapted from Hart (1998)

2.1 KNOWLEDGE INDICATORS

As highlighted by the OECD (2006) and Lev and Daum (2003), there is no control, census or assessment framework to give an understanding or to gauge knowledge at organisational level. The OECD has developed macro-level indicators; however, these on their own, are not sufficient enough to explain complex knowledge activities at firm-level. In addition, a consistent picture of knowledge can only be achieved by combining several indicators (Kurtossy 2004; Sirilli 1992; Grupp 1990).

The OECD has recognised the importance of knowledge assessment and that organisations are now more strongly dependent on the production, distribution and use of knowledge than ever before. It is also recognised that in order to facilitate any kind of knowledge assessment, distinctions have to be made between different types of knowledge (know what, know who, know why, know how) that are important to the knowledge-based organisation (OECD 2006; 1996a). KM is useful in this regard. In 2004 the OECD’s study on the significance of KM suggested that KM practices are being used more frequently, but it also recognises the association between such practices and innovation and productivity, even if the link is not that well understood (Brinkley 2006).

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1 See full list of quantitative OECD science and technology indicators in Appendix C
There is consensus within the literature that accepts knowledge can be assessed indirectly, using impact indicators that the OECD (2006, 2002b, 1996a) has suggested (Kurtossy 2004). The indicators presented by the OECD are, however, aimed at the macro-level of evaluation and based upon higher-level knowledge performance.

In Chapter One the importance of knowledge in the modern economy was established (Forfás 2011a). The OECD (2006, 1996a) has suggested along with writers in other disciplines (Moffett & Hinds 2010, Lev and Daum 2003; Wagner & Sternberg 1991), that there is no company knowledge record, census, or assessment instrument that can gauge knowledge at the organisational level. In the absence of such a tool the OECD has presented certain indicators for knowledge. These indicators do not necessarily enable an organisation to provide or account for an organisational knowledge base; however, they do create a starting point with which to build upon.

Indeed as during the mid-90s (OECD 1996a), it was established that there were several key reasons why knowledge indicators, no matter how carefully constructed, could not approximate the traditional quantifiable economic indicators. These reasons are:

- There is no stable formulae or recipe for translating inputs into knowledge creation into outputs of knowledge
- Inputs into knowledge creation are difficult to map
- Organisations lack systems that can serve as a basis for aggregating pieces of knowledge that are essentially unique
- The obsolescence of knowledge is not documented, therefore the creation of new knowledge is not documented

The OECD suggests in its various reports that only through improved understanding of knowledge indicators can the knowledge-based economy and the knowledge-based organisation truly benefit. The indicators are:

- Knowledge Inputs
- Knowledge Stocks
- Knowledge Networks
- Knowledge Learning
2.1.1 Knowledge Inputs

The first use of the noun “input” was in 1753, meaning “a sum, a contribution”. J.D. Black introduced the term to economics in 1926, to mean the total resources necessary for production. In 1948 its meaning expanded to include data or programme instructions, and in 1954 it expanded to include the psychological meaning of input in the “resources of mental and sensory stimuli available to an individual” (Chartrand 2005). Standardised OECD indicators of inputs into knowledge are:

2. Technical personnel such as engineer and R&D personnel: Again suggested in the Frascati Manual (OECD 1993)

The first attempt at deploying these indicators came in 1999 when the OECD deployed a scoreboard of indicators which did not prove useful and was too broad in nature to deal with assessment at the firm-level (Godin 2004). Again despite the significant advances in data collection methods (OECD 2009), these traditional indicators have a number of shortcomings with respect to mapping and understanding in-depth complex knowledge work as organisations grow (OECD 2004). The OECD take an accounting type of approach to assessing knowledge whereas it has been suggested that knowledge is inherently social and embedded in terminology, procedures and people (Wright 1999). The criticisms of the OECD indicators will be discussed in section 2.1.6.
2.1.2 Knowledge Stocks

A stock can be defined as a supply of goods kept on hand for sale to customers by a merchant, distributor or manufacturer, for example an inventory. With traditional economic indicators, the transmission of goods and services from one individual or organisation to another involves transfer of money, which provides a “tracer”. On the other hand, most knowledge stocks do not often involve money so no tracers exist (OECD 1996a). It is, however, much easier to assess inputs into the creation of knowledge than knowledge stocks or even related flows (OECD 2006, 2002a, 1996a).

Some of the measures presented by the various OECD reports to calculate stocks of knowledge are amortised annual R&D, stocks of R&D personnel, and diffusion of embodied and disembodied technology (OECD 2001, 1996a). These quantitative measures are broad, however, and hamper their application in specific organisations (Comin & Mulani, 2009).

Research suggests that measuring the stock of knowledge is not precise as “it is apparent that this is far from being a crystal clear concept” (Steedman 2001:2). Growth theory asks whether knowledge is a homogeneous quantity of which there is simply more or less of. Authors such as Steedman argue that it is not possible to quantify knowledge as a stock (Steedman 2001) and ask how then it is possible to construct a measure for the “stock” of knowledge. In Arrow’s (1962) paper he refers to a variable so difficult to measure as the quantity of knowledge. He, therefore, did not make any amount of knowledge a central variable in his analysis. Instead he posits that a stock of knowledge may be positively related to the acquisition of knowledge. For the purpose of the KAF, this research will focus on the acquisition of knowledge.

Even if knowledge is or could be rendered homogeneous, Steedman (2001) posits that there exists no cardinal measure for a single stock of knowledge. He goes onto argue that throughout the literature, not just common to EGT, that a stock of knowledge is treated as if it comes with a cardinal measure without any justification given for this dubious assumption. Since there are no indicators available, this research will not use knowledge stocks going forward. For the framework to be able to use knowledge stocks, “markers” of knowledge would be needed to track its diffusion (Gault 2005).
2.1.3 Knowledge Networks

A network is defined as an association of individuals having a common interest, formed to provide mutual assistance or helpful information, for example, a network of recent college graduates. In information technology, a network is a series of points or nodes interconnected by communication paths. Networks can interconnect with other networks and contain sub-networks (Harbeck 2006).

This is very similar in structure to what a knowledge network is. Instead people are interconnected on nodes with similar ideas and goals. A knowledge network, in the field of KM and organisational learning, has the practical problem of transferring knowledge from one part of the organisation. How does the organisation effectively use the vehicle of the knowledge network to facilitate the exchange of technology and commercial information through sharing (Miller et al 2011, OECD 2005, 1996b, 1992)?

The OECD has suggested that current indicators for knowledge networks are not adequate to describe the dynamic system of knowledge distribution and sharing which is at the heart of the knowledge-based organisation (OECD 1996a). The current knowledge indicators for knowledge networks are codified knowledge flows which are not adequate to describe the dynamic system of knowledge distribution.

The OECD carried out research between 1994 and 2001 that produced several reports that examined flows and forms of transactions within knowledge networks in organisations, among them; clusters, networks and mobility of personnel (Godin 2004). The programme did not have the expected impact, however, and the OECD (2002c) admitted that their approach to assessing knowledge networks had “little operational value and difficult to implement” (OECD 2002c:11).

It is very important for organisations to develop strategic knowledge and competence. It is important that these are developed interactively and shared within groups and across knowledge networks. The organisation becomes a hierarchy of networks, driven by the acceleration in the rate of learning and knowledge acquisition (OECD 1996a). Flows of more tacit forms of knowledge, such as informal networks depend on conversation, demonstration and observation. These forms of knowledge cannot
effectively be understood or traced using the indicators being employed by the OECD. New indicators are needed or at least new ways of understanding these phenomena and the process and distribution of knowledge among key actors within these organisations (OECD 1996a). It only is recently that both scholars and practitioners alike have shown an increasing interest in networks due to their ability to serve as vital conduits for knowledge flows. The mobilisation of networks, intra-organisational or otherwise, can help with knowledge that is largely tacit (Miller et al 2011, Hislop 2000).

2.1.4 Knowledge Learning

Learning is essential to any of the activities of knowledge generation, transmission and use, and is not just the learning of an individual, but of the team and the institution (Gault 2005). Zach (2005) argues that the new driving competitive strategy is “work smarter not harder”, but access to information does not make the person know something. Sense must be made of the information. Where innovation can be described as the creation and exploitation of new ideas from pre-existing knowledge (a latent construct representing the potential form generating novel actions), learning can be described as the acquisition and retention of existing knowledge through experience with the external environment (Haragadon & Fanelli 2002) or as acquiring knowledge by systematic study in any field of scholarly application or the act or process of acquiring knowledge or skill. According to the learning literature the process of learning or the converting of an organisation’s experience into possibilities for future action is vitally important (Haragadon and Fanelli 2002). It is in other words what the organisation knows how to do or learning by sharing (Peng et al 2012). The OECD suggests that micro-level firm indicators on human resource requirements are needed to better match supply and demand for certain skill-sets.

The learning process is more than just acquiring formal education. In the knowledge-based organisation “learning-by-doing” is paramount (Arrow 1962). A fundamental aspect of learning is the transformation of tacit into codified knowledge and the movement back to practice where new kinds of tacit knowledge is developed. Training and learning in non-formal settings is increasingly possible due to information technologies and increasingly more common (Hansen et al 1999). Firms
face the need to become learning organisations, continuously adapting management, organisation and skills to accommodate new technologies. They are also joined in networks, where interactive learning involving producers and users in experimentation and exchange of information is the driver of innovation (OECD 1996a).

The OECD (2004:1) suggests that evidence shows that organisations are increasingly paying attention to their systems of knowledge management to “ensure that they are capturing, sharing and using productive knowledge within their organisations to enhance learning and improve performance” The most important forms of learning may be regarded as the interactive forms of learning (Godin 2004). While information technologies may be moving the border between tacit and codified knowledge, they are also increasing the importance of acquiring a range of skills or types of knowledge. The OECD (2002c) suggests that the accumulation of tacit knowledge needed to derive benefit from knowledge codified through information technologies can only be done through learning.

In building his endogenous theory, Arrow (1962) posits that learning is produced from experience and only can take place as part of an activity-focused attempt to problem solve. With the advent of the knowledge economy, questions arise about the efficiency and effects of education and training in what must also be a “learning economy”. Improvements in education can cause improvements in economic and firm outcomes and almost certainly have a causal role that is positive (Romer 1989). Romer (1989) argues our knowledge is still imprecise and previous analyses may have missed that education has fostered growth. Traditionally, economists measured the development of human capital in terms of years in education or experience. Measures do not then reflect the quality of education or learning nor the economic returns to investment in education and training.

Organisational knowledge comes from the experience of its members, including observations of others, memories, routines and processes; therefore effective learning is critical for future knowledge creation.
2.1.5 Knowledge Outputs

The term “output” appeared for the first time in 1858 as a technical term in British iron works and coal mines (Chartrand 2005) and did not take its economic meaning of “the act or fact of putting or turning out; production; the quantity or amount produced; the product of any industry or exertion” until after 1880 (Chartrand 2005).

Only rough indicators have been developed which translate into knowledge outputs in order to describe and compare the economic performance of countries (OECD 1999, 1996a, 1996b), but there is even less available at firm-level. These measures tend to categorise work groups, sectors or parts of the organisation as more or less intensive in knowledge creation, acquisition, sharing and re-use, and are based on the assumption that certain knowledge-intensive sections play a key role in the production of spillover benefits for the rest of the organisation. These measures also tend to generate tangible returns from projects.

Knowledge outputs such as R&D intensity are confined to manufacturing sectors and have not been developed for the fast-growing service portion of OECD economies (OECD 1999, 1996a, 1996b). Indicators are needed which capture the impacts of progress within the organisation. Other quantitative indicators for knowledge outputs at firm-level are the number of new-to-market products, the number of scientific and engineering publications, publications per euro of R&D spending, and patents granted to firms (OECD 2006, 2007, 2002).

2.1.6 OECD Recommendations

The OECD has made several recommendations with regard to knowledge assessment. The primary conclusion the OECD makes is that the present understanding of what is happening in knowledge organisations is constrained by the extent and quality of the available indicators (OECD 2007a; 1996a). It is also suggested that while advances are being made in theories and methodologies, these will not be fruitful unless they are applied to the right data. The OECD (2002a) advised that more qualitative work is needed in the form of case studies and field studies to produce the “right data”. Indeed traditional frameworks were designed in an era when organisations and economies were simpler and the role of knowledge was not fully acknowledged (OECD 1996a).
As a result “this measurement framework is not offering reasonable explanations” and “the effects of networks, the role of tacit learning...are among the phenomena which presently elude us” (OECD 1996a:43). To fill these gaps research is needed that must improve, extend and provide new knowledge indicators. The OECD (2002:85) calls for “the development of relevant indicators”. A clearer picture of knowledge at organisational level must be achieved. Due to the central role of learning in organisations it is also recommended that there is a need for new indicators for learning.

2.1.7 Criticisms of the OECD Approach

Intangibles, by nature, are difficult to measure. The primary criticism of the OECD’s indicators is not the indicators themselves, but that they are based primarily around broad “fuzzy” macro terminology and that they are predominantly quantitative in nature, without taking into consideration other more suitable approaches to knowledge assessment (Brinkley 2006; Godin 2004:18). The problem in developing these knowledge indicators is in itself an indication of the unique character of the knowledge-based economy. Firms need to escape the conventional concepts and measures used to track knowledge phenomena. They need to do this to fully understand their knowledge base. One of the primary justifications for this research is that the OECD has acknowledged this and has suggested that these quantitative statistics are not enough on their own (OECD 2002a). It has become increasingly clear that indicators such as knowledge inputs need to be examined within the realm of a more qualitative-based approach (OECD 2002a). The effects of knowledge on the business cannot be determined exclusively by financial assessment linked to a pyramid of ratios (Prieto and Revilla 2005).

Only field studies provide unlimited access to accounts of personal experience (Zinning & Sheffield 2006). Quantitative methods are not always applicable to all research questions (Karami et al 2006). Qualitative research provides valuable insights and understanding of the problem setting (Zining & Sheffield 2006; Karami et al 2006), and this research presents “consistent definitions, discourses and concepts” that are needed in KM research (Zining & Sheffield 2006: 1)
A significant obstacle to adequate intellectual capital or knowledge assessment is that many firms create enormous amounts of indices that are difficult to maintain and update. By utilising knowledge indicators derived from the OECD and operationalising them using KM and Endogenous Growth models, the framework presented in this dissertation will be used as a foundation for future studies. A 2007 report on the worldwide use of 25 management tools, by consultants Bain and Company (Burton-Jones 2008:4), claimed that, based on usage, “knowledge management tools”, defined as “systems and processes to capture and share”, have moved up from 21st place in 1996 to 8th place in 2006, ahead of tools such as the balanced scorecard. Paradoxically, the same report claims these tools were rated by users as being among the least effective (Burton-Jones 2008). Covin and Stivers (1998) found that while 63% of CEOs believe intangible measurement is important, only 10% were utilising the results for the formulation of strategy. This may mean firms are developing the wrong indicators. It is one of the researcher’s objectives to identify the appropriate indicators and constructs of knowledge and focus on these throughout the case studies. Research found Irish firms (Burton-Jones 2008; Brennan 2001) are making little progress in actually understanding or assessing intangibles such as knowledge, and when these assets are referred to in annual reports it is with no great depth or clarity. This is complemented by an OECD (2006) report that finds there is no current indicator or framework for knowledge at organisational level.

A further criticism of the OECD approach to knowledge assessment is the oversimplification and broad use of terms (Brinkley 2006). The OECD suggests three broad ways in which knowledge can be assessed. They suggest that organisations must:

- **Enhance knowledge diffusion**: Support to innovation will need to be expanded from mission-orientated projects to diffusion orientated programmes. Frameworks or firm collaborations and knowledge diffusion are needed to enhance knowledge infrastructures within organisations.

- **Upgrade human capital**: Strategies are needed to promote broad access to skills and competencies and especially the capability to learn. This includes providing broad based formal education, establishing incentives for firms and individuals to engage in training and life-long learning.
• **Promote organisational change**: firm-level organisational changes to increase flexibility, particularly relating to work arrangements, networking, multi-skilling of the labour force and decentralisation. Governments can provide the conditions and enabling infrastructures for these changes through appropriate financial, competition, information and other policies.

The issue with these strategies is that if you present these to a manager in an organisation there is very little they can practically do with them. Traditional statistics and indicators based on input and activity data still dominate the OECD measurement methods, but above all the concept of knowledge (Godin 2004). “It may also be that the links between innovation, competitiveness and conventional productivity measures are not well understood in services and even less so in knowledge based services” (Brinkley 2006:7). There have been some efforts in new fields (mobility and personnel) to account for the nature of knowledge, however, nothing fruitful and according to Brinkley (2006), Godin (2004) there has been far less if any work on the central characteristics of the knowledge indicators for the supposed knowledge based economy. Indeed, “the major innovation remains simply the collection of several indicators from different sources under a new label” (Godin 2004:21).

The primary conceptual work carried out on knowledge assessment has to do with the collection and development of indicators under the umbrella of the knowledge-based economy (Godin 2004). Evidence documenting the trends in the knowledge-based economy are in fact anecdotal. This is a damming inditement of the OECD’s knowledge indicators. Godin (2004) describes these indicators as synthetic and attractive that generalise using statistics, but without delving into any meaningful understanding.

The aim of this dissertation is to provide a tool that can be used at organisational level and give a more in-depth understanding of knowledge assessment that traditional measures cannot explore. In figure 2.1 below, the synthesis of the KAF to this point is presented. The aim of the subsequent sections is to build and add to the KAF, using KM and EGT literature. This KAF is then be taken and deployed at organisational level within the case studies.
2.2 KNOWLEDGE MANAGEMENT

This section presents and reviews the definitional characteristics of KM and identifies knowledge indicators within KM that will be used in the KAF. KM is used because it provides for the distinction between the different types of knowledge and in addition to this, offers some different approaches to knowledge management at firm-level. This chapter also presents some of the current perspectives relating to knowledge, such as dimensions (explicit versus tacit) and knowing. This discussion is not meant to be exhaustive of the perspectives relating to knowledge, but rather offer an initial understanding of these perspectives as related to the purpose of this thesis. This is followed by a discussion of EGT and the identification of indicators used in the framework. The chapter will conclude by presenting the KAF.

KM, since the early 1990s, has established itself among practitioners and academics as an area of study for ensuring organisational competitiveness and, ultimately, longevity. U.S. spending alone on KM initiatives grew by 16%, to account for $73 billion in 2007, according to a report by AMR research (McGreevy 2007). As a
discipline, however, KM shows immaturity. A plethora of definitions for the term Knowledge Management exist with the only consensus seeming to be that it refers to organisational knowledge and ultimately leads to organisational competitiveness. The OECD recognises that “knowledge management practices seem to have a far from negligible effect on innovation and other aspects of corporate performance. But there is little systematic evidence of just how great an effect knowledge management has. Among the various categories of knowledge-related investments...knowledge management is one of the areas about which little is known in terms of quality, quantity, costs and economic returns” (OECD 2004:1). Table 2.2 offers some definitions of KM.

### Table 2.2: Definitions of Knowledge Management

<table>
<thead>
<tr>
<th>Author</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Productivity Centre</td>
<td>The broad process of locating, organising, transferring and using the information and expertise within an organisation. The overall KM process is supported by four key enablers: leadership, culture, technology and measurement.</td>
</tr>
<tr>
<td>Malhorta (1998)</td>
<td>KM caters to the critical issues of organisational adaption, survival and competence in the face of increasingly discontinuous environmental change. Essentially, it embodies organisational processes that seek synergistic combinations of data, information processing capacity of information technologies, and the creative and innovative capacity of human beings.</td>
</tr>
<tr>
<td>Dimattia &amp; Oder (2000)</td>
<td>KM involves blending a company’s internal and external information and turning it into actionable knowledge via a technology platform.</td>
</tr>
<tr>
<td>Alvesson &amp; Karreman (2001)</td>
<td>The idea of KM has been paved by organisational analysis through organisational learning and organisational culture. There is a division between those interested in technology, and those emphasizing the “people” side of KM. It encompasses any process and practices concerned with the creation, acquisition, capture, sharing and use of knowledge, skills and expertise.</td>
</tr>
</tbody>
</table>

KM, as a discipline, has been somewhat limited in its attempts to comprehend its underlying and fundamental concepts; in essence, it is striving to manage what it does not fully understand. Some authors in the area who have studied the concept of knowledge and management have realised that the terms are indeed mismatched (Alvesson & Karreman 2001; Malhorta 2002; Wilson 2002) or have been too broadly used (Ruggles 1998; Wilson 2002). What is needed is a classification of the types of knowledge that, firstly, can be managed and, secondly, impact on organisational
performance and even classification of the types of KM. Researchers seem to have difficulties in defining what KM or knowledge is and “black box” the issue (Moffett & Hinds 2010; Lloria 2008; Alvesson & Karreman 2001). Writing in the area of KM comes from both academic and practitioner sources with some seeing the field as one driven by consultancy companies rather than academic research in which there is a disconnect between the theory and practice (Wilson 2002). Each needs to inform the other sufficiently. The field of KM does however, originate from a worthy base – an economically fuelled recognition of the growing importance of knowledge as an input to the organisation when compared to the traditional material inputs “as free natural resources and cheap labour are exhausted, the last untapped source of competitive advantage is the knowledge of people in organisations” (Davenport 1997: 191).

To date, KM has predominantly focused on the existence and importance of knowledge internal to the organisation as evident from KM definitions. “KM has been defined as the process of identifying/creating, capturing and applying organisational knowledge to exploit new opportunities and enhance organisational performance” (Bassi 1997). Research in the area of KM has tended to focus on knowledge workers (Drucker 1959), knowledge organisations (Sveiby & Risling 1986), and knowledge creation and sharing (Nonaka 1991, 1995, 1998, 2007) within these organisations. Research, such as Matusik (2002) and Appleyard (1966), attempted to create a typology of knowledge external to the organisation, although increasingly, research has showed that knowledge is dispersed outside the firm’s boundaries and among other companies, customers, suppliers, universities, national labs, industry consortia, start-up firms and individual minds (Chesbrough 2003).

Given the importance of knowledge in all areas of daily and commercial life, it stands to reason that organisational knowledge, both internal and external, should become part of any organisation’s KM strategy. As Ruggles (1998: 80) states, KM; “is more than just a sales pitch. It is an approach to adding or creating value by more actively leveraging the know-how, experience and judgement resident within, and in many cases, outside of an organisation”. Other important aspects of KM that are worth noting are absorptive capacity (Cohen & Levinthal 1990), interorganisational relations (Doz & Hamal 1998), and resource-dependency theory (Pfeffer & Salancik 2003). These aspects also should be acknowledged for their perspectives on internal and
external organisational knowledge.

### 2.2.1 Dimensions of Knowledge

As the KAF will attempt to explore knowledge at organisational level it is worthwhile then to explore the dimensions of knowledge. Since its connection with the organisational learning literature, research in knowledge has continued to grow. In the KM literature, researchers have tended to focus their discussions on two dimensions of knowledge: the tacit/explicit dimension and the individual collective or group dimension (Cook & Brown 1999). Spender (1996a) argues the best way to comprehend the concept of knowledge is to understand the different types of knowledge. The various definitions of knowledge offered, point to the existence of two basic kinds of knowledge (see Table 2.3 also).

1. That which is internal to the person (embodied) (Nickols 2000) or practical skills, encultured knowledge as argued by Alvesson and Karreman (2001).
2. That which has been articulated (disembodied) (Nickols 2000).

#### Table 2.3: Some Definitions of Knowledge

<table>
<thead>
<tr>
<th>Plato</th>
<th>Allee (1997: 27)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Knowledge is experience, concepts, beliefs or information that can be communicated and shared.</td>
</tr>
<tr>
<td>Davenport &amp; Prusak</td>
<td>(1998: 5)</td>
</tr>
<tr>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>Joai (2000: 69)</td>
<td>Knowledge is linked to the capacity for action (Sveiby 1997). This is intuitive, and therefore hard to define. It is linked to the user’s values and expertise, being strongly connected to pattern recognition, analogies and implicit rules.</td>
</tr>
</tbody>
</table>

The variety of terms is a problem that Alvesson and Karreman (2001) dub the “relabeling effect”. The tacit/explicit dimension was one of the first distinctions of knowledge to be made in organisational literature. The distinction has its roots in the work by the philosopher Ryle (1949: 25). He distinguishes between the “knowing that” of theory and the “knowing how” of practice. Polanyi (1962: 56) further expanded on this to discuss the two inseparable aspects of knowledge: “knowing what” and “knowing how”. Based on Polanyi’s work, Nelson & Winter (1982)
introduced this tacit/explicit distinction into the organisational literature when they defined tacit knowledge as “knowledge that cannot be articulated”. Tacit knowledge has a personal quality and is deeply embedded in action and context, making it difficult to formalise and communicate. Kogut & Zander (1992), who discussed information and know-how, state that information is defined as knowledge that can be transmitted without loss of integrity. One of the syntactical rules for deciphering are known, while know-how is based upon Von Hippel’s (1988: 76) definition, “know-how is the accumulated practical skill or expertise that allows one to do something smoothly and efficiently”. Explicit knowledge is that which has been codified and refers to knowledge that can be transmitted in formal, systematic language.

In 1962, Arrow offered an explanation of tacit knowledge as knowledge which is not easily captured in transferable form, but is acquired through observation or interaction, or simply learning-by-doing. In 1994, Von Hippel added to this idea that as the holder of tacit knowledge is unaware of or unable to express what they are doing, tacit knowledge tends to be sticky, and therefore is best transferred through direct experience. Both Arrow (1962) and Von Hippel (1994) are seen to echo Polanyi by referring to a master-apprentice relationship similar to mentoring in organisations, while Gertler (2001) argues tacit knowledge can be transferred both internally and externally through communities of practice. Polanyi (1966, 1969) posits that knowledge exists on a continuum ranging from tacit to explicit. By his definition, tacit knowledge is knowledge that cannot be articulated. As Polanyi (1966: 4) states “we know much more than we can tell”. Polanyi uses the example of the bicycle to describe the difference between tacit and explicit knowledge (Cook & Brown 1999). He posits that tacit and explicit are forms of knowledge at each end of the continuum. Each form of knowledge can often be used as an aide in acquiring the other; however, neither tacit nor explicit knowledge can be used solely to acquire the other. Explicit knowledge cannot by itself enable one to ride a bicycle, and it does not by itself enable a rider to decide which way to turn (Cook & Brown 1999). Polanyi also offers the example of a person’s ability to recognise a familiar face in a crowd as testament to the nature of tacit knowledge. “We know a person’s face and can recognise it among a thousand ... indeed a million ... yet we usually cannot tell how we recognise a face we know” (Polanyi 1966: 4). Tacit knowledge can, however, be communicated in situations of close physical proximity over a long period of time, such as in master-
apprentice relationships. Although, it is questionable whether the actual version or interpreted version of the master’s tacit knowledge is being transferred.

Whether tacit and explicit knowledge are two distinct forms of knowledge or on opposite ends of a continuum is one area of debate amongst researchers. In Ryle’s (1949) framing, he described them as two distinct forms of knowledge. Brown and Duguid (1998) adapted a similar view as they propose that “know-how” is different from “know-what”. Polanyi (1966) and Taylor (1993) posit that tacit and explicit knowledge exists on a continuum. Tacit knowledge provides the background understanding on which an individual’s explicit knowledge rests. Figure 2.2 illustrates this continuum.

**Figure 2.2: Explicit-To-Tacit Continuum**

![Explicit-To-Tacit Continuum](image)

Inherent within the tacit dimension is implicit knowledge, which is unarticulated knowledge that can be articulated. To be articulated, implicit knowledge requires an initiating action of a second party or the need to problem solve (Polanyi 1966). Polanyi (1966) defines explicit knowledge as knowledge that has been articulated. Although he does refer to explicit knowledge as information, this research posits that explicit or articulated knowledge is information. Many authors in the area of KM have used elements of Polanyi’s “typologies” of knowledge as the basis for their own concepts and models.
Authors such as Alavi and Leidner (2001) feel the need for a consensus on the meaning of knowledge is unfounded, and that a knowledge-based theory of the firm was never built on a universal truth of what knowledge really is, but rather on a pragmatic interest in being able to manage organisational knowledge (Stenmark 2002). This research accepts that Polanyi’s definition of tacit knowledge should be taken as stated – knowledge that cannot be articulated – but also that research in the area of KM should focus on implicit, explicit and tacit knowledge as it is these dimensions that must be addressed within knowledge assessment for organisations (see Figure 2.3). The lack of consensus surrounding the nature of internal and external knowledge is one of the gaps in KM literature. EGT provides another lens with which to address this and there is potential to bring both literatures together in this regard. Below, in Figure 2.3, the classification between tacit, implicit and explicit knowledge is illustrated.

**Figure 2.3: Explanation of Explicit, Tacit and Implicit Knowledge**

![Flowchart](image)

Polanyi’s (1966) categories of knowledge remain the most cited in the literature, although more recent concepts can be found predominantly in renewed interest in the topic stemming from the growth of KM. Other types of knowledge worth noting (see Table 2.4) are Machlup’s (1980) five categories of knowledge: practical knowledge, intellectual knowledge, small talk and pastime knowledge, spiritual knowledge, and unwanted knowledge; Wigg’s (1993) three types of knowledge: public knowledge, shared expertise and personal knowledge; Sveiby’s (1997) classifications of know-
what, know-why, know-how and know-who; Boisot’s (1995) categories of proprietary, public, personal and common-sense knowledge; and Blacker’s (1995) classes of embodied, embedded, embrained, encultured and encoded knowledge. However, all are seen to reflect the tacit, implicit and explicit components of Polanyi’s knowledge dimension. This research posits that explicit knowledge is the equivalent of information (Hinds et al 2010: Stenmark 2002: Hedlund’s 1994: Nickols 2000) and that tacit knowledge is knowledge that is intuitive and embedded in the individual (Polyani 1966) that can be shared through suitable environments such as proper mentoring. KM should focus on managing and measuring organisation-enhancing forms of knowledge, such as tacit knowledge, which will foster environments for the sharing and creation of knowledge.

Table 2.4: Popular Categories of Knowledge

<table>
<thead>
<tr>
<th>Author</th>
<th>Categories of Knowledge</th>
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<tbody>
<tr>
<td>Machlup (1980)</td>
<td>Practical knowledge: useful in the knower’s work</td>
</tr>
<tr>
<td>Wigg (1993)</td>
<td>Public knowledge: explicitly available public knowledge</td>
</tr>
<tr>
<td>Sveiby (1997)</td>
<td>Know-what: knowledge about facts</td>
</tr>
<tr>
<td>Blacker (1995)</td>
<td>Embodied knowledge: action orientated and acquired by doing</td>
</tr>
</tbody>
</table>

In the literature, the second dimension of knowledge, individual/collective, has emerged and has gained increasing attention. The more traditional view considers knowledge as held by the individual because the individual is the primary wielder and repository of what is known (Cook & Brown 1999). This view also is presented in Polyan’s (1962) work. He viewed knowledge at the individual level and originating in individual intuition, reflected in the title of his book *Personal Knowledge.* This
individual focus also is represented in Simon’s (1991: 125) statement that “all learning takes place inside individual human heads”. However, research has focused on a more sociological approach to knowledge and has grown considerably. This approach sees knowledge as socially constructed and embedded in the social relationships between individuals (Kogut & Zander 1992), and as distributed across groups or collectives of individuals who develop and possess social relationships. Work on thought collectives by Fleck (1935, 1979) is another source of the sociological perspective. He provides an insightful description of knowledge communities, combining the creativity and socialisation aspects of thought.

The activities of knowing, thinking and knowledge creation are intricate and complex. These activities also can take place in thought collectives, or groups with similar modes of thinking (Haas 1992; Tuomi 1999). The discussion of a “collective mind” in the organisational literature continued, while examples of an interest in the collective level include works by Wenger (1998) and Brown and Duguid (1991, 1998) in which they discuss communities of practice, by Kogut and Zander (1992, 1996) in their view of the firm as a social community, and by Nonaka and Takeuchi (1995) in their spiral of organisational knowledge creation. Spender (1996a) also discusses this dimension. In addition, von Krogh (1994, 1995) has investigated terms such as “organisational knowledge”. For example, a group of repair technicians possesses a body of knowledge about repair that is held in common by the various technicians; however, each individual technician does not possess the entire body of knowledge (Cook & Brown 1999).

The two dimensions of tacit/explicit and individual/collective knowledge have been incorporated into models by several authors. Spender (1996a) developed a two-by-two matrix, creating four types of knowledge: conscious (explicit knowledge held by the individual), objectified (explicit knowledge held by the collective), automatic (preconscious individual knowledge), and collective (highly context-dependent knowledge that is manifested in the collective’s activities). In this way, Spender argued that the psychological individual type of tacit knowledge, which was examined by Polanyi, could be separated from the collective type. Several scholars have made an extension of this two-by-two model. Hedlund and Nonaka (1993) and Kogut and Zander (1992) present models of organisational knowledge with information and
know-how on one axis and individual group, organisation and network on the other. Models also have been proposed to account for the dynamics of complex organisational knowledge. Nonaka (1994) and Nonaka and Takeuchi (1995) discuss the interactions between the two dimensions, arguing that a firm’s knowledge creation is performed by individuals and cannot occur without them; however, the organisation plays a critical role in articulating this knowledge. In the model, knowledge creation spirals between tacit and explicit knowledge and moves between the individual, group, organisation and interorganisational levels. Their key argument is that knowledge creation occurs when individuals share and develop knowledge through social interaction throughout the formal and informal levels of the organisation (Nonaka 1994).

However, as with definitions of knowledge and KM, many different interpretations of Polanyi’s work have been published, and what was a continuum of tacit to explicit knowledge has become a dichotomy of tacit/explicit knowledge in many texts (Mattsson 2003). Some authors such as Hakanson (2003) and Mattsson (2003) question the use made of the concept of tacit knowledge and see its general acceptance as a testament to “vagueness”, researchers’ “lack of a clear understanding or consensus of its meaning” (Hakanson 2003: 8), and a “hindrance to further analysis” (Mattsson 2003: 2). A lack of focus across the body of literature is apparent. While Hakanson and Mattsson do critique the use made of the concept of tacit knowledge, they do not attempt to critique the concept itself. Examples of authors proposing the ability and importance of managing actual tacit knowledge include Zucker et al (1998), Breschi and Lissoni (2001) and Johannessen et al (1997). While Wagner and Sternberg devise an instrument for measuring tacit knowledge (1991), no audit instrument or framework exists to assess organisational knowledge. Some authors, including Baurmard (1999), have critiqued KM models and research such as those mentioned above. Baurmard sees the models and research based on flawed interpretations of tacit and explicit knowledge. Tacit knowledge itself cannot be managed; however, situations, which allow for the communication of tacit knowledge, can be fostered.

Discussion of different types of knowledge provides us with an understanding of the knowledge possessed by people, according to Cook and Brown (1999). For example,
to say “William knows about repairs” points to William possessing knowledge of repairs. Yet in order to give a full account of what individuals know, there must be a focus on both the knowledge they possess as well as the actions they perform using the knowledge they have. Describing the knowledge that individuals or groups have does not provide us with an understanding of how it is used when individuals or groups take action in their work. Researchers are widening their focus of knowledge to include knowing, a verb connoting action, doing and practicing, as well as knowledge, a noun connoting things like elements, facts, processes, etc. (Orlikowski 2002).

Cook and Brown (1999) defined the concept of “knowing” as “not something that is used in action or something necessary to action, but rather something that is a part of action (both individual and group)”. Thus, knowing is part of the actual work performed, such as when a repair man services a printer. While there is a growing interest in knowing, researchers have differing opinions regarding the concept. Building on the American pragmatist perspective and in particular the work of philosopher John Dewey (1934), Cook and Brown see knowing as being distinct from knowledge and thus distinct from the tacit form of knowledge. However, Orlikowski (2002) proposes that tacit knowledge is a form of knowing, inseparable from action since it is constituted through such action. She bases her argument on the work of Ryle (1949) and Polanyi (1966). The debate over whether tacit knowledge and knowing are distinct will continue, but more essential to the organisational literature is the argument that knowing and tacit knowledge (depending on one’s definition) and action are mutually constituted.

Empirical studies of work practices have provided evidence of this relationship (Suchman 1987; Lave 1988; Orr 1996). Knowing is then argued to be an ongoing social accomplishment that is constituted and reconstituted in everyday work practice (Orlikowski 2002). In order to emphasise the relationship between knowledge and/or knowing and action at work, researchers have developed the practice-based perspective. This perspective emphasises the collective and provisional nature of knowledge in contrast to the rational cognitive view of knowledge (Sole & Edmonson 2002). The object of focus is practice as a means to capture the nature of knowledge in action in organisations, and researchers have developed concepts such as
“knowledge in practice” (Carlile 1997), “knowing in practice” (Orlikowski 2002) and “epistemology of practice” (Cook & Brown 1999). The notion of practice has a long history. Dewey argued that knowledge is manifested mainly not in what you claim to understand, but what you can do (Schon 1983). There also is a body of work in social theory that develops the nature of practice (Bourdieu 1977). Practice implies the actions of groups and individuals, such as nurses, mechanics, teachers, etc., when conducting real work. Practice is an activity, an interaction among individuals (Lave 1988) doing “real work” as it is informed by a particular organisation or group context (Cook & Brown 1999). Cook and Brown (1999) distinguish practice from behaviour and action, explaining that behaviour is “doing of any sort” and action is behaviour instilled with meaning, while practice refers to action informed by meaning within a particular group context. The differences are best explained by an example provided by Cook and Brown (1999). Behaviour is when the knee jerks; action is when one taps the knee with a doctor’s hammer to check reflexes. However, practice is when a doctor taps the knee with a hammer as part of a yearly check-up.

Researchers argue that if we are to understand the means by which organisations generate and create knowledge, we need to focus on knowledge as well as practice and their interplay (Cook & Brown 1999). When individuals and groups interact with the world through practice, the forms of knowledge, such as tacit, implicit, explicit and collective, are brought into play. Through this interaction between action and knowledge, new knowledge and new ways of using knowledge are created. As a group of individuals collaborate on a common task, they apply a common body of knowledge. Through applying this common knowledge, they also increase their knowledge because knowledge and learning are difficult to separate in dynamic task environments. An individual learns by participating in an activity and thus builds his or her knowledge. Thus, social interactions, rather than the isolated behaviour of individuals, are the basis for knowledge creation, exchange, evaluation and integration. As such, knowledge creation and learning are social processes that cannot be separated from working with knowledge as the outcome (Brown & Duguid 1991; Lave & Wenger 1991; Purser et al 1992; Boland & Tenkasi 1995; Wenger 1998). This is useful in applying characteristics to knowledge indicators such as knowledge creation within the KAF.
2.2.2 Approaches within Knowledge Management

This section will describe some of the approaches to understanding knowledge at firm-level within this discipline and their limitations. Given the importance of knowledge as a resource, many organisations are struggling to ensure that their workers are armed with the right knowledge at the right time. Recent data from the IDC Consulting Group illustrate this point (IDC 2009). Knowledge-based workers spend more than 6 hours a day duplicating knowledge work. Only one hour and 48 minutes of an eight-hour day is spent doing productive work. In an attempt to create and sustain competitive advantage, many firms began examining how knowledge is stored, transferred, and used in their organisations. This systemic and organisationally specified process of acquiring, organising and communicating knowledge of employees so that other employees can use it to be more effective and productive in their work has been termed “knowledge management” (Minonne & Turner 2009, Alavi and Leidner 2001). There are several models of thought within KM of how to approach knowledge at firm-level. This section will break these down into categories; knowledge category models, intellectual capital models and socially-constructed models of KM.

Knowledge Categories:

Nonaka and Takeuchi’s (1995) model is a high-level model and, in its simplest form, considers KM as a knowledge-creation process at the conceptual level. Knowledge is also considered as consisting of explicit and tacit elements. Polanyi (1966) defines tacit knowledge as intuitive and unarticulated (McAdam & McCreedy 1999). Explicit knowledge is defined in Hedlund’s (1994) study as writings, drawings, computer programmes or knowledge that has been articulated (Nickols 2000). Boisot’s (1998) knowledge category model differentiates between codified or uncodified knowledge, as codified refers to knowledge that is readily prepared for transmission (e.g. financial data) (McAdam & McCreedy 1999). He also uses the terms “diffused” and “undiffused”. Diffused knowledge refers to knowledge that is readily shared and undiffused is knowledge that is not. Knowledge category models show the process of socialisation or sharing of tacit knowledge and are important (Lloria 2008). The criticism of this broad-in-scope model is that it only considers knowledge as a “creating” process rather than a more holistic approach. Going forward, the social aspect of sharing is important for the purpose of the framework. For example how do
people share knowledge? In what organisational circumstances is knowledge sharing best fostered and what problems arise when sharing knowledge.

**Intellectual Capital:**
A typical intellectual capital (IC) model is the Skandia IC model (that has a strong emphasis on measurement), which assumes IC and KM can be segregated into human, customer and growth elements that are contained in the two main categories of human capital and structural capital. These are mechanistic models by nature and ignore the social and political side of KM (Lloria 2008; McAdam & McCreedy 1999). In summary, intellectual capital models are indeed mechanistic in nature and assume that knowledge can be treated as an asset, similar to other assets (McAdam & McCreedy 1999). Though the framework is exploratory in nature, it views knowledge as context based and changes in nature from problem to problem. The social aspect of knowledge must also be acknowledged and it is naive to consider assessing knowledge without incorporating this aspect. Some of the weaknesses of the IC model may be highlighted by treating knowledge as more than just mechanistic.

**Socially Constructed:**
These models view knowledge as being intrinsically linked with the social and learning processes within the organisation (Lloria 2008; McAdam & McCreedy 1999). Later, the similarities between this model and learning-by-doing models of Endogenous Growth will be presented (Arrow 1962; Lucas 1988; Stokey 1988). This model also focuses on the importance of communities of practice as arenas for the fostering of knowledge interchange at a social level (Lloria 2008). This model is almost a balanced version of the previous two models (McAdam & McCreedy 1999). The importance of learning within the KAF is informed and supported by EGT although socially constructed models within KM are acknowledged.

KM approaches to knowledge at firm-level can be broken down into three main areas (Lloria 2008). As highlighted in Table 2.5., KM approaches are identified as: (1) *measuring knowledge* (European firms), (2) *creating knowledge* (Japanese firms), and (3) *managing knowledge* (American firms), with the American approach also being divided into the human factor and the information technology factor. The classifications proposed by McAdam and McCreedy (1999) can now be translated
here, as KM category models can be associated with knowledge creation, intellectual capital models can be associated with measuring knowledge, and socially constructed models can be associated with KM (Lloria 2008).

Table 2.5: Approaches to Knowledge Management

<table>
<thead>
<tr>
<th>Author/Year</th>
<th>Approach to KM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Takeuchi (2001)</td>
<td>Measuring knowledge</td>
</tr>
<tr>
<td>Argote (2005)</td>
<td>Emphasis on human factor</td>
</tr>
<tr>
<td>Andreu &amp; Sieber (1999)</td>
<td>Perspective focused on the culture of the firm</td>
</tr>
<tr>
<td>McAdam &amp; McCreedy (1999)</td>
<td>Models of IC</td>
</tr>
<tr>
<td>Alvesson &amp; Karreman (2001)</td>
<td>KM as community/KM as normative control</td>
</tr>
<tr>
<td>Earl (2001)</td>
<td>Economic school</td>
</tr>
<tr>
<td>Swan &amp; Scarbrough (2001)</td>
<td>Capture of knowledge through the introduction of information technologies</td>
</tr>
<tr>
<td>Grant (1996)</td>
<td>Knowledge-based theory of the firm/KM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Author/Year</th>
<th>Approach to KM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Takeuchi (2001)</td>
<td>Managing knowledge</td>
</tr>
<tr>
<td>Argote (2005)</td>
<td>Emphasis on information technology</td>
</tr>
<tr>
<td>Andreu &amp; Sieber (1999)</td>
<td>Perspective focused on information/technology</td>
</tr>
<tr>
<td>McAdam &amp; McCreedy (1999)</td>
<td>Socially constructed models</td>
</tr>
<tr>
<td>Alvesson &amp; Karreman (2001)</td>
<td>KM as extended libraries/KM as enacted blueprints</td>
</tr>
<tr>
<td>Earl (2001)</td>
<td>Technocratic school (systems/cartography/engineering)</td>
</tr>
<tr>
<td>Swan &amp; Scarbrough (2001)</td>
<td>Knowledge category models</td>
</tr>
<tr>
<td>Grant (1996)</td>
<td>Behavioural school (organisational/spatial/strategic)</td>
</tr>
</tbody>
</table>

Source: Adapted from Loria (2008)

Handzic et al (2007) describes various KM auditing models and offers a KM audit model that extends his knowledge-process-enabler framework by incorporating additional driver and outcome elements as well as contextual contingencies within the knowledge lifecycle. The existing KM models encompass a broad range of issues and groups. This section will describe and compare some of the KM audit models. There are five major groups, according to Handzic et al (2007):

1. **Knowledge-orientated models**: These models come from the Intellectual Capital and Economic schools (Sveiby 1997; Earl 2001) and deal with explicit and tacit knowledge, which will be important for this study.

2. **Process-orientated models**: These models (Nonaka 1998; Wigg 1993) see the development of an organisation’s IC as the result of the organisational dynamic knowledge processes. They focus on the socialisation/internalisation
of tacit and explicit knowledge and the ways they are transformed.

3. **Social/technological enablers:** This group focuses on the capturing of experts’ knowledge, documenting processes and storing best practices, or locating the best person with the necessary knowledge.

4. **Contingency models:** This group questions the widely held belief that knowledge processes, tools and methods for the creation and sharing of knowledge as appropriate.

5. **Evolutionary models:** This group emphasises the evolutionary nature of KM (von Krogh et al 2000), makes use of what is available, and enables new knowledge creation and innovation. The models focus on the progression of organisational goals.

Handzic et al (2007) bring together various components from the various groupings into a comprehensive KM audit model as depicted in Figure 2.4. Organisations need to have a clear picture of what they wish to accomplish and must consider how KM can support their drivers. This model argues that no one solution is best and emphasises the importance of socio-technical enablers, knowledge processes and knowledge stocks, however, fails to offer organisational indicators for each. The most important emphasis of the model is that knowledge within this lifecycle is valuable in an organisation, especially where that knowledge is located and that valuable knowledge needs to be identified and its flow and measure enabled and managed effectively, also taking into account that tacit knowledge is sticky and slow to move, unlike explicit knowledge (Handzic et al 2007).

Handzic et al’s (2007) model recognises that KM is driven by the knowledge lifecycle in the organisational environment, as is the need for knowledge assessment at organisational level. This, however, is as far as many of these models go. They are theoretical frames around which definitions are built. Practically, it does not go far enough to help managers. It does not help inform KM decisions or policy at organisational level.
Figure 2.4: Handzic et al’s Knowledge Management Audit Model

A criticism of these models is that many are simply too conceptual in nature. They offer definitions and categorisations of knowledge. This is one of the main criticisms of the KM literature. It offers definitions and broad soft terms. Table 2.6 below also highlights other KM frameworks within the literature. The outcomes of the KAF presented in this research will attempt to offer organisations actual valuable insight into their knowledge base. For example, rather than stating that organisations need to have a KM contingency in place such as “socio-technical enablers” as offered in Handzic’s model, the KAF will be deployed to help gain insight into knowledge sharing problems or learning issues or, for example, within the organisation, why is a certain group of engineers unable to locate certain knowledge? The framework uses the literature to inform and drive the analysis. These models are far too macro in nature to achieve practical diagnoses. This researcher recognises the importance of the knowledge lifecycle within KM and will discuss its relevance to the KAF subsequently.

Source: Adapted from Handzic et al (2007)
### Table 2.6: Other KM Frameworks

<table>
<thead>
<tr>
<th>Author</th>
<th>Framework</th>
<th>Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hedlund &amp; Nonaka (94)</td>
<td>Knowledge Carrier</td>
<td>Organisational Domains</td>
</tr>
<tr>
<td>Von Krogh &amp; Nonaka (01)</td>
<td>Strategic Framework</td>
<td>What can you do with Knowledge</td>
</tr>
<tr>
<td>Skandia</td>
<td>IC Models</td>
<td>Human/Process/Growth</td>
</tr>
<tr>
<td>Demerest (97), Staunton (89)</td>
<td>Socially Constructed</td>
<td>Social Learning</td>
</tr>
<tr>
<td>OECD (96)</td>
<td>Macro Framework</td>
<td>Knowledge Metrics</td>
</tr>
<tr>
<td>King &amp; Zeithaml (03)</td>
<td>Methodological Framework</td>
<td>Perceived value of knowledge</td>
</tr>
<tr>
<td>Choi et al (08)</td>
<td>Socio Technical Enablers</td>
<td>KMS quality factors</td>
</tr>
<tr>
<td>Gallagher &amp; Hazlett (00)</td>
<td>KM3</td>
<td>Maturity Model: knowledge evaluation</td>
</tr>
<tr>
<td>Handzic (07)</td>
<td>KM Audit</td>
<td>KM contingencies</td>
</tr>
<tr>
<td>Moffett (02)</td>
<td>MeCTIP Model</td>
<td>Suggestive Model</td>
</tr>
</tbody>
</table>

### 2.2.3 The Knowledge Lifecycle

Within KM, the knowledge lifecycle (Minonne & Turner 2009) emphasises the capability to create, acquire, share and re-use explicitly documented knowledge, potentially articulable implicit knowledge and that of tacitly held knowledge, which emphasises knowledge sharing by interpersonal interaction (Choi et al 2008; Choi & Lee 2003). Figure 2.5 depicts the lifecycle.

**Figure 2.5: Knowledge Lifecycle**

The sharing of knowledge (Szulanski 1996), the knowledge creation process (Nonaka 2007; Nonaka & Takeuchi 1995), communities of practice (Brown & Duguid 1991) and the distinction between tacit and explicit knowledge (Polanyi 1966) are discussions about the various aspects of managing knowledge (Becker 2001).
studies (Nevis et al 1995; Bierly & Chakrabarti 1996; Hansen et al 1999; Swan et al 2000)\(^2\) have indicated that organisations should pursue either explicit or tacit knowledge, while others propose companies manage both simultaneously (Choi & Lee 2003). The KAF incorporates both explicit and tacit themes simultaneously while acknowledging that, within organisations, both are inherently linked (Polanyi 1997) as knowledge undergoes a lifecycle. The subsequent sections will discuss the various sections within that lifecycle and their inclusion within the KAF.

2.2.3.1 Knowledge Creation

Knowledge creation is generally the first process in a KM framework. The creation of knowledge is innately a social process among individuals, (Wittgenstein 1953; Vygotsky 1962; Berger & Luckman 1966), though tacit knowledge held by individuals may be at the heart of the knowledge-creating process (Cook & Brown 1999). This process, however, must most importantly ensure that investments in knowledge contribute to top-line growth and profitability for organisations (Moffett & Hinds 2010). Von Krogh et al (2001) introduce the knowledge domain, which consists of relevant data, information, articulated knowledge (such as manuals or presentations) and tacit knowledge. He argues that knowledge creation and sharing are key to the development of this domain. Nonaka’s SECI model of organisational knowledge creation (Nonaka 1995), which is itself a process-orientated view of KM, has made a seminal contribution to the KM movement. Nonaka argues that new knowledge is created through the continuous conversion between tacit and explicit knowledge. Specifically, four modes of knowledge conversion are identified; socialisation (S), externalisation (E), combination (C), and internalisation (I). Individual knowledge can be created in each of the four modes, however, that knowledge remains personal and individual unless shared in social interactions. For example, the externalisation mode refers to the conversion of tacit knowledge to new explicit knowledge, such as the articulation of best practices or lessons learned. Organisational knowledge creation takes place when the four modes are managed to form a continuous cycle. Through this cycle, individual knowledge becomes amplified and the practical benefits associated with it can be realised. Nonaka refers to this process as the “spiral” of organisational knowledge creation. The model views

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\(^2\) See Appendix P: Comparisons of KM Studies
organisational knowledge creation as an upward spiral process, starting at the individual level moving up to the collective (group) level, and then to the organisational level, sometimes reaching out to the inter-organisational level. The interactions between tacit and explicit knowledge become faster and larger as more people become involved. Once new knowledge has been created, the process view of KM advocates that new knowledge be documented for future use. For the purpose of the framework the researcher needs to understand how workers create knowledge everyday within the organisation.

2.2.3.2 Knowledge Acquisition

The acquisition of knowledge is where one unit seeks out and acquires knowledge. There is an element of specialisation in knowledge acquisition. Simon’s principle of bounded rationality is recognition that the human brain has limited capacity to acquire, store and process knowledge (Grant 2002; 1996). It requires that the individuals specialise in particular areas of knowledge. This implies that experts are invariably specialists, while jack-of-all-trades are masters of none (Grant 2002; 1996). Von Krogh (2001) then contends that knowledge can be acquired. Individuals within the knowledge domain can attempt to make these collective experiences explicit by documenting proper, accurate descriptions of their experiences. Knowledge acquisition has also been referred to as organisational memory. Acquiring explicit knowledge can often depend on storage which includes knowledge residing in various component forms, including written documentation, knowledge stored in electronic databases, and knowledge acquired by individuals and networks of individuals (Carlsson 2003). Indeed, the first era of KM relied heavily on IT systems to store the codified knowledge of employees.

A study on knowledge learning carried out by Andrews and Delahaye (2000), although based on only 15 semi-structured interviews of scientists in an inter-organisational consortium, found that the respondents (1) deliberately mediated the knowledge acquisition process by deciding from whom they would seek potentially useful knowledge, as well as from whom they were willing to accept knowledge, and (2) actively deciding with whom they would share their knowledge. These choices are

See Appendix B and E (Research Probes)
primarily made based upon individual interests, which are diverse and distributed. As a result, the process of knowledge sharing and acquisition among individuals is a rather fragile and uncertain activity. This research aims to further explore this issue within the case organisations.

2.2.3.3 Knowledge Sharing

Knowledge sharing refers to the process of placing that knowledge in the “hands” of those individuals who need it and can use it. However, the sharing of knowledge is not a straightforward process. The term “sticky knowledge” has been frequently used to describe the difficulties involved in transferring knowledge from one location to another (Peng et al 2012; Szulanski 1996; von Hippel 1994). Formal sharing mechanisms include training sessions, plant tours, apprenticeships, employee transfers, and a variety of IT tools that enable collaboration. Informal mechanisms such as coffee break conversations, unscheduled meetings, and informal seminars have also been promoted as a means of sharing knowledge (Davenport and Prusak 2000).

The OECD identifies that one of the key KM practices is creating a knowledge sharing culture (Brinkley 2006). Knowledge sharing is a multi-dimensional activity and thus involves several contextual, cognitive and communicative skills (Choi et al 2008; Choi & Lee 2003); therefore, the challenge present to knowledge sharing is that a social relationship must be present. Research has consistently shown that social relationships are important to the ability of individuals to gather knowledge and perform their work (Pelz & Andrews 1968; Mintzberg 1973; Allen 1977; Monge et al 1985; Brown & Duguid 2000; Cross et al 2001). However, a growing body of research has addressed the enablers (trust, expertise and rewards) that facilitate the willingness to share knowledge (Choi et al 2008). Knowledge sharing is a conduit to be used selectively. Not everyone needs to know everything all the time (Von Krogh 2001). To accelerate knowledge sharing in an organisation, some things inevitably can help: (1) awareness of the opportunities to exchange knowledge, (2) the parties involved expect knowledge sharing to be worthwhile, (3) parties must be motivated to pursue knowledge sharing, and (4) starting with the specific knowledge to be

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4 See Appendix Q: Summary of the Studies on Knowledge Sharing
transferred (Von Krogh 2001). Szulanski (1996) also acknowledges these issues around sharing and other matters such as unprovenness, lack of motivation to share, retentive capacity and arduous relationship. Von Krogh (2001) shows the need to understand how people share knowledge. In what situations do they share knowledge and when can issues arise? It will be important to try to understand this going forward with the framework.

Many organisations are in the process of implementing electronic communities to promote knowledge sharing between individuals (Alavi & Leidner 1999; Davenport & Prusak 2000; Peng et al 2012). In addition, the use of codified sources of data, such as company documents, facilitates an individual when solving work-related tasks. For example, access to an internal document can help an individual avoid reinventing the wheel, thus facilitating the completion of a work-related task. This codification and documentation of knowledge within the firm is one of the main thrusts of management in organisations in order to ensure the transfer and application of codified knowledge. Hislop et al (2000) states that the character of organisational and technical knowledge or expertise, much of which is tacit rather than explicit, embodied in people and structures makes knowledge integration complex and difficult. Other emerging companies, as cited in Wenger and Snyder (2000), are using communities of practice to galvanise knowledge sharing and learning. They use the example of deep-water drilling in which a group of people are informally bound together by shared expertise and a passion for a joint enterprise. They are particularly useful at providing the work context within which members construct both shared identities and the social context that helps the sharing of those identities (Broen & Duguid 2001). The aim of the framework is to observe the issues, such as documenting and capturing techniques, described above and to use the correct methodological tools to tap into the organisational knowledge, where it is often necessary to directly engage with the staff that possesses it (Hislop 2000). The framework aims to explore knowledge sharing within the case firms.

2.2.3.4 Knowledge Re-use

Finally, knowledge re-use refers to the filtering of useful information through the human brain and applying these to job tasks (Davenport 2005). The objective here is
not necessarily the creation of new knowledge but the application of existing knowledge to familiar or unfamiliar situations (Miller et al 2011). In essence, the goal of the knowledge re-use process is to “reuse” knowledge more effectively. Prominent authors remind us that it is the application of knowledge rather than knowledge itself which serves as the basis for organisational competitive advantage (Grant 1996). At the level of the individual, the re-use of existing knowledge is relatively straightforward. A productive lecturer would review and index all the lectures they have ever delivered, and routinely use these to improve future presentations. Routines have also been promoted as an effective mechanism for improving the re-use of knowledge at the organisational level (Cyert and March 1963; Demsetz 1991). For example, the complex checks performed by a cockpit crew before flying a passenger airplane would be considered to be an organisational routine.

Re-use often deals with the exploitation aspect of knowledge and because of that, firms miss the exploration aspect of the KM phenomenon (Winter & Szulanski 2000). Winter & Szulanski (2000) call for new ways of developing capabilities to routinise knowledge re-use. Majchrzak et al (2001), in their research on jet propulsion, also use case studies to make a distinction between the re-use of knowledge for routine tasks (for example, the use of templates, boilerplates, and existing solutions) and the re-use that stimulates knowledge synthesis and innovation (for example, searching a database to find new ideas to combine with existing knowledge to build a lessons learned archive). They argue that very little research has focused on the latter type of re-use and, as a result, leave questions as to how to facilitate re-use for knowledge creation. If lessons learned can be implemented within organisations properly, the experiences can be used going forward. The process of re-use is a powerful factor in converting collective experience into improved average performance (Levinthal & March 1993). As many organisations are involved in the cataloguing of knowledge for later use, most KM systems today have been developed to enhance the efficiency of a work process. As such, documents are captured and catalogued to support likely known future re-uses, such as consultant services or administrative templates, etc., (Majchrzak et al 2001). KM systems need not only be used to support process efficiency, however. Since knowledge sharing is a critical part of knowledge creation, both within and across organisations, KM systems should be designed to support knowledge sharing for innovation, rather than only for routine re-use (Majchrzak et al
2001). The framework aims to explore the level of re-use within the case organisations with a focused attempt to understand any attempts to re-use knowledge within the organisation and also whether lessons learned are used.

### 2.2.4 Conceptual KM Foundations Adopted by the KAF

Having identified the various dimensions and definitional characteristics of knowledge, this section provides a conceptualisation of the key indicators that are used within the KAF. The literature has criticised the OECD both in terms of the nature of their approach to knowledge assessment and the nature of the indicators themselves. Although KM can be criticised further by being too soft in its approach, it offers a base with which to build a detailed framework because of the way it describes how organisations track, measure, share and make use of knowledge (Brinkley 2006).

Regarding knowledge and the overall conceptualisation of the KAF, the synthesis has two components. Firstly, knowledge is understood to be something more complex than, and superior to, simple information. In this regard, knowledge incorporates an element of interpretation. Knowledge is information understood and applied in reference to specific objectives and contexts. In essence, the researcher is in close agreement with McDermot (1999) who considers knowledge to be the residue of thinking. Secondly, the view is also taken that knowledge has both tacit and explicit components or constructs (Moffett & Humphreys 2012) and only the proportions differ (Cook & Brown 1999). As an example, Ph.D. researcher can think about his or her chosen discipline and articulate their thoughts into a journal article. To an informed reader, this journal article represents knowledge, albeit knowledge that is more explicit than tacit. This distinction recognises that the transfer of knowledge from one individual to another is a slow and costly process. However, knowledge can be made more transferable by increasing the explicit proportion in relation to the tacit. As this study is specifically concerned with knowledge indicators within the KAF, a conceptualisation of the indicators also needs to be given.

As highlighted by (Lloria 2008; McAdam and McCreedy 1999), KM delivers many conceptual descriptions of various KM auditing models that extend the core knowledge-process-enabler research, such as knowledge-orientated models, process-
orientated models, evolutionary models, contingency models, social/technological enablers. Handzic et al (2007) offers a KM audit model that incorporates additional drivers and outcome elements as well as contextual contingencies within the knowledge lifecycle. He also posits that the location of valuable knowledge is very important for the knowledge organisation. None of these on their own, however, can offer anything in the realm of a working assessment framework for use at organisational level. The researches goal, more specifically, is to use KM to highlight key indicators that can be considered useful within a more holistic framework to take and use at organisation level.

Knowledge is social and embedded in procedures, terminology, products and people (Wright 1999). It is within this lifecycle that knowledge is actively created, acquired, shared and re-used. KM identifies several knowledge lifecycle activities such as creation (Nonaka 1995), acquisition (Grant 2002), sharing (Szulanski 1996) and re-use (Majchrzak et al 2001). These are structurally very similar to their OECD counterparts, however, offer the framework a way of using theoretical concepts rather than broad macro-level terminology (Godin 2004).

Nonaka (1991) argues that knowledge creation must be central to any knowledge framework. The researcher agrees that new knowledge is created through the continuous conversion between tacit and explicit knowledge. The KAF will include knowledge creation and seek to explore this within the case organisations.

Knowledge acquisition and the dissemination of knowledge is also a central indicator within the KAF. Within the case organisations acquisition occurs internally and with sources originating from within the boundaries of the firm. This includes, but is not limited to, knowledge acquired from colleagues, work systems and technical manuals.

Knowledge sharing refers to the complex exchange processes that are directed at understanding the knowledge transmitted between a source (which may be another person or a document) and a recipient. Knowledge sharing therefore necessitates reflection on the part of the recipient which may not be the case with processing information. Knowledge sharing can either be unidirectional (e.g. an engineer reflecting upon the knowledge contained in a work process) or reciprocal (two or
more engineers discussing how new knowledge can be exploited). Within the dimensions of knowledge itself the framework will work upon the basis of tacit, explicit and implicit knowledge. KM provides the characteristics and definitional characteristics of these forms of knowledge. The research accepts that there are flawed interpretations of tacit and explicit knowledge (Baurmard 1999) where research based on tacit knowledge itself cannot be managed, however, the KAF will explore situations, which allow for the communication of tacit knowledge.

Knowledge Re-use will also be used within the KAF. Within the case organisations the KAF will seek to examine if knowledge, when explored, can help build and add to the pool of knowledge and indeed whether this is being done.

In the past, the practice of KM was frequently reduced in the literature to the implementation of new IT systems for knowledge sharing. The two biggest mistakes were the view that as long as networks were structurally in place, then knowledge sharing across internal boundaries would happen, and focusing on technology rather than people – encouraging employees to actively network and share ideas (Swan et al 1999). It is hoped through the exploration of the cases with the KAF that an improved understanding of knowledge indicators and the associated activities will enable firms to overcome these challenges while facilitating their ability to understand better their knowledge activities. The goal is to provide access to relevant knowledge (Hinds et al 2010; Hislop 2000). As pointed out earlier, the OECD indicators are considered weak for several reasons, one being that they are too macro in nature. The research uses KM to provide better knowledge indicators and as a lens with which to focus on the organisational level.

2.3 ENDOGENOUS GROWTH THEORY

Endogenous Growth theory is used in the construction of the KAF because firstly, it provides for the existence of knowledge as internal to an economic system such as the firm. Secondly, it provides for the study of knowledge in the macro environment while highlighting the shortcomings in the microenvironment and thirdly, provides core material regarding the understanding of learning-by-doing in the workplace. In addition, in response to the challenges apparent in KM literature, Endogenous Growth
Theory provides another lens with which to examine the nature of knowledge (Burton-Jones 2008). The shift to the knowledge or smart economy is widely regarded as having been driven by technological innovations (Burton-Jones 2008). The resultant “economics of ideas” (Romer 1990), while offering massive growth opportunities, poses new challenges for organisations. Codified representations of human knowledge can be easily replicated, transmitted around the world in seconds and exploited by anyone who can access them (Romer 1990).

2.3.1 What Constitutes Knowledge

Within the realm of growth theory, the term knowledge often is used interchangeably with the term technical change. Technology is seen to refer to “the way we work”, and therefore, technical change refers to “changes in the way we work”. Technical change, or new knowledge (Chartrand 2005), is seen to exist in tacit, implicit and explicit forms (Romer 1990; Polanyi 1966). The lack of a precise definition for what constitutes technical change within EGT has been one of the main critiques of the field to date (Comin & Mulani 2009; Langlois 2001).

The difficulty associated with defining knowledge is not restricted to new growth theory alone as it has been a staple of philosophical debate since the time of Aristotle. Aghion and Howitt (1998: 435) state “we do not have any generally accepted empirical measures of such key theoretical concepts as the stock of technical knowledge, human capital … the rate of obsolescence of old knowledge and so forth”. The following table shows the descriptions and attitudes toward knowledge of the main authors in growth theory literature. This enables commentary on the nature of knowledge within growth theory.

Table 2.7: Descriptions & Attitudes Toward Knowledge

<table>
<thead>
<tr>
<th>Author</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solow (1956: 85)</td>
<td>Knowledge is that which constitutes perfectly arbitrary changes over time in the production function that are hardly likely to lead to systematic conclusions.</td>
</tr>
<tr>
<td>Arrow (1962)</td>
<td>Technical change is ascribed to experience that it is the activity of production, which gives rise to problems for which favourable responses are selected over time, i.e. learning-by-doing.</td>
</tr>
<tr>
<td>Romer (1986: 1003)</td>
<td>Knowledge should be viewed as a basic form of capital and is assumed to be the product of a research technology, i.e. the combination of human and physical capital.</td>
</tr>
</tbody>
</table>
Lucas (1988) | Human capital grows without bound; human capital is used to refer to a person’s “general skill”.
---|---
Romer (1989: 4) | Every agent has an endowment of three types of skills:  
1. Physical skills like hand-eye coordination and strength.  
2. Educational skills acquired in primary and secondary school.  
Scientific talent acquired in post-secondary education.  
Romer (1990: S72) | Technical change is defined as improvements in the instructions for mixing together raw materials.  
Barro (1991) | Human capital drives growth; human capital is measured in the study of education levels.  
Aghion & Howitt (1992: 323) | Knowledge accumulates through formal education, on-the-job training, basic scientific research, learning-by-doing, process innovations and product innovations.  
Young (1993) | Technical change is both the result of bounded learning by doing and investment in research and development.  
Pack (1994) | Knowledge is the stock of human and physical capital, both of which affect technology.  
Jones (1995) | Knowledge is the accumulation of ideas; technical change is equal to the stock of knowledge or technology in the economy.  
Jones (1999) | Knowledge is equal to the stock of ideas.  
Wright (1999: 296) | Technical knowledge is not simply a body of abstract information, but is inherently social and embedded in terminology, procedures, physical equipment and products.

Although it is hard to conceptualise the fact that creation and diffusion of technological knowledge is at the centre of economic growth, it is widely acknowledged (OECD 2006; Nonaka 2007). It can be deduced that knowledge or technical change is embodied in people and institutions and refers to changes in the way in which we work. Some authors also offer technology as an endowment of knowledge; however, this conflicts with previous research definitions of knowledge. Knowledge that is embodied in technology is codified knowledge or information. Nelson (1992) noted the idea of tacit knowledge creating problems for new growth theory. Tacit knowledge by its very nature cannot be communicated unless through high cost imitation (apprenticeship) relationships (Langlois 2001), and even then the success or failure of this knowledge transfer cannot be explicitly measured (though measures such as productivity and skill-level improvement can be employed). Increasing productivity (Romer 1986, 1990) is based on the notion of knowledge spillovers (Langlois 2001), which require knowledge to be easily transmittable. Authors, such as Saviotti (1998), have tackled this problem by defining economic knowledge as either tacit or codified. This coincides with KM’s approach to the mentoring-type relationship.
2.3.2 Knowledge and Endogenous Growth Theory

Economists studying growth have turned to Endogenous Growth models (Mankiw et al 1992). There are two schools of thought concerning the origin of knowledge in the economic arena. Knowledge is either viewed as exogenous (external) to the system (Solow 1956; Swan 1956) or endogenous (internal) (Arrow 1962; Romer 1986, 1990; Lucas 1988). EGT also is known as “new growth economics” or “new growth theory”. These viewpoints, however, are not mutually exclusive, with each theory lending itself to the other.

EGT has provided two major contributions to economic literature: (1) that technical change is a significant factor in generating growth, and (2) that this technical change impacts growth endogenously. Within Endogenous Growth Theory literature, models can be divided into invention-based and learning-by-doing categories. In invention-based models (Romer 1986, 1990; Aghion & Howitt 1992; Jones 1995), technical change is the outcome of deliberate investment in the research and development (R&D) process. In learning-by-doing models (Arrow 1962; Lucas 1988; Stokey 1988), Young (1993) states technical change is a by-product of experience gained in the production function.

EGT stems from three areas. These are early discussions based on knowledge as a driver of economic growth (Vilben 1898; Marshall 1920); the classical models of growth, which incorporate the traditional factors of labour and capital (Domar 1947; Harrod 1948); and neo-classical models that recognise the importance of technical change but view this knowledge as exogenous to the system (Solow 1956).

The most prominent of these neo-classical models is Solow’s (1956) model of economic growth, which is viewed as the main precursor to new growth theory. Solow (1956), however, deviated from the earlier models of Domar (1947) and Harrod (1948) by proposing a closed model with an equilibrium solution to growth, where all the elements (labour and capital) were defined (Gylfasson 1999). Solow (1956) showed that 87.5% of growth process was essentially outside the boundaries of quantitative enquiry. He attributed this unexplained driver of growth to technical advancement and knowledge-enhancing processes. He states “the neo-classical model is a theory of growth that leaves the main factor of growth unexplained” (Solow
1994: 48). From looking at the literature, it is clear that a real attempt to define and explain technical change only was made once it was contended that the diffusion of this technological knowledge was governed by the issue of profitability (Arrow 1969). For organisations, EGT’s approach to knowledge provides some important conclusions. For one, knowledge is a significant factor in producing growth in whatever fashion that might be. Second, knowledge impacts the organisations growth internally. Finally, coupled with KM, EGT can offer a more holistic approach to knowledge assessment.

2.3.3 Endogenous Growth Models

3. Hybrid Models (Young 1993)

2.3.3.1 Learning-by-Doing Models of Endogenous Growth

In 1962, Arrow introduced the idea that new knowledge is produced within the economic system or economic process (Arrow 1994) by arguing that learning-by-doing was an important by-product of production that diffused into the economic system. He states that “information that is privately produced for private gain contributes as an unintended by-product to the pool of information. This in turn is an input into both production of goods and creation of new knowledge” (Arrow 1994: 8)

Arrow’s model was not, however, fully integrated into the growth context (Acs et al 2003). It is in effect a model of technical change. The model does, however, act as the starting point for all subsequent learning-by-doing based models by suggesting that an endogenous view be taken of knowledge (Arrow 1962). In building his endogenous theory, Arrow (1962) posits that learning is produced from experience and can only take place as part of an activity-focused attempt to problem-solve.

Arrow (1962) also generalises that learning associated with replication will lead to
diminishing returns. Arrow furthers his hypothesis by positing that technical change can be attributed to experience – that it is the result of learning-by-doing acquired in the experience gained in the production of goods. He offers the Horndal effect (Lundberg 1961) as evidence for the importance of learning-by-doing for growth. In the Horndal Iron Works in Sweden, there was no new investment for 15 years, yet output per man-hour rose by a steady 2% per annum. This increasing performance is attributed to learning from experience (Arrow 1962). In essence, Arrow (1962) posits that technical change is the result of experience gained from the production of goods (Young 1993). Therefore, he assumes economic knowledge is embodied in both physical capital and human capital (Romer 1986). Arrow’s (1962) model of learning-by-doing contributes two-fold to EGT, firstly through the suggestion that technical change be viewed as endogenous to the economic system, and secondly by attempting to offer an account of what constitutes technical change.

In 1988, both Lucas and Stokey fully incorporated Arrow’s (1962) learning-by-doing model, and along with it the knowledge-producing function, into economic growth literature, offering it as an endogenous concept. Lucas (1988) introduces a linear model of unbounded learning using human capital, which grows without bound as a measure for economic knowledge (Romer 1989). Stokey (1988) differs from Lucas (1988) in that she models vertical product innovations as obsolete in the sense that new innovations render old ones unnecessary akin to Schumpeter’s notion of creative destruction (Aghion & Howitt 1992). Stokey (1988) posits that innovations are the unintended by-product of learning-by-doing, as hypothesised by Arrow (1962), and the “accumulation of knowledge through economy-wide learning-by-doing is the sole force behind growth; there is no physical capital” (Stokey 1988: 702). Learning-by-doing models of endogenous growth are not too dissimilar to socially constructed models of KM as they both focus on the learning process within the organisation (McAdam & McCready 1999).

2.3.3.2 Critique of Learning-by-Doing Based Endogenous Growth Theory

Critical appraisals of EGT in the literature mainly come from within the discipline and are predominantly offered by authors attempting to improve on previous models.
Most criticism of learning-by-doing models (Arrow 1962; Lucas 1988; Stokey 1988) rests mainly with the view that the productivity gains from learning are unbounded, and therefore, the models do not account for the times of “technological improvement and stagnation apparent in pre-modern history” (Young 1993: 444). Young (1993) offers the example of China which, until the end of the Sung Dynasty (mid-13th century), experienced extraordinary technical progress and thereafter suffered from total technological stagnation (Young 1993: 444).

Arrow’s (1962) model displays an over-reliance on exogenously specified population growth, thus suggesting that the growth rate of per capita income should monotonically increase the rate of population growth (Romer 1986). Both Arrow’s (1962) and Lucas’s (1988) models fail to deal with the concept of knowledge conclusively. In an attempt to make economic knowledge reactive to market motivations, Arrow (1962) assumed an increase in capital would lead to an increase in knowledge through learning-by-doing. Although, like Solow (1956), Arrow still viewed knowledge as a public good. Lucas (1988), like Arrow (1962), treats knowledge as a “public good that is privately produced as a side effect” (Romer 1990: S77). This view of knowledge treats technical change as something that is both non-rival and non-excludable. Non-rival means the use of a commodity by one organisation does not limit its uses by another. Non-exclusivity means the technique or skill required to use some form of knowledge, such as a patent, is known and available to everyone. The terms non-rival and non-excludable were not introduced until Romer (1990), but they are used here in discussion for continuity.

Lucas’ (1988) measure of human capital invites criticism for his deviation from traditional measures of schooling and on-the-job training as used in economics (Romer 1989). Stokey’s (1988) failure to include physical capital in her model of learning-by-doing implies the model cannot account for long-term rates of investment or returns on capital investment.

2.3.3.3 Invention-Based Models of Endogenous Growth

Invention-based models differ from learning-by-doing models of economic growth in that they view knowledge as being produced by forward-looking, profit-maximising
agents. Within Romer’s (1986, 1990) growth models, technical change is seen as the product of profit-maximising agents at micro level, while at macro level knowledge is channelled into growth through increased firm efficiency and knowledge spillovers, the result of the failure of each individual organisation to appropriate all the knowledge they generate at any one time (Comin & Mulani 2009; Acs et al 2003). The model assumes that knowledge is a non-depreciating stock; for example, once knowledge is created it exists forever. The main departure of Romer’s (1986) model from others before it was to emphasise the role of increasing returns in knowledge-based products. Diminishing returns can be seen in software development, when after a large initial investment to produce the first unit of output the price of producing each additional unit of output decreases significantly. This can be understood in terms of knowledge re-use (Langlois 2001) and the role of diminishing returns in research and development, which opens a discussion on the economics of information, where given the stock of knowledge at any point in time, doubling the inputs into research will not double the amount of research produced (Romer 1986).

Romer’s first model also posits that investment in knowledge suggests a natural externality, echoing Arrow’s (1962) “spillovers effect”, meaning the creation of knowledge by one firm has positive external affects on the production of others due to the non-private nature of knowledge (Romer 1986). Romer (1990) defines spillovers as relating to the excludability of knowledge.

In 1990, Romer incorporated ideas from his 1986 work into another model. This represented the first real attempt to “model the endogenous component to technological progress as an integral part of economic growth theory” (Solow 1994: 51). Romer carried three fundamental concepts from his 1986 paper to build the model:

1. Technological change is central to economic growth and provides the incentive for capital accumulation. Together, capital accumulation and technological change account for the increase in output per hour (for example, endogenous to the economy).
2. Technological change is the result of intentional actions taken by profit-maximising agents.
3. The increasing returns to scale of knowledge-based goods (Romer 1990: S72).

Scale effect, according to Howitt (1999: 715), is when, for example, increased population leads to increased supply of R&D workers and increased demand for services. Romer (1990: S73) also incorporates scale effects, stating “larger markets induce more research and faster growth”. He views “human capital as the key input into the research sector, which generates the new products or ideas that underlie technological progress” (Barro 1991: 409). Romer (1990) attempted to model the elusive concept of technical change (Solow 1994); to do so, he altered the non-rival and non-excludable characteristics attached to knowledge by Arrow (1962) and Lucas (1988).

Aghion and Howitt’s (1992) model borrows two concepts from Romer’s (1986, 1990) work, namely that the knowledge-producing activity is endogenous to the economic system and that knowledge is produced by profit-maximising agents, mainly through investment in the R&D process. They also borrow from Stokey (1988) the concept of obsolescence. It differs in the respect that it is a model of vertical product invention rather than horizontal, like Romer’s (1990) model. Vertical invention implies previous inventions are obsolete because of the creation of a new, better invention. Horizontal invention implies inventions do not disappear once improved upon, but instead still may act as the base for further improvements. To achieve this notion of vertical innovation, Aghion and Howitt (1992: 323) integrate Schumpeter’s (1942) notion on creative destruction into new growth theory, the result of which is a model in which “better products render previous ones obsolete”, and where “progress creates losses as well as gains”. Each innovation therefore is an act of creation aimed at capturing monopoly rents and also destroys the monopoly rents that motivated the previous creation (Aghion & Howitt 1992: 331). The model concludes that growth results entirely from technological progress, which in turn results from rivalry among research firms that create innovations (Aghion & Howitt 1992). It is worth noting, however, that both the Romer (1990) and Aghion and Howitt (1992) models posit a change in the level of knowledge is equal to the number of people attempting to discover original ideas multiplied by the rate at which R&D creates new ideas (Jones 1995).
Jones (1995) departs from earlier R&D-focused models by labelling his model semi-endogenous, due to his belief that long-term growth is in fact not endogenous. In this he describes growth as endogenous in that the technological progress, which generates long-term growth, is the result of the efforts of profit-maximising agents (Jones 1995). He also critiques earlier R&D based growth models, namely those by Romer (1990) and Aghion and Howitt (1992), based on their “prediction of scale effects”. For example, the number of scientists engaged in R&D in the United States has grown from 200,000 in 1950 to nearly 1 million in 1987; per capita growth rates in the United States exhibit nothing remotely similar to this five-fold increase (Jones 1995: 760). Jones’ (1995) model remains centrally an R&D model, but he posits that economic growth depends on the generation of new designs, which in turn depends on individuals as an input to the design process.

2.3.3.4 Critique of Invention-Based Models of Endogenous Growth

As with learning-by-doing models, critiques of invention-based theories come mainly from within the discipline itself and usually are an antecedent of the attempted improvement of an R&D-based growth theory. An overriding fault with all growth models is authors’ inability to precisely measure the concept of knowledge (Pack 1994). Romer’s (1986, 1990) models’ use of scale effects has been another major critique. Empirical and observational evidence would suggest increases in the number of people involved in R&D do not correlate with per capita growth rates (Jones 1995). Also R&D-based growth theories do not allow for a period of development for new technologies, and assume that they achieve their full potential at the instant of invention (Young 1993). Young (1993) offers the example of the steam engine and its incremental improvements over time, which were required before the steam engine completely dominated older technologies (Young 1993: 446). This also is especially true for Aghion and Howitt’s (1992) model based on obsolescence. Authors, such as Solow (1994), critiqued early invention-based models, including Romer’s (1986), for their requirement of exactly constant returns to scale, citing the theory as resting on a “knife-edge assumption”. Others, including Jones (1999) and Li (2000), have added later growth models, such as Romer’s (1990) and Aghion & Howitt’s (1992) creative destruction model, to this list. Also from within the field of social economics, authors have critiqued new growth theory for its apparent failure to allow cultural and social
variables within growth models (Brinkman & Brinkman 2001).

Another assessment of the models leads to contention regarding the assumption that knowledge is distributed evenly (Acs et al 2003). Evidence from regional economics regarding the reasons for industrial districts and the spatial clustering of firms contests this (Porter 1998; Florida 1995; Gertler 1995). Other authors, such as Pack (1994), view an over-reliance on the macro elements of EGT as distracting from the important role played in economic growth by organisations and their ability, or lack thereof, to measure knowledge and take advantage of innovations and general economic knowledge.

2.3.3.5 Hybrid Models of Endogenous Growth

Young’s (1993) model of invention and bounded learning attempts to rectify the problems inherent in each category of models. Young’s model contends that the rate of invention is dependent upon the rate of learning due to “recognition of the need to actualise the productive potential of newly invented technologies”, which creates “incentives to engage in costly invention” (Young 1993: 447). The model also assumes a minimal level of invention must be present for learning to take place, pointing to the interdependence of what previously had been separate categories within endogenous growth literature (for example, invention and learning-by-doing). Young’s (1993) model also proposes that the prospect of learning-induced output improvements is bound by the entire number of goods society has created. Young (1998) incorporates aspects of this hybrid model into another, which combines the notions of vertical and horizontal innovation while avoiding the assumption that economic policy and incentives can affect growth in the long run (Dalgaard & Kriener 2001).

2.3.4 Conceptual Endogenous Growth Foundations Adopted by the KAF

EGT provides an established economic field that looks at knowledge from a different perspective: as an item, technical change, rather than a soft term than has not found its place as some of the inconsistencies in KM might suggest. EGT also contributes to the framework in several ways. It offers a second lens with which to examine the
knowledge phenomenon. Where Intellectual Capital based initiatives have largely focused on measuring and valuing human and other intellectual assets, and focused somewhat more on the human and social aspects of knowledge, EGT does not (Burton-Jones 2008; Roos et al 2005; Spender 1996; Blacker 1995). Concerning the framework EGT contributes in three major ways and in one more minor way; 1) through the nature of firm growth, 2) the nature of the phenomenon (knowledge) itself, 3) the nature of knowledge goods/outputs and finally, in a side note, the framework aims to move away from the traditional macro-level indicators surrounding knowledge assessment as criticised by Pack (1994), a weakness highlighted in endogenous growth models (Steedman 2001). Within Romer’s (1986, 1990) growth models, knowledge is seen as the product of profit-maximising agents (organisations) at micro-level. This will aid the theoretical validity of carrying out the research at firm-level. EGT suggests the following:

1) Concerning the nature of firm growth

- EGT suggests that knowledge is the driver of growth in firms through knowledge advancement and more effective knowledge processes.
- This diffusion of knowledge beyond the boundaries of market leaders has increased the productivity of private R&D (Comin & Mulani 2009).

2) The nature of the phenomenon (knowledge)

- EGT establishes that knowledge exists endogenously within the firm and that this knowledge is embodied in physical and human capital.
- As discussed that nature of knowledge is both non-rival and non-excludable (see 2.3.3.2)
- Knowledge is a result of experience gained in production function (learning-by-doing)
- Knowledge creation depends on the individual.
- Highlights master-apprentice type mentoring as the best way to transmit that highly important tacit knowledge

3) The nature of knowledge goods/outputs

- A better understanding of knowledge leads to increasing returns to scale within the organisation
- Increases in the knowledge outputs of the firm leads to an increase in output
endogenous to the firm

At macro-level, knowledge is channelled into growth through increased firm efficiency, knowledge spillovers and conscious economic investments and explicit decisions by many different economic units (Griliches 1992), which as a result, each individual organisation cannot appropriate all the knowledge they generate at any one time, thus creating spillover effects. At the organisational level knowledge is created, acquired, shared and reused by knowledge workers in a social setting. It is this phenomenon the framework seeks to explore. The Endogenous Growth models, as well as providing evidence for the existence of internal knowledge, provide a theoretical base for the knowledge indicators, particularly knowledge learning. Arrow (1962) posits that learning is produced from experience and can only take place as part of an activity-focused attempt to problem-solve.

2.3.5 The Conceptual KAF

The chapter began by criticising the OECD’s knowledge indicators (see section 2.1). The synthesis (see section 2.2.5 and 2.3.4) of the framework indicators using KM and EGT has already been discussed. This section, for the purpose of clarity, will bring this synthesis together. It will highlight the various indicators of knowledge that will be used in the KAF and the sections of the literature they are taken from. As stated earlier, the OECD indicators are insufficient. The various indicators and measures associated with these are described as fuzzy, broad, anecdotal and lacking the practical operational use that knowledge constructs should exhibit (Moffett & Humphreys 2012; Godin 2004; OECD 2002c). The KAF uses indicators from both KM and EGT as shown in Figure 2.6. The core indicators used in the KAF are as follows:

Knowledge Creation/Acquisition (see 2.2.3.1 & 2.2.3.2)

The KAF will look at how the organisation creates knowledge. This will be not limited to how the organisation creates knowledge, but what individuals are doing in this regard. KM suggests that creation is a social process; however, EGT suggests that it is entirely dependent on the individual. Furthermore it will be explored how knowledge is acquired within the organisation.
Knowledge Network/Sharing (see 2.2.3.3)
The KAF will explore the knowledge networks within the case firms. Areas such as informal and formal networks will be explored and how the sharing of knowledge occurs.

Knowledge Learning (see 2.3.3.1)
Taken primarily from EGT, knowledge learning is seen as a result of experience within the work situation. The KAF will explore areas of the organisation that are conducive to learning and how these can add back to the overall knowledge base of the organisation.

Knowledge Re-Use (see 2.2.3.4)
The framework will also look at how knowledge is exploited and re-used within the organisation. The framework will attempt to explore the knowledge activities associated with this also.

The Nature of Knowledge
The KAF will use a combined approach from the KM and EGT literature with regard to the nature of knowledge itself. Though this is not graphically depicted in Figure 2.6, it is worth noting the position. Knowledge is treated as the primary driver of growth and has several dimensions the researcher needs to be aware of (explicit, implicit, and tacit).

The previous sections have reviewed the KM and EGT literature pertinent to this research. The attention now turns to how the lessons learned from the literature are taken forward in this study. Despite the lack of a clear and concise conceptualisation of exactly what knowledge is, there is widespread agreement that knowledge is one of, if not the most important assets of the modern organisation (Cohen and Levinthal 1990; Nonaka 1991; Kogut and Zander 1992; Nonaka 1994; Grant 1996; Minonne & Turner 2009; Miller et al 2011). Knowledge is the fuel of innovation and modern innovation processes require that firms are aware of their knowledge activities (Chesbrough 2003). Yet, we have a limited understanding of the processes and knowledge indicators through which knowledge becomes embedded in the firm as previous researchers have tended to use indirect macro data from large scale databases.
(OECD 2009). What researchers and practitioners do understand is that effective KM today is about enabling knowledge as opposed to managing it. KM is about creating the environment where the knowledge lifecycle (creation, acquisition, sharing and re-use) can flourish. Thus, this researcher’s interest lies in examining the usefulness of deploying the KAF at organisational level. In Figure 2.6 the knowledge assessment framework is presented from the established indicators taken from KM and EGT (acquisition/creation, network/sharing, learning and re-use).

This KAF will be deployed in the case study organisations. It will have incorporated those knowledge indicators. Some of the activities associated with these indicators of knowledge are outlined in the literature before the deployment of the framework within the case studies. These may include for example, within acquisition; the documenting of knowledge (Hansen et al 1999), within learning; the training available at organisational level (OECD 2004). However, within, re-use, for example, the research cannot determine completely what knowledge activities are present until the framework is deployed. Once these new knowledge activities are discovered they will be added to the operationalised framework in a post-deployment phase. The main aim of the research is to explore the usefulness of the framework as a tool that can be further operationalised and aid in knowledge assessment at organisation level, by drawing on data, analysis and discussion from the deeply exploratory nature of the case studies presented. The probes used in conjunction with this are presented in Appendix B and E.
Figure 2.6: Knowledge Assessment Framework (Pre-Deployment)

Inputs:
- OECD Indicators
- Knowledge Acquisition
- Knowledge Network/Sharing
- Knowledge Learning
- Knowledge Re-Use

Networks:
- Knowledge Acquistion
- Knowledge Network/Sharing
- Knowledge Learning
- Knowledge Re-Use

Learning:
- Derived from Case Studies

Outputs:
- Outcomes
2.4 CONCLUSION

This chapter has provided a review of the relevant literature pertaining to the main theoretical issues covered in this thesis: KM, EGT and the indicators deployed within the KAF. It began presenting the OECD knowledge indicators. Following this the research defines the term knowledge within the context of the research and offers discussion around the dimensions of knowledge. The types of approaches to KM are discussed while also offering some of the prominent KM audit models. The existence of knowledge as an endogenously created item is explored using EGT. Three models of endogenous growth are presented and then critiqued.

The chapter concludes by conceptually presenting the KAF in Figure 2.6, which draws together the core areas of the literature. This framework also is used to inform the methodological choices made regarding the research tools best suited to carry out the analysis and assessment of knowledge at organisation level. The next chapter outlines the research methods used to observe and collect the data in this study.
CHAPTER 3: RESEARCH METHODOLOGY

“An increased use of both interpretive and critical field studies is required to make KM research more relevant and more sensitive to values.” (Zining & Sheffield 2006: 10)

3.0 INTRODUCTION

This chapter discusses research methods in general and the method that will be used in this dissertation. This chapter is divided into three sections. Part One will investigate paradigms of enquiry. The ontological positions open to different researchers and the practicalities of choosing a paradigm will be discussed. Furthermore, the key areas of distinction between differing paradigms will be reviewed. Interpretivism will be discussed as the dominant ontological means of gaining deeper meaning of subjectively framed knowledge on assessment indicators, procedures and behaviours. Table 3.1 illustrates the research process taken in this thesis.

Table 3.1: The Research Process

<table>
<thead>
<tr>
<th>Theoretical paradigms and perspectives (philosophy)</th>
<th>Research strategies (methodologies)</th>
<th>Methods of collection and analysis (methods)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positivism, post-positivism</td>
<td>Design</td>
<td>Interviewing</td>
</tr>
<tr>
<td><strong>Interpretivism</strong></td>
<td><strong>Case Study</strong></td>
<td>Observing</td>
</tr>
<tr>
<td>Constructivism</td>
<td>Ethnography</td>
<td>Documents and records</td>
</tr>
<tr>
<td>Hermeneutics</td>
<td>Ethnomethodology</td>
<td>Visual methods</td>
</tr>
<tr>
<td>Feminism</td>
<td>Phenomenology</td>
<td>Questionnaires</td>
</tr>
<tr>
<td>Racialised discourses</td>
<td>Grounded theory</td>
<td>Data management</td>
</tr>
<tr>
<td>Critical theory</td>
<td>Life history</td>
<td><strong>Computer-assisted analysis</strong> (nVivo)</td>
</tr>
<tr>
<td>Marxist models</td>
<td>Historical method</td>
<td>Surveys</td>
</tr>
<tr>
<td>Cultural studies models</td>
<td>Action research</td>
<td>Focus groups</td>
</tr>
<tr>
<td>Queer theory</td>
<td>Clinical research</td>
<td>Applied ethnography</td>
</tr>
</tbody>
</table>

Source: Adapted from Creswell (2007)

In Parts Two and Three of this chapter, reference will be made to documents contained in the research audit document (RAD) accompanying this project, such as examples of
correspondence with respondents and interview transcripts. A list of all documents contained in the RAD is available at the beginning of the thesis. Part Two will focus on the ontological, epistemological and methodological choices made during this research project. The research purpose, strategy and design will be outlined, and the role of the researcher also will be discussed. The use of an exploratory multi-case study also will be evaluated. The section also will discuss the micro methods used, including in-depth interviewing, document analysis and observation. Part Three of this chapter will address issues of quality and appropriateness in this research.

In line with the research objectives, outlined in Table 1.2, this dissertation aims to operationalise a KAF, by understanding the indicators of knowledge through the application of flexible design methods, while adhering to interpretivist ontology. The key objectives are: To explore knowledge acquisition activities at organisational level; To explore knowledge sharing activities at organisational level; To explore knowledge learning at organisational level; To explore knowledge re-use activities at organisational level; Develop a knowledge assessment framework with accompanying research probes; Explore the nature of knowledge at organisational level; Unearth avenues for future research opportunities. In addition, the case settings of Creganna and DePuy will be explored within the context of highly secretive medical device organisations. Table 3.2 shows the breakdown of the case studies’ structures.

Table 3.2: Summary of Case Studies

<table>
<thead>
<tr>
<th>Case</th>
<th>Industry</th>
<th>Context</th>
<th>Research Location</th>
<th>Role of Researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creganna</td>
<td>Medical device</td>
<td>Exploration of knowledge indicators/activities</td>
<td>Organisation-wide</td>
<td>Interviewer and observer</td>
</tr>
<tr>
<td>DePuy</td>
<td>Medical device</td>
<td>Exploration of knowledge indicators/activities</td>
<td>Innovation Centre groups</td>
<td>Interviewer and observer</td>
</tr>
</tbody>
</table>

Furthermore, Chapter Four and Five will describe several characteristics and scenarios within Creganna and DePuy: the Inventory Management Project IMP, the introduction of Oracle, the use of lean, the Knowledge Performance Indicator (KPI) system, knowledge cards, the User Productivity Kit UPK system, the 70-20-10 learning
initiative, Agile, Compliance Wire, and knowledge activities in both organisations. This discussion will take the form of a narrative, content-based description. This is to allow the reader to immerse him or herself in the richness of the cases, while having access to commentary on each issue.

The ontological understandings impact the research design. Two exploratory case studies are developed using in-depth interviews, non-participant observation and document analysis. These cases are chosen through convenient, purposeful sampling. Data collection, reduction and display are aided by the use of the qualitative data analysis programme, QSR NVivo. The quality of the research is analysed by evaluating the significance, completeness and consideration of alternative findings in each case and the overall trustworthiness of the research design and outcome. Limitations of this research include issues of researcher competence, the possibility of sampling error and issues of gender bias among respondents. The research design also was challenged by the sensitive nature of the research question: for example, respondents were from highly secretive industries and were discussing their KM practices, organisational knowledge and daily interactions. In addition, respondents would be regularly admitting their own inability to solve problems. For the respondent organisations, the time requirements also were demanding.

This chapter will discuss the proposed research and data collection methods. In subsequent sections, the research location will be discussed, and an explanation of why it was chosen will be given. Also, various research paradigms will be discussed followed by a description of the positivist and interpretivist approaches to research. Finally, a selection of the appropriate research paradigm will be explained, followed by the limitations to the research.

3.1 RESEARCH LOCATION

The development of the high technology sector has been a key factor in the attainment of substantial GDP growth rates in Ireland from 1998 to 2003, averaging 7.3% per annum. In 2004 this figure fell to 4.5%, mainly because of rising global oil prices. By 2005 Ireland’s GDP figure had increased to 5.1%. Collectively, these figures highlight that Ireland has experienced the fastest GDP growth rate amongst OECD countries over the past decade (Government of Ireland 2005).
The medical device sector is chosen for this study as part of the high-technology industry, as outlined by the OECD (2006). As defined by the OECD (2009, 2006, 2001b, 1996a) the high technology sector is comprised of computers and office machinery, electronic communications, medical device and pharmaceuticals based upon their expenditures or relative expenditures on R&D intensity (ratio of R&D expenditure to gross output). The service portion of OECD economies has not yet been developed, so that area also may warrant further investigation. High-knowledge sectors include electronic products, health services and business services (OECD 1996a).

Unfortunately, the economic landscape has changed in the last two years. Dell has long since moved its manufacturing operations from Limerick, while a whole host of other companies close their Irish subsidiaries. As of July 2012, Ireland had 450,000 people on the live register and was closing in on 14.9% unemployment. (Washington Post 2012) Coupled with people spending an average of 185% of their disposable income and Ireland losing its AAA credit rating (now junk status), the economic climate is a very different one than that of a decade ago. The economy once fuelled by exports became invested in the artificial property bubble, that later burst, and a decaying manufacturing sector (34,000 jobs were lost from 2000 to 2012). Consequently, the research location took on a different being – from one of practicalities to one of urgency from a national perspective.

3.1.1 The Medical Device Industry

Key characteristics define the medical device sector globally. First, the industry regularly undergoes rapid change due to shifts in the market. There are a number of dynamics driving this change, including mergers of smaller firms with larger firms to access financial resources in order to bring products to market. Larger firms often are better positioned to negotiate superior deals with national healthcare systems. Larger firms also have targeted each other. In 2006, Boston Scientific acquired Guidant, another large organisation in the market, and more recently in 2010, Creganna acquired Tactx Medical and had combined revenue of $110 million in 2010.
The medical device industry also is characterised by continuous litigation, with many of the sectors’ leading companies facing multiple and continual legal disputes. These often have long-term impacts on revenues. The end result is an industry-wide paranoia and common distrust between the major players.

Ten of the world’s top twelve medical device companies are based in Ireland. On a relative scale, this gives Ireland the largest cluster. Other areas of high concentration are Minnesota and Massachusetts in the United States.

Galway, in the West of Ireland, has established itself as a centre for launching medical device companies and as a major hub for manufacturing. Overall, there are about 140 companies involved in the medical device sector in Ireland, including supply organisations. This is not surprising considering the sector employs 24,000 people and accounts for 11.5% of Ireland’s manufacturing workforce, the highest number of people working in the industry in any country in Europe, per head of population (www.ibec.ie). The sector exports €6.2 billion worth of product. Exports of medical devices and diagnostics products now represent close to 10% of Ireland’s total exports.

3.1.2 History and Background of Creganna
Creganna started business at Ballybane, Galway, in 1980, providing services to local computer industries. During the early years, the company grew to provide metal products, such as housings and casings, to a large number of Irish customers, including Digital, Nortel and Apple. As the Irish industrial landscape changed, the company reinvented itself by being innovative, open to change and by taking advantage of opportunities. In 1999, the company had an opportunity to supply metal shafts (hypo-tubes) to the medical device industry. After significant investment in product development, the first hypo-tube shafts were supplied to Boston Scientific. At that time, the company employed 42 people.

During the following three years, the company established itself as the global leader in the supply of metal shafts for cardiovascular applications. This growth was possible because customers found Creganna open with work practices and flexible in ensuring their requirements were met. In 2001, the company moved its medical business to
In 2003, the company decided to focus on the delivery of devices for the medical industry. It continued to invest in new technologies and capabilities to expand its product offering, including the establishment of a contract design business. Creganna became a strategic supplier to a number of large multi-national companies and won supplier awards for quality and service. It concentrates on medical devices for minimally invasive procedures and this includes specialty needles for use in medical procedures, such as biopsies and the insertion of catheters or delivery shafts. These are designed to follow the natural entry points to the body.

In 2005, Creganna opened a second building on the Parkmore site which doubled the space available to the business and allowed a high level of growth to continue. In 2006, the company opened a facility in Marlborough, Massachusetts, in the United States, where it invested in design services and extrusion technology. At the end of 2006, the company employed 380 people in five locations worldwide.

During 2007, Creganna continued to grow and opened a third building at Parkmore. The company also won awards for innovation and for being the fastest growing company in the European Union. In January 2010, Creganna announced the acquisition of U.S. firm Avalon Medical Services, which trades as Tactx Medical. In a statement, it said the company, to be known as Creganna-Tactx Medical, will be “positioned as a world leader in the provision of technologies and services for minimally invasive delivery and access devices” (Irish times 2010).

After the acquisition, the company offered a range of technologies and services, with a particular emphasis on high-end therapeutic catheters. Creganna chief executive Helen Ryan said the move was a key step in the company’s vision to build a leading global medical technology company. “Our customers, medical device companies, are increasingly looking to strategic partners to fulfil more of their supply chain requirements. With our global locations, combined technologies and range of service,
Creganna-Tactx Medical is strategically positioned to meet these evolving needs” (IrishTimes 2010).

The new company, with bases in Ireland, California, Minnesota, Massachusetts and Singapore, will have a presence in many of the key medical device markets. Creganna-Tactx Medical employs more than 800 staff worldwide and has combined revenue of $110 million in 2012. For the purpose of the research, Creganna’s base in Galway will be studied. A detailed organisational chart of Creganna is presented Appendix T.

3.1.3 History and Background of DePuy

The DePuy family of companies have been pioneers in the fields of orthopaedics, spinal care and neuroscience therapies for decades. In 1895, Revra DePuy founded the first commercial orthopaedic manufacturer in the world by offering a fibre splint to replace the wooden staves then used to set fractures. The DePuy family of companies is now a $5 billion global presence that employs 5,300 people around the world. The companies in the DePuy family include DePuy Orthopaedics Inc., DePuy Spine Inc., DePuy Mitek Inc. and Codman & Shurtleff Inc. From non-surgical pain management to complete surgical solutions, DePuy’s range of treatment options include those for treating or reconstructing damaged or diseased joints, caring for traumatic skeletal injuries, treating spinal disorders and deformity, and repairing injured soft tissue. DePuy also offers a wide range of state-of-the-art therapies for neurological and central nervous system care. The DePuy headquarters is in Raynham, Massachusetts, and Warsaw, Indiana. The following is a synopsis of Depuy’s recent history:

In 1998, Roche officially became the parent of DePuy and Boehringer Mannheim. DePuy purchased Cleveland-based AcroMed, the second largest spinal company. This acquisition made Depuy Motech AcroMed the second largest spinal company. DePuy, the oldest manufacturer of orthopaedic implants in the United States, was acquired by Johnson & Johnson in a $3.7 billion transaction.
DePuy expanded its portfolio in 2003 into the field of orthopaedics and spine surgery with the acquisitions of Orquest Inc. and Link Spine Group Inc. Mitek, the supplier of the most widely used anchor in the world, the GII anchor, became part of the DePuy family and was renamed DePuy Mitek Inc.

In 2007, DePuy Orthopaedics launched Pinnacle Hip Solutions, a modular hip-bearing system with TrueGlide technology that provided surgeons with the freedom to choose the bearing surface and cup option that best met the individual needs of each patient. With Pinnacle, surgeons could choose either ultra-low-wear polyethylene liners or metal inserts, all in the same titanium cup to replace the socket of the patient’s natural hip. Also in 2007, DePuy Spine entered a strategic collaboration with Axial Biotech Inc. to develop a gene-based test to predict the likelihood of progression of scoliosis, an abnormal curvature of the spine that primarily affects children. DePuy Spine also acquired assets related to the treatment of vertebral compression fractures from Disc-O-Tech Technologies to bring treatments for the aging spine to market.

During 2009, DePuy introduced a new brand identity across the franchise and throughout the world. Never Stop Moving presented a unified vision for patient health and well being through the restoration, retention and improvement of movement, and it is embodied through a shared brand identity, character and values (Depuy 2010, [Accessed online], http://www.depuy.com/corporate-information/about-depuy).

3.1.3.1 DePuy Ireland
DePuy established its Irish operation in 1998 with a manufacturing facility in Cork to produce hip and knee orthopaedic implants for a worldwide market. The young company since has experienced tremendous growth with a workforce of more than 600 highly skilled staff. The plant is recognised as a leading exponent in lean manufacturing principles, and underpinning its success has been a positive commitment to the development and engagement of its employees.

In 2002, a Global Supply Chain (GSC) function was established in Cork to develop DePuy as a best-in-class supply chain organisation. This group manages the entire
supply chain for DePuy Orthopaedics, from the procurement and manufacturing of a product to inventory management, customer service, supply-and-demand planning, quality and risk management, and financial management. Its objective is to develop a world-class supply chain function that delivers the highest quality product, in a capital-efficient manner within a customer service environment.

The company aspired to achieve further success and recognised the need to move up the value chain to accomplish this. A five-year strategic plan was developed to position Cork as the location of choice for future investment. The foundation of this strategy was DePuy Ireland’s embrace of CPD activities, which allowed it to maximise the capability of its staff and create an innovative and dynamic culture. The success of this journey led to the announcement in 2008 that DePuy would establish an Innovation Centre in Cork to support advanced product and process development for next generation orthopaedic solutions. Appendix M shows an organisational chart of DePuy’s Innovation Centre.

The Innovation Centre itself is broken into two distinct groups; with a third group that is present across the other two groups. Firstly, Advanced Manufacturing Technology’s (AMT) role is as Respondent Sixteen describes to find “a better way to do this or ... a cheaper, more efficient way to do this” (Respondent Sixteen, RAD 16). It is “identifying and delivering projects that, in the advanced technologies arena, include conversion technology combination products, which is combining drugs and pharmaceuticals and medical devices, which is a new area for us” (Respondent Seventeen, RAD 17). Secondly, New Product Development’s role is “bringing new products in, setting new processes up” (Respondent Twenty Six, RAD 26). The Quality (QA) group functions as the quality watchdog for the company and works with procedure improvement and focuses on implementing and regulating best practice. The bulk of the Depuy field work was carried out within the Innovation Centre of these three groups. Depuy’s organisational chart is depicted in Appendix M.

### 3.2 PARADIGMS OF ENQUIRY

Paradigms of enquiry are defined as “the set of basic beliefs that guide action. Paradigms represent a world view that defines the nature of the world, the individual’s place in it and the range of possible relationships to that world and its parts” (Guba &
The methodological basis for a positive distinction has its roots in the fact value distinction in philosophy, the principal proponents of such distinctions being David Hume and G.E. Moore. The logical basis of such a relation as a dichotomy has been disputed in the philosophical literature. Such debates are reflected in discussions of positive science and specifically in economics, where it is disputed that economics can be completely neutral and agenda-free. In choosing a research approach, the empirically minded economic researcher must recognise that good economic research might not satisfy either the disciplinary purist or the practising economist, but should strive to achieve a practical balance between both extremes. It is the researcher’s belief that “social science methods should not be treated as mutually exclusive alternatives among which we must choose and then passively pay for the costs of our choices” (Brewer & Hunter 1989: 16). To achieve the most effective research, the researcher must identify the most suitable research paradigm or theoretical perspective capable of meeting the stated research objective. There are two main philosophical paradigms that form the basis of social science research (Denzin & Lincoln 1998): positivism and interpretivism. Each represents a position on a philosophical continuum. Alternative ontological positions rest along the continuum between both extremes (see Figure 3.1).

**Figure 3.1: Philosophical Continuum**

<table>
<thead>
<tr>
<th>Positivism</th>
<th>Hermeneutics</th>
<th>Phenomenology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Realism</td>
<td>Critical Theory</td>
<td>Constructivism</td>
</tr>
<tr>
<td></td>
<td>Humanism</td>
<td>Interpretivism</td>
</tr>
</tbody>
</table>

*Source: Adapted from Carson et al (2001)*

Researchers usually choose a paradigm best suited to their research objectives and general world view. Paradigm choice is aided by assessing the way researchers interpret and answer questions to do with ontology, epistemology and methodology (Creswell 2007).

*Ontological* questions focus on the nature of reality and whether research scholars view reality as independent human thought (positivism) or as a product of human
thought systems resulting in multiple realities (interpretivism). Ontologically, positivism follows the order of the natural sciences and assumes our world is regular, ordered and not random. Reality exists independent of human experience. Human action is assumed to be intentional and rational and, hence, predictable. Interpretivist approaches assume social reality is produced and reproduced by human beings through their actions and interactions. Organisations or other social systems do not exist separately from individuals and thus cannot be perceived and measured in some objective and universal way. Guba and Lincoln (1994) cite the ontological position of the researcher as having huge implications on the perceived ability to generalise and replicate the research findings, in that those who believe in the fixed “real” reality can easily advocate generalisability as opposed to those following a reality characterised by ongoing change.

**Epistemologically**, positivism is concerned with the rigorous testing of hypothesised cause and effect. Similar to the natural sciences, a positivist social scientist would conduct carefully constructed experiments or statistical analysis to find evidence to confirm or reject hypotheses. Indeed the relationship between researchers and the social actors and objects under study form the basis of epistemological questions. The research design can enable the researcher to remain external to the research subjects (positivism), and thus enhance the perceived objectivity. Alternatively, the researcher can immerse himself or herself in the culture of those under study (interpretivism) and engage in the subjective process of the social construction of knowledge (Walsham 2006). There is no single version of “the truth”. What we take to be “real” or “knowledge” is a construction of our minds, either individually or in a group. Whatever reality is, it can only be accessed and transmitted to others through yet more social constructions, such as language, shared meanings and understandings (Creswell 2007; Oates 2006). Interpretive knowledge is gathered through understanding these social constructions.

**Methodologically**, positivists have a strong preference for mathematical modelling, proofs and statistical analysis. A quantitative method, such as the survey, is a typical positivist instrument. The use of mathematics provides logical and objective means of analysing observations. Methodological questions relate to the tools used to collect and analyse the data. Techniques of data collection enable the researcher to collect and
construct knowledge based on their ontological and epistemological beliefs (Guba & Lincoln 1994). Interpretivist research methods are characterised by a deep immersion into the context of what is happening and the avoidance of pre-selected hypotheses and theoretical constructs beforehand (Kaplan & Duchon 1988). There is a strong preference for generating and analysing qualitative data, which includes the words people use, the metaphors they employ and the images they construct. Field work that engages the researcher in real social settings is more appropriate for generating interpretive knowledge.

3.2.1 Paradigm Conflict
There are four areas of conflict between the various paradigms of enquiry. The first, *tacit knowledge*, refers to the understanding of the unobservable and subjective elements of human action, such as knowing and being, and receives differing treatment within the paradigms. At the simple level, interpretivist researchers regard tacit knowledge as the intervening variable in any causal relationship. Positivist social science on the other hand regards actors’ subjectivity as an unobservable phenomenon, and as such it is for the most part ignored.

*Validity and reliability* form a very important role of quality social science research; however, conceptions of what they entail differ across paradigms. Validity posits that the research measures only what it is supposed to measure, therefore factors that may lead to biased results must be avoided. Gill and Johnson (1991) divide validity into key areas: internal validity, external validity, population validity and ecological validity. Different research designs enhance different elements of validity. The aim of the social science researcher should be to maximise these elements through research design and accurate measurement. Reliability is concerned with the consistency level of the findings; therefore, if the study is replicated under the same conditions but by an alternate researcher (Gill & Johnson 1994), the results remain consistent.

The validity of research can be improved through effective research design, specifically through the use of triangulation (Denzin & Lincoln 1998). Triangulation overcomes bias inherent in research, at the data, researcher and methodological levels (Gill & Johnson 1991), by using different methods to come up with the same answer to a single theoretical question (Creswell 2007). Denzin (1978: 327-328) distinguishes
between four types of triangulation:

1) Data triangulation sees the researcher use different data sources taken at different stages in different locations and from different people, as distinct from different investigation methods.

2) Investigator triangulation aims at decreasing and/or detecting researcher bias by employing different observers or interviewers depending on the research design.

3) Theoretical triangulation extends the frames of reference of the researcher and possible outcomes by approaching the data with multiple theories and hypotheses in mind.

4) Methodological triangulation involves the use of different methods and research techniques in order to maximise their strengths. There are sub-types: *Within-method* refers to the use of multiple approaches to one methodological tool, for example, employing questionnaires and semi-structured interviews.

The convergent findings of a triangulation approach are generally accepted to increase confidence in reliability and validity. As Brewer and Hunter (1989: 17) note, “*each set of data increases our confidence that the research results reflect reality rather than methodological error*”. The validity of cross-validated sets of data can be inferred from convergence across methods, divergence or disagreement among data, and often signals the need for further research.

Different *methodological tools*, depending on the chosen paradigm, can probe various objects. The roles methods play in positivist and interpretivist paradigms are vastly different. Positivist methods are seen as a way of insuring objectivity, increasing validity and decreasing bias.

However, as Tsoukas and Knudsen (2005: 14) warn, “*acts of probing are acts of construction: they bring forth aspects of the object under investigation ... while an object of study is often independent of the researcher and his/her vocabulary, the moment it is framed in a particular language it acquires a contingent existence*”. Interpretivist methods, however, recognise the value of the researcher’s embeddedness and the social actor’s knowledge when investigating highly contextualised settings.
Finally, paradigms differ in the conception of the role of the researcher. As the knowledge produced by positivist research is considered to be external to both its users and producers, methodological tools need to be developed, which enable objectified separation. Within the positivist tradition, the researcher is regarded as external to the object of research. This perceived objectivity is viewed as being achieved through research design, such as employing the experimental approach. Epistemologically, the investigator and the subject under investigation are assumed to be independent of each other, leading to an outcome of objective knowledge. Conversely, in the interpretivist ontology, the researcher and the social subject being enquired are interlocked in an interactive, embedded process, thus resulting in subjectively framed knowledge.

3.2.2 Positivism

Positivism represents the oldest scientific theory (Sarantakos 1998) and refers to the study of positive phenomena that can be perceived by the senses using only scientific methods (Berg 1995; Crotty 1998; Easterby-Smith et al 1991). This particular paradigm perceives the world to be “mathematically drafted” and regards mathematics as a guarantee of precision. By implication, those engaged in positivist research tend to utilise mainly quantitative research techniques, which are often seen to command more respect and imply more accuracy than their qualitative counterparts, reflecting the general tendency to regard science as related to numbers (Berg 1995).

Positivist research aims to find causal explanations that determine effects, for example, causes that are external from the people being studied but yet limit the same people (Creswell 2007; Donalson 2005). These causal explanations lead to the development of positive theories that describe and explain how the world works, as opposed to normative theories that explain how the world should work based on value judgements (Friedman 1953). The applicability of causal logic is called into question, however, by the study of dynamic and complex systems using tools such as process-based analysis (Burrell & Morgan 1979). Causal logic also implies that positivist thought places more importance on generalised concepts and categories than on actual experience. To achieve positive theories, according to Donaldson (2005), positivism draws distinction between “facts” and “values”, with greater emphasis placed on the former. Thus, social
positivism holds that social facts should be explained in terms of other social facts as opposed to the subjective values of social actors (Durkheim 1938). The following table outlines the strengths and weaknesses of the positivist approach.

Table 3.3: Strengths and Weaknesses of Positivism

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can be fast and economical</td>
<td>Methods tend to be inflexible and artificial</td>
</tr>
<tr>
<td>Provides a wide range of situations</td>
<td>Not very effective in understanding processes or the significance people attach to activities</td>
</tr>
<tr>
<td>May be of considerable relevance to policy decisions, especially when statistics are aggregated from big samples</td>
<td>As they focus on what is, it is difficult for policy makers to infer what future changes and actions should take place</td>
</tr>
</tbody>
</table>

Source: Adapted from Easterby et al (1991: 32)

Through the application of deduction and quantitative techniques, positivism seeks for answers objectively. Conceptual and theoretical structures are developed and operationalised. These theories and concepts are tested through empirical observation. The results of this empirical work take the form of theory falsification, or the creation of an unfalsified theory, to explain observations (Gill & Johnson 1991).

Subjective approaches question the plausibility of a research paradigm that bases explanations dominantly on observable experience alone (Guba 1990). For example, post-positivism derives from the philosophical recognition in positivist and other fields that the fundamental beliefs of the paradigm are no longer defensible. Ontologically, post-positivism researchers view reality as mentally constructed during the research process by those engaged in it. Thus, reality is regarded as subjective and highly context-dependent, and such multiple realities can exist around a single research effort (Creswell 2007; Hughes 1994). Post-positivism has moved away from the claims of absolute truth attributed to traditional positivist findings; instead the focus is on valid evidence acting as proof for the existence of phenomena. A critical stance encompassed the post-positivist approach in that it adheres to essential elements of the positivist approach, including rigor, logical reasoning and attention to the evidence. But unlike positivism, these guidelines are not confined to what can be physically observed. Methodologically, post-positivism is informed by critical multiplism (Guba & Lincoln 1994), that research is critically approached using many methods, both qualitative and quantitative. Epistemologically, it is the interactions between the
researcher and the researched which generates findings. Thus, action research is a method often used in post-positivist research.

An increase in the number of available methodologies since the 1960s has resulted in the positivist approach losing its once privileged position within the social sciences (Berg 1995; Sarantakos 1998). The inherent limitations of the positivist paradigm have led some researchers to argue that quantitative measures alone cannot capture the real meaning of social behaviour as they often result in meanings that are closer to the researcher’s own particular beliefs than to those of the respondents. In addition, research objects, including respondents, are considered scientific objects under this approach and are therefore treated as merely informants or data producers (Berg 1995; Crotty 1999).

3.2.3 Positivist Influence on KM Organisational Theory

The aim of positive social science in organisations is to build general causal theories about the firm based on valid explanations of how the organisation operates in reality. Positivist organisational science views organisations and actors within the firm in almost a biological sense – as constantly struggling for survival within the environment (Katila 2002; Nelson & Winter 1982). Thus, positivism analyses organisations in terms of situational-determined functionalism5 (Donaldson 2005). This results in theories of adaption and selection (Levinthal 1997). The relatively low concentration of positivist research within studies of KM in organisations can account for the equally low consensus levels at organisational level, of positivist work in the research into knowledge assessment (OECD 2006, 1996a; Lev & Daum 2003; Wagner & Sternberg 1991).

However, the dominance of the positivist paradigm in organisational research has impacted the characterisation of organisational knowledge. Within the positivist tradition, an objective view of organisational knowledge is adopted and it is regarded as a cognitive possession and commodity and is viewed as static and taxonomic. Schultze and Stabell (2004) refer to this as the neo-functionalist view of knowledge in

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5 Broad perspective in sociology and anthropology that sets out to interpret society as a structure with interrelated parts. Functionalism addresses society as a whole in terms of the function of its constituent elements, namely norms, customs, traditions and institutions.
organisations. Within research of this vein, knowledge assets often are preferred over the knowing action (Miller et al 2011; Grant 2002, 1996; Teece et al 1997; Sveiby 1997) and as something “explicit that is quite distinct from philosophy or values” (Pfeffer & Sutton 1999: 92). To this end, the empirical qualities of knowledge are emphasised as something that can be possessed by both people and organisations (Nonaka & Takeuchi 2007; Grant 2002, 1996; Nelson & Winter 1982). Blacker (1995: 1021) summarises the traditional approaches to organisational knowledge as offering “a compartmentalised and static approach to the subject”.

Positivist studies of organisations also are impacted upon by a growing need to recognise tacit knowledge and its importance to organisational performance (Nonaka & Takeuchi 2007). While logical positivism rejects the need for science to measure the tacit elements of knowing, post-positivism in organisational science accepts unobservable processes and elements as legitimate areas for study (Creswell 2007; Guba & Lincoln 1994). These unobservable objects, however, must be inferred from observables to maintain objectivity. Post-positivists never negate the prevailing view that unobservables lack reliability when compared to observable facts (Donaldson 1997). This in many instances leads positivism’s avoidance of reduction in favour of macro approaches to social phenomena.

3.2.4 Interpretivism

Interpretivism posits that information about the world does not occur naturally in the form of numbers. It is researchers who bring structure to data by imposing a numbering system and meaning on raw data they collect (Punch 1998). However, as certain experiences cannot be meaningfully expressed by numbers (Berg 1995), interpretivism, also referred to as anti-positivism or post-positivism, attempts to fill this void by seeking to understand and explain human and social reality (Crotty 1998; Fay 1975).

Interpretivists tend to believe reality is not objective, but subjective; reality is what people perceive it to be. While positivism emphasises facts and predictions, interpretivism emphasises meaning and understanding (Berg 1995). This hermeneutic approach to research puts the onus of interpretation on the part of the researcher.
Therefore, it is primarily adopted in conjunction with qualitative research techniques and is used to examine various social settings, as well as to engage in discussions with those who live in these social settings (Berg 1995; Denzin & Lincoln 1998; Punch 1998).

Ontologically, interpretivist researchers regard reality as socially constructed and multifaceted. Interpretivism acts as an umbrella for many movements that take issue with positivism as a social science, including phenomenology, hermeneutics, grounded theory and ethnomethodology (Creswell 2007; Hatch & Yanow 2005). Interpretivist meaning comes from the understanding that social worlds cannot be understood using physical science’s attributes and measures. Interpretivist research aims to develop an understanding of the phenomena under study, as opposed to the explanation-based goals of positive science (Creswell 2007). Knowledge of the social world is viewed as coming from the interpretation of sense perceptions. This interpretation occurs in the context of events or experiences, both of which are informed by the tacit knowledge of social actors. It is these subjective processes that act as an explanation for human behaviour. Because interpretivist approaches have included multiple levels of analysis and contextual environmental issues, particularly in organised science, interpretivist researchers are somewhat limited in their quest for a more macro understanding of phenomena (Creswell 2007; Guba 1990).

The predictable element of interpretivist research is negated by actors’ abilities to alter behaviour on the foundation of meaning-based prediction. This implies the notion of multiple realities, as reality is constructed differently by different people. Therefore the certainty of knowledge from the subjective perspective does not come from an external verification based on universal rules or truths, but from the collective sense-making of the interpretive community. Critical theories critique interpretivist science for the disengaged manner in which it addresses issues such as power and control (Hatch & Yanow 2005). In addition, interpretive methods are regarded as weak in relation to reliability and population validity (Creswell 2007). Population validity in particular is considered weak due to the small number of cases investigated; this limits validity to cases being studied and decreases the ability of the research to generalise. In interpretivist research, researchers take on “lived” experiences as they attribute meaning to both actors and artefacts. Therefore, researcher bias can take the form of
selective filtration of information, selective interpretation of information and the imposition of order on data in the form of coding (Creswell 2007; Guba 1990). Qualitative research methods also are perceived as difficult and time consuming due to their multiple characteristics and multifaceted nature. The strengths and weaknesses of the interpretivist approach are outlined in Table 3.4.

**Table 3.4: Strengths and Weaknesses of Interpretivism**

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to look at processes changed overtime</td>
<td>Data collection is time consuming and needs many resources</td>
</tr>
<tr>
<td>Ability to understand meanings</td>
<td>Analysis and interpretation of data may be difficult</td>
</tr>
<tr>
<td>Ability to adjust to new issues and ideas as they emerge and to contribute to the evolution of new theories</td>
<td>Difficult to control pace, progress and endpoints of study, and is often criticised as untidy</td>
</tr>
<tr>
<td>Provides ways if gathering data that are seen as natural rather than artificial</td>
<td>Often assigned low credibility by policy makers</td>
</tr>
</tbody>
</table>


Although qualitative research methodologists have not featured in the social sciences as predominantly as quantitative techniques, they have nonetheless left their mark both conceptually and theoretically (Bogdan 1975). Whereas the virtues of qualitative research are seldom questioned, its practice is sometimes criticised for being non-scientific and thus invalid (Berg 1995; Sarantakos 1998; Punch 1998). Berg (1995) argues many of these critics have lost sight of the probability inherent in quantitative practices and have instead replaced it with the assumption of certainty. Fitzgerald and Howcroft (1998) provide a concise summary of this positivist/interpretivist divide in terms of ontology; epistemology, method and axiology (see Table 3.5). In Table 3.5, the tick marks show the research method that is reflected in this dissertation.

**Table 3.5: Soft versus Hard Research Dichotomies**

<table>
<thead>
<tr>
<th>Soft</th>
<th>Hard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ontological Level</strong></td>
<td><strong>Epistemological Level</strong></td>
</tr>
<tr>
<td><strong>Relativist:</strong> Belief that multiple realities exist as subjective constructions of the mind. Socially transmitted terms direct how reality is perceived and will vary.</td>
<td><strong>Realist:</strong> Belief that the external world consists of pre-existing tangible structures that exist independently of an individual’s cognition.</td>
</tr>
</tbody>
</table>

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### Interpretivist
No universal truth. Understand and interpret from researcher’s own frame of reference. Uncommitted neutrality impossible. Realism of context important.

### Positivist
Belief that the world conforms to fixed laws of causation. Complexity can be tackled by reductionism. Emphasis on objectivity, measurement and repeatability.

### Subjectivist
Distinction between the researcher and the researcher situation is collapsed. Research findings emerge from the interaction between the researcher and the research situation. The values and beliefs of the researcher are central mediators.

### Objectivist
Both possible and essential that the researcher remains detached from the research situation. Neutral observation of reality must take place in the absence of any contaminating values or biases on the part of the researcher.

### Insider/Subjective
Origins in anthropology. Research orientation centred on insider’s view, with the latter viewed as an appropriate judge of research adequacy.

### Etic/Outsider/Objective
Origins in anthropology. Research orientation of outside researcher, who is seen as objective and as the appropriate analyst of research.

### Methodological Level

| **Qualitative** | Determining what things exist rather than how many exist. Thick description. Less structured and more responsive to needs and nature of research situation. |
| **Quantitative** | Use of mathematical and statistical techniques to identify facts and causal relationships. Samples can be larger and more representative. Results can be generalised to larger populations. |

| **Exploratory** | Concerned with discovering patterns in research data and with explaining/understanding them. Lays basic descriptive foundation. May lead to generation of hypotheses. |
| **Confirmatory** | Concerned with hypothesis testing and theory verification. Tends to follow positivist, quantitative modes of research. |

| **Induction** | Begins with specific instances that are used to arrive at overall generalisations, which can be expected in the balance of probability. New evidence may cause conclusions to be revised. Criticised by many philosophers of science, but plays an important role in theory/hypothesis conception. |
| **Deduction** | Uses general results to ascribe properties to specific instances. An argument is valid if it is impossible for the conclusions to be false if the premises are true. Associated with theory verification/ falsification and hypothesis testing. |

| **Field** | Emphasis on realism of context in natural situations, and posits that precision in control of variables and behaviour cannot be measured. |
| **Laboratory** | Precise measurement/control of variables, but at the expense of naturalness of situations, since real-world intensity and variation may not be achievable. |

| **Indiographic** | Individual-centred perspective, which uses naturalistic contexts and qualitative methods to recognise unique experiences of the subject. |
| **Nomothetic** | Group-centred perspective, which uses controlled environments and quantitative methods to establish general laws. |

### Axiological level

| **Relevance** | External validity of the actual research question and its relevance to practice is emphasised, rather than constraining the focus to that which is researchable by “rigorous” methods. |
| **Rigour** | Research characterised by hypothetic-deductive testing according to the positivist paradigm, which emphasises internal validity through tight experimental control and quantitative techniques. |

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**Source:** Adapted from Fitzgerald and Howcroft (1998)

### 3.2.5 Interpretivist Influence on KM Organisational Theory

The study of meaning is a key component of KM theory research (Ichijo & Nonaka 2007) and of broader organisational theory research (Barnard 1948). This became
prevalent in interpretivist research on organisations in the 1970s, 1980s and 1990s (Hatch & Yanow 2005). The prevalence was driven by an increasing recognition of the importance of tacit knowledge in organisations (Sveiby 1997; Polyani 1962; Cook & Brown 1999). In early studies, sociological and anthropological theories are applied to organisations, most notably in relation to culture. Turner’s (1971) approach to “get under the skin of the organisation” partly led to the development of the grounded theory approach of organisational research.

While cultural-based studies focus predominantly on cultural artefacts in the hermeneutic tradition, other researchers (Weick 1979, 1995; Chia 1997; Ichijo & Nonaka 2007) began to look at process-based social construction and sense-making in organisations. This was seen as the move from studies focusing on structure within organisations to a more in-depth look at processes within organisations. Process-based thinking represents one of the larger shifts from causal logic dominant in positivist studies. In Chia (1997: 696), the term “process of becoming” was coined to highlight the dynamic and emergent nature of the phenomena under study. Empirical research, such as that of Blacker (1995), views organisational learning as resulting from context-specific sense making in activity systems. Collecting stories as artefacts also receives continued attention in interpretivist organisational studies (Hatch & Yanow 2005).

Interpretivist ontology’s basis on process has aided the development of a subjective view of knowledge in organisations, where the act or practice of knowing takes precedence (Spender 1996b; Cook & Brown 1999). Schultze and Stabell (2004) refer to this as a “constructivist” view of knowledge in the organisation. Within this view, knowledge is regarded as both dynamic and emergent in nature, and the social aspects of the knowing process are emphasised (Spender 1996b). This view focuses on the emergent qualities of knowledge as the “traditional conceptions of knowledge as abstract, disembodied, individual and formal are unrealistic” (Blacker 2004: 351). This suggests knowledge is understood to be a creating act, not solely a representation. This creating act is referred to as knowing or practice, which “refers to the coordinated activities of individuals and groups in doing their real-work as it is informed by a particular organisational group or context” (Cook & Brown 1999: 386-387). Social relations are viewed as the vital building blocks of knowledge, which in turn leads to a focus on knowledge processes as opposed to the knowledge object (Spender
3.3 RESEARCH, PURPOSE, STRATEGY AND DESIGN

The choice of research purpose, strategy and design is influenced by three major factors (Yin 2009, 1989):

1) The types of research questions and problems posed define the objectives, inform what is required to answer the questions and meet these objectives, and guides the areas of interest prior to data collection.

2) The extent of control an investigator has over behavioural events influences the requirement for methods that allow for the manipulation of events.

3) The degree of focus on contemporary as opposed to historical events determines the levels of primary and secondary research.

The perceived role of the researcher in relation to the research also informs the design and the strategy adopted. The interpretivist researcher must acknowledge that the object of study may be objective to the researcher until such a time as it is framed in the researchers’ language, and thus acquires a contingent existence and multiple meanings. In essence, all research actions within the research setting become acts of construction for the researcher (Tsoukas & Knudsen 2005). This view of the role of the researcher is linked to the adopted ontology in this study: interpretivism. This research then adheres to the interpretivist stance on the relationship between the researcher and the research, and to that which is given in organisational theory, that the object of study is a social object. The relationship between the researcher and his and her object also is a social one.

Within interpretive case-based research, the resulting commentary is a combination of the actors’ and researcher’s interpretation of events. True interpretive scholars integrate into their research the recognition that researchers rarely enter research settings as an empty vile waiting to be filled with evidence. Researchers are viewed as carriers of assumptions, values and frames of reference, all of which impact what is observed and what is not (Creswell 2007; Pettigrew 1997). This acceptance of an embedded researcher fuels cycles of induction and deduction, which characterise interpretive case-based research. Epistemologically in this study, the author became
immersed in the research setting through the use of in-depth interview and observation techniques. This embedded and socially constructed view also is informed by interpretivist understandings, which allowed the author to present two case studies that detail the deployment and testing of knowledge assessment indicators within each case.

3.3.1 The Research Purpose: Exploratory

Before detailing the methodological approach used in this thesis, the researcher will examine the purpose of the research. The particular design of a qualitative study, or the methods used, depends on the purpose of the enquiry. Creswell’s (2007) and Robson’s (2002) purposes distinguish between exploratory, descriptive and explanatory purposes. They point to the fact that all three purposes can appear as elements in the same research over time, however, one purpose generally tends to have a dominant influence.

This study is exploratory in nature and aims to operationalise a KAF for use within organisations. Furthermore, additional questions and theory generation will be outcomes of this research. Generalisation of the findings is not the main focus of exploratory research. The focus instead is on providing narrative accounts of the complex and dynamic actions within the organisation. The following discussion highlights the research strategy and design the author employs in answering the research question.

3.3.2 The Research Strategy: Exploratory Case Study

Research strategy refers to the particular strategies chosen by the researcher to answer the research question (Yin 2009, 1989). Llewellyn (1993) proposes that “methodology reflects the ontological and epistemological assumptions of the researcher, whereas methods are secondary concerns around the techniques used for data collection”. Understandings about what organisational knowledge is, how it develops, how it is validated, how it is linked to practice and what role people play in generating knowledge act as the foundation for devising any research strategy. In order to enact the strategy, a researcher must choose specific research designs or tools aimed at
probing and collecting research data within the context of the research site. The research strategy employed in this thesis is that of a qualitative case study, specifically the exploratory case study.

The exploratory case study seeks to satisfy curiosity, provide a better understanding for general interest, and examine the feasibility of further study by indicating what might be relevant to study in more depth and by providing illumination on a process of a problem (Creswell 2007; Hart 1998). Questions focus on the how, what, when and where. Studies tend to be small scale and often informal in structure (Hart 1998). With this in mind, this study seeks to assess knowledge performance within high technology firms and within the relationships that knowledge has with creation, acquisition, sharing and re-use. There are many valid reasons for doing qualitative research, but a crucial one, according to Strauss and Corbin (1998) and Hewison (2003), is the nature of the research problem. Therefore, the choice of research strategy is governed by the questions the researcher asks. In this study, the questions are about the how and why of knowledge assessment and the applicability of the framework.

This study uses the case study approach for a number of reasons posited by Yin (2003a: 9), including that the nature of the research findings is exploratory in nature, that the researcher was unable to access actual events on site, and that the relevant behaviours themselves could not be manipulated. Although case studies can overlap with other methods or research, such as histories, its unique strength is its ability to deal with a full variety of evidence, including documents, artefacts, interviews and observations. The focus, according to Yin (2003a: 12), is on contemporary rather than historical phenomena. By choosing to ask “how” and “why” questions, the case is exploratory in nature. These questions deal with operational links needing to be traced over time rather than frequencies and incidences. The case study is a useful method of to explore how or why a process is working.

The qualitative case study essentially is “an umbrella term for a family of research methods having in common the decision to focus an inquiry around an instance”, (Adelman et al 1980: 49). Strauss and Corbin (1990) claim qualitative methods can be used to better understand any phenomenon about which little is known or where quantitative measures cannot adequately describe or interpret the situation under study.
The essence of qualitative case study-based methodology, as Guba and Lincoln (1985: 120) describe, “if you want people to understand better than they otherwise might, provide them with information in the form in which they can usually experience it”. Qualitative methods are typically rich with detail and give insights into participants’ experiences of the world that connect with the reader’s experience, and thus are more meaningful. Therefore, the recognition and context outlined in the case study-based approach make it more suitable to interpretivist research ontology. As Schramm (1971), cited in Yin (2003a: 12), notes, the essence of a case study is “… to illuminate a decision or a set of decisions: why they were taken, how they were taken, implemented, and with what result”. This definition cites decisions as the focus of the case study; but it can apply as much to processes, programmes, institutions, events or people. The case study involves an intensive examination of the units to be explored, be it the process or entity of knowledge assessment, as in this research.

Qualitative case studies are observed as the most appropriate strategy for exploratory studies (Yin 2009, 1989). Types of qualitative case studies are distinguished by the size of the bounded case, such as whether the case involves one individual, several individuals, a group, an entire programme or an activity. Creswell (2007) highlights three variations that exist in terms of intent:

1) The single instrumental case study
2) The collective or multiple case study
3) The intrinsic case study

In the single instrumental case study, the researcher focuses on one issue. In a collective or multiple case study, the one issue or concern again is selected, but the inquirer selects multiple case studies to illustrate the issue. The researcher may select several programmes from several research sites, or multiple programmes within a single site. Often, according to Creswell (2007), the researcher selects multiple cases to show the issue’s different perspectives. Yin (2009; 2003b) suggests the multiple case study design uses the logic of replication, which states that the inquirer replicates the procedures for each case. The final type of case study, according to Creswell (2007), is an intrinsic case study in which the focus is the case itself (for example, evaluating a programme or studying a student having difficulty) because the case
presents an unusual or unique situation. This resembles the focus of narrative research, but the case study’s analytic procedures of a detailed description, set within its context, still hold true.

The cases in this study follow the multiple-case approach and are both exploratory and dynamic with the intention to provide open descriptions and analysis of knowledge assessment within these organisations.

There are procedures for conducting a case study; indeed, several procedures are available (see Merriam 1998; Stake 1995; Yin 2009, 2003a). Stake (1995) effectively outlines the procedure:

First, researchers determine if a case study approach is appropriate to the research problem (more on this will be outlined in subsequent sections). A case study is a good approach when the inquirer has clearly identifiable cases with boundaries and seeks to provide an in-depth understanding of the cases or a comparison of several cases (Creswell 2007). Researchers need to identify their case or cases. The case can be single or collective, multi-sited or within-site, or focused on a case or an issue (Stake 1995; Yin 2009; 2003a). The data collection in case study research is typically extensive, drawing on multiple sources of information, such as observations, interviews, direct observations, participant observations and physical artefacts.

Analysis of the data can be a holistic analysis of the entire case or an embedded analysis of a specific aspect of the case (Yin 2009, 2003a). Through this data collection, a detailed description of the case (Stake 1995) emerges where the researcher details such aspects as history, chronology, or a day-to-day rendering of the activities of the case. Yin (2003a) suggests an analytic strategy of identifying issues within each case and then looking for common themes that transcend the case. When multiple cases are chosen, a typical format is first to provide a detailed description of each case and themes within the case, called within-case analysis (Creswell 2007), followed by a thematic analysis across the cases, called cross-case analysis, as well as to offer assertions or an interpretation of the meaning of the cases (Creswell 2007; Yin 2009; 2003a; Stake 1995).
Among the design decisions to be made is determining the primary unit of analysis on the study, choosing how context will be defined and operationalised, and determining the time frame of the study (Guba & Lincoln 1985). Each element is discussed in the following sections.

3.3.2.1 Justification for Multiple Case Strategies

Looking to systems-based organisational theory, Lorsch and Lawrence (1970) note there is no “one best way” to achieve a given result. It is the result of fit among the internal functioning of the organisation, the task, the technology and the environment. The response to these concerns is to use cases in a comparative methodology. The advantages and disadvantages of multiple cases compared to a single case study often are a methodological consideration as well as a pragmatic one. Indeed, for this research, access to case organisations was thought to be a particular challenge, given the focus of the study on organisational knowledge in a highly secretive industry. It is argued that theory derived from single cases is richer and more coherent (Dyer & Wilkins 1991), but Eisenhardt (1989) states that the argument between single or multiple cases is a false one as it is difficult to substantiate whether certain single cases contributed more than that of certain multiple cases. Yin (2009, 1994) concurs with this and states that the single case is eminently justifiable under certain conditions – where the case represents a critical test of existing theory, where the case is rare, unique or deviant or where the case is a revelation. These criteria do not apply to this research.

The advantages of multiple case studies are proposed by Yin (2009, 1994) and Eisenhardt (1989). The study is considered more robust and highly contextual (Creswell 2007). Improved theoretical understanding and methodological rigour also can be achieved when results are compared across multiple cases. This, according to Pettigrew (1997), allows for cases at each end of the spectrum to be exposed, which then provides an opportunity to raise additional dimensions or factors that explain the empirical variation, and this affords another chance for more pattern recognition. When using a multiple-case design, another question asked regards the number of cases deemed necessary for the research. Yin (2009, 1994) argues the case number decision is a reflection of the number of case replications, both literal and theoretical.
A minimum of two or three literal replications is needed. Eisenhardt (1989) finds, however, that in a multiple-case approach there is no ideal number of cases. Pettigrew (1997) also argues the in-depth quality of the exploratory case approach emphasises the use of theoretical sampling and not that of statistical sampling, and suggests sticking with the comparison of a small number of cases.

The approach for this research then is to select two cases for study and to utilise the opportunity for comparisons and contrasts by selecting cases with varying contexts, between which differences can be expected with respect to knowledge assessment. This method of selection is convenient purposeful sampling (Patton 1990).

### 3.3.2.2 Identification of Case Studies

Although the research question is concentrated on developing a KAF for use in organisations, the criteria for selection related more so to the organisation itself, as it was assumed that knowledge-intensive activity alone would not be a pragmatic way to distinguish organisations. The goal was to identify Ireland’s knowledge-intensive firms, which contained groups or projects within varying contexts, namely where a level of knowledge creation, acquisition, sharing and re-use was occurring. Given the need to select cases of interest and other pragmatic concerns, as well as the need to overcome access challenges, criteria were defined to help identify sufficient potential cases from which a final selection could be made. These criteria include manufacturing organisations operating in the high technology sector as defined by the OECD. These were located and supported by the Industrial Development Authority (IDA).

The task of identifying firms began in late 2007 to early 2008, using various websites and, particularly, the high technology database from the Industrial Development Authority. Up to 150 firms were identified and contact details for managers, technical supervisors, R&D managers and marketing departments were noted. A Prime Time special on “successful Irish high technology organisations” revealed some companies that may have been interested in the concept of knowledge assessment. Creganna was the first company that agreed to become a research site, and this became the primary case for the research. The earliest working relationship began here. The informal
contact with their KM and Training Advisor served to build relationships with key people and to allow data collection and observations to begin. Field work with Creganna began in January 2009. As discussed previously, knowledge-intensive or high technology firms were defined using the OECD (2001b) classification for high technology sectors: aircraft and spacecraft; pharmaceuticals; medical device, precision and optical instruments; radio, television and communication; and office, accounting and computing machinery.

The high technology sector was chosen for this research because it has a high intensity of knowledge and innovation, where the best way to achieve success is to develop a new and better technology or capability (Leonard-Barton 1995). Also, indicators of knowledge as per the OECD literature, such as inputs, outputs, networks, stock and learning, are clear and present in organisations and projects in this sector. Other criteria for Ireland's high technology sector include the hiring of educated and skilled employees (Yang 2005), geographic clustering (Amin & Thrift 1994) and innovative manufacturing processes developed through acquisitions and partnering (Stuart 2000). It also is interesting to note that Ireland as a setting is interesting in itself, as Irish R&D investment is slanted toward the high technology sector. For example, in 2002 Ireland’s manufacturing industry had the highest percentage (73%) of high technology firms across OECD members (OECD 2002b).

The criteria for the selection of case firms and case groups within them was a much more prolonged and delicate process, and it developed over time during informal communications with various managers and contacts. To this end, different contexts for groups were identified, which would prove most interesting for the case studies. These centred on a macro look at the Creganna organisation. This was achieved by speaking with people from different business units to give an overarching organisational picture. Within DePuy, knowledge indicators were observed within the company’s Innovation Centre. This was achieved by discussing processes and initiatives with some core members of the Innovation Centre. The size of the groups also was an important factor. It was felt that smaller groups would allow for a more in-depth analysis using the framework at individual, group and organisational levels. This was because smaller groups would know what was happening across all members of their group. It was felt, for the purpose of the study, larger groups would be more
likely to discuss issues at either individual or group level but probably not both. A
detailed chronology of the negotiation of access and the data collection phases is
available in Appendix J.

3.3.2.3 Access

A key challenge when conducting this research was gaining access to the case firms.
From the database of companies, communication over time determined some had
salience for involvement in a more in-depth study, as well as a willingness to give
access. From the initial organisations, six stood out and showed promise: Dell,
Creganna, Boston Scientific, DePuy, Cordis and Gensyme. The contacts in each
organisation were given the background to the research and the intended research
agenda as well as potential outcomes and goals. These organisations would not have
been aware of the research prior to this initial contact and explanation. Early in
January 2009, it became apparent Dell would no longer be suitable for the research
due to access restrictions, but follow-up calls and emails continued with the remaining
five organisations. Boston, Cordis and Gensyme also were eliminated at this point, but
progress continued with the final two. The companies explained the time requirements
of the research and the study in more detail, as well as ethical requirements on behalf
of researchers from the University of Limerick. The potential benefits for the host
organisation also were outlined. Lofland and Lofland (1984: 25) describe interpretivist
researchers as asking participants to “grant access to their lives, their minds, and their
emotions”, so it is important to provide respondents with a straight-forward description
of the research and its goals. They also argue that researchers are more likely to gain
successful access to situations if they make use of key contacts to help remove
barriers.

Over the next few months, correspondence continued with the remaining two
organisations. Initially, there was much guardedness and reluctance to take part, the
main concern centred on the issue of confidentiality. To overcome these obstacles, a
number of methods were employed. Firstly, the relationships were managed on an
ongoing basis, through emails and telephone conversations. This helped develop a
working relationship and a rapport between the researcher and the respondents.
Secondly, an idea borrowed from a previous colleague at the research centre
encouraged the author to consistently send both interesting journal articles and literature about the thesis to various contacts to show enthusiasm. The next step, naturally, was to arrange a face-to-face meeting in which a variety of topics were discussed, including negotiation of the research agenda, what the organisation expected of the researcher, on-site access, access to documents and personnel, etc.

The organisations (particularly Creganna, which was interested in the long-term goals of the research) saw their potential involvement as part of a more long-term relationship with the Centre for Information & Knowledge Management (CIKM) at the University of Limerick; therefore, the researcher also presented information on the centre itself and invited the organisations to visit for “research days”, where they could share problems, concerns and tools. These efforts progressed toward cementing the trust between the researcher and the case organisations.

Once the case groups had been identified, individual contact via email was made with each respondent to inform them about the study and to provide them with an interview consent form (available in the RAD). Following this, subsequent site visits were made to meet respondents face-to-face and to answer any questions they may have had about the study; for example, at Creganna each respondent was met face-to-face on the day of this meeting to inform them about the study and issues pertaining to confidentiality.

The author would argue though that this initial gaining of entry did not resolve the issue of access in its entirety. This was a first step, and the process of gaining the respondents’ trust and confidence was a delicate one. Two of the respondents within the Creganna group declined to take part because they disliked the interview technique, despite the assured confidentiality and the explanation of advantages for both the organisation and the study.

3.3.2.4 The Cases Selected

Discussions with representatives in the selected organisations who committed to taking part in the research established a working relationship that grew over time. The first case involves the design group at Creganna in Galway and explores the issues involved with the inventory management problems within the organisation as a whole.
The second case involves the Innovation Centre at DePuy Ireland in Cork and the application of their KM initiatives. Both cases and host organisations are described in Chapter Four and Five.

### 3.3.2.4.1 Case Selection Criteria

In identifying the case study organisations a number of key criteria were used:

- The organisations needed to be in the high-technology sector (as discussed in section 3.1)
- The organisation needed to be either currently using, or in the process of implementing KM practices or a KMS.
- The knowledge management system was central to the completion of the day-to-day work practices being examined.
- Learning and development are required.
- The work involves dealing with complex problems.
- Workers possess some level of expertise/know-how
- There is a need for workers to exhibit intellectual ability by thinking for themselves when applying their know-how to context specific problems
- Sufficient access to all levels of the organisation could be negotiated so that an understanding of the detail of daily work practices could be communicated and sufficiently understood by the researcher.

While a number of contacts with potential case companies were initiated it took longer than anticipated to identify a willing case company that met the above criteria. A chronology of access is also detailed in Appendix J.

### 3.3.3 Research Design: Micro Methods of Data Collection

In this study, data collection included several different micro methods. Easton (1998) describes exploratory case work as allowing researchers to probe the data and go behind what may be immediately evident. In this research, the data collection methods
include the use of in-depth interviews with key personnel in each case, the reading and analysis of relevant documentary evidence from the organisations, and finally non-participant observation.

In the study, the combination of observation, in-depth interviewing and document analysis enables both cross-validation of data and the integration of contextual and temporal observations with the perceptual and attitudinal data gathered from interviews. Case research undertaken by Pettigrew (1985) and Dawson (1997) is characterised by the use of multiple methods, which have included the use of in-depth interviewing, analysis of archive data, and the collection of observations and ethnographic material. Dawson (1997) cites the multiple method approach as making it possible to cross-check varying types of data to construct an end narrative. This is accomplished by method triangulation and is a key tool in overcoming perceived quality issues in interpretivist research.

3.3.3.1 In-Depth Interviewing

Interviews are the most common and powerful way to try to understand human action (Fontanna & Frey 2000). Interviews were held after access to the case organisations was granted and group members were identified and selected. The key advantage in using in-depth interviewing is that it offers the ability to further probe complex answers. Burgess (1982: 107) states that interviews provide “the opportunity for the researcher to probe deeply to uncover new clues, open up new dimensions of a problem and to secure vivid, accurate, inclusive accounts that are based on personal experience”. The willingness of the interviewee to talk, however, is dependent on both the levels of trust between the interviewee and the interviewer and the contextual setting chosen for the interview (Guba & Lincoln 1985). In the research cases, the respondents were interviewed at their place of work in private meeting rooms. Most interviews averaged an hour to an hour and a half in length. They also followed extensive communication between the researcher and the respondents, including a previous face-to-face meeting and the supply of documents explaining the research, all aimed at building each relationship prior to conducting the interviews.

It also is worth noting that ethical approval for this research was received on the 13th
of February 2009, and a copy of the approval can be found in Appendix G, “KBS Research Ethics Committee Approval”.

There are three types of qualitative interview: the informal, conversational interview; the semi-structured interview; and the standardised structured interview. Structured interviews are informed by the positivist frame; semi-structured and unstructured are informed by the interpretivist tradition (Patton 1990); and the unstructured interview allows respondents to use free association in telling their stories (Fontana & Frey 2000). In this research, the semi-structured interview was chosen based on the literature and a pre-understanding of the case organisations’ projects. This understanding was compiled from documents received and from previous contacts with the organisations. For example, in the Creganna case a timeline of the “Inventory Management” project was pre-defined with the aid of the company contact. This ensured that all the main stages of the project were discussed with each respondent.

The interviews devised in this study resembled a series of indicators, guides and probes. This ensured that all topics of concern were covered. The recognition that other aspects may emerge also was a key concern and was allowed for in the interview. This allowed the interview guides to be modified over time to focus attention on areas of particular importance. This was especially aided by three pilot interviews carried out prior to the case interviews (see Appendix D). This not only helped with the practice of carrying out an interview, but assisted in writing and organising questions.

The interview questions were mixed, in that some were open and phenomenological and used to ease the respondent into the interview, also allowing the respondent and researcher to begin a “conversation with purpose”, while others were more focused in that they asked about a specific phenomenon, but only if this had not been addressed previously in the generic phase of the interview. A set of interview questions and probes for each case firm is available in Appendixes B and E respectively. The interviews were conducted in 2009 and 2010 and each lasted an average of an hour to an hour and a half. In total, there were thirty-two interviews conducted. The in-depth interviews were digitally recorded and transcribed by a professional transcriptionist to ensure accuracy of the interactions. This resulted in a large amount of raw data,
including interview transcripts, supporting documentation and field notes. Although the respondent sample size appears low, the author is confident, given the well-defined nature of each context, that the research objective is achieved with regard to understanding indicators and processes surrounding knowledge assessment. Each respondent interview is available in the RAD file.

The in-depth interview method is best complemented by also using other methods (Denzin 1998). For instance, Bryman (1988: 115) warns against the use of interviewing in the absence of observation because it could cause a lack of a sense of process. Triangulation methods enable the data in this study to be cross-checked, that is the statements of interviewees are combined with observation notes and documented accounts. Discrepancy between these various sources of data can be usefully highlighted (Dawson 1997). The following sections describe the complimentary qualitative methods used at the research sites in conjunction with in-depth interviewing.

### 3.3.3.2 Non-Participant Observation

Observation data are used for the purpose of descriptions of settings, activities, people and the meanings of what is observed from the participants’ perspectives (Guba & Lincoln 1985). This is done by enabling the researcher to see things participants themselves are not aware of or that they are unwilling to discuss (Patton 1990). However, the researcher must remain aware that his or her presence may introduce a distortion of the natural scene. In this study, the author undertook overt non-participant observation, meaning the researcher observed the activities of the participants without overtly engaging in the activities and referred to the reality that the respondents were aware of the observation. Also, notes were taken during these sessions and were constructed into field notes. All face-to-face meetings at the organisations proved to be good context for observation, as did any meetings I was allowed access to attend. For example, the author attended one of the initial meetings about the “Inventory Management” project in Creganna, in which I observed senior management and their juniors interact. Maintaining presence at meetings also helped strengthen the researcher’s relationship with individual respondents.
3.3.3.3 Document Analysis

The in-depth interview and observation phases were aided by the collection and analysis of documents. Access to documents was provided early in the field work; this continued to inform the research and acted as a buffer against interviewer bias and perception versus reality gaps. Documents first were received from Creganna regarding the “Inventory Management” project, but also included documentation about the history of the company, which was most useful. The documentation allowed for the factual and chronological elements of the case to be detailed, which overcame the challenge of respondents confusing the timeline by merging events. Coffey and Atkinson (1996) acknowledge this phenomenon and view it as the past being shaped by narrative. Documents relating to the research are available in the RAD file.

3.3.3.4 Respondent Profiles

This section will outline the respondent profiles selected in the case studies. The “respondent level” notes the participant level within the organisation. For the particular case study a “C” means Creganna and a “D”, DePuy. The respondent is also linked to the actual interview transcript in the RAD file by noting the RAD number in the far right column. Table 3.6 presents the respondent profiles in both case studies.

Table 3.6 Respondent Profiles

<table>
<thead>
<tr>
<th>Respondent Job Description</th>
<th>Case</th>
<th>RAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shift Lead</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>Senior Manager</td>
<td>C</td>
<td>5</td>
</tr>
<tr>
<td>Shift Lead</td>
<td>C</td>
<td>6</td>
</tr>
<tr>
<td>IT lead</td>
<td>C</td>
<td>7</td>
</tr>
<tr>
<td>Experienced Engineer</td>
<td>C</td>
<td>8</td>
</tr>
<tr>
<td>HR lead</td>
<td>C</td>
<td>9</td>
</tr>
<tr>
<td>Design Services Lead</td>
<td>C</td>
<td>10</td>
</tr>
<tr>
<td>Shift Lead</td>
<td>C</td>
<td>11</td>
</tr>
<tr>
<td>Experienced Engineer</td>
<td>C</td>
<td>12</td>
</tr>
<tr>
<td>Frontline IT</td>
<td>C</td>
<td>13</td>
</tr>
<tr>
<td>Novice Frontline Engineer</td>
<td>C</td>
<td>14</td>
</tr>
<tr>
<td>HR/Knowledge Champion</td>
<td>C</td>
<td>15</td>
</tr>
<tr>
<td>Experienced Engineer</td>
<td>D</td>
<td>16</td>
</tr>
<tr>
<td>Middle Manager</td>
<td>D</td>
<td>17</td>
</tr>
<tr>
<td>Experienced Engineer</td>
<td>D</td>
<td>18</td>
</tr>
<tr>
<td>Experienced Engineer</td>
<td>D</td>
<td>19</td>
</tr>
<tr>
<td>Middle Manager</td>
<td>D</td>
<td>20</td>
</tr>
<tr>
<td>Experienced Engineer</td>
<td>D</td>
<td>21</td>
</tr>
<tr>
<td>Senior Manager</td>
<td>D</td>
<td>22</td>
</tr>
</tbody>
</table>
These respondents were chosen by convenience purposeful sampling. The limitations of this approach and ways of avoiding bias are discussed in section 3.4.3. For detailed organisational charts see Appendices M and R.

### 3.3.3.5 Data Analysis

The method of qualitative data analysis in this study follows the process documented by Miles and Huberman (1994). This incorporated the interdependent processes of data collection, data reduction and data display, and conclusion verification. First, data reduction began prior to data collection; the parameters of the research were narrowed using the pre-defined theoretical frame and the understanding that had been developed from the literature. This also was impacted by the lengthy process of gaining access to the case organisations and to the knowledge that was gathered during this phase with each organisation.

The author became immersed in the data by engaging face-to-face with all respondents on multiple occasions, as well as by meticulously reviewing the transcribed interviews and attending as many meetings in the respondent firms that access agreement and time practicalities would allow.

The data was further reduced using analytical and coding techniques. The interviews were read and re-read, and then each interview was coded into themes, which emerged from the initial conceptual framework and the raw interview material. As the context
of each case is similar, the same codes and categories were used for both studies. This process was aided by the creation of files and memos, that is, the computerised version of margin notes and reflective passages, in order to develop and clarify potential coding categories. Using the constant comparative method, each interview was meticulously searched to find manifestations of the category and to ensure all possible codes had been identified. The material contained in each category was then read to develop sub-categories. The categories and sub-categories were defined in terms of their properties and dimensions in order to ensure clear concepts of the categories existed that the materials contained truly were representative of the corresponding codes, and that it was possible to build and extend upon the categories (see Strauss & Corbin 1990).

Once the categories had been developed, the process of axial coding was undertaken. Axial coding involves combining the data that is collected in new ways, which explores the relationships between the categories. Generally, the process of axial coding is developed around a central phenomenon, and the investigation of the manner in which other categories help explain that phenomenon in terms of casual conditions, context and strategies (Strauss & Corbin 1990). In the research cases, the central phenomenon was using knowledge assessment indicators within the organisation; however, explaining the phenomenon was not the only focus of the analysis. The purpose of this study is to develop and operationalise a working framework at organisational level.

Noting the frequency of patterns also was an important part of the process of axial coding because the researcher needed to ensure the significance of particular themes were not over-emphasised. It may be worth noting the emergent nature of qualitative research design. As the researcher seeks to observe and interpret meaning in context, it is neither possible nor appropriate to finalise research strategies before data collection has begun (Patton 1990). Axial coding was aided by the use of the qualitative data analysis programme QSR NVivo as each category could be further coded into parent/child relationships, allowing that data to be coded from the original categorisation. The codes used in the analysis of the two case studies are available in Appendixes K and L.
The use of the qualitative data analysis programme QSR NVivo greatly facilitated analysis. NVivo is a key tool for contemporary qualitative data analysis. The programme assists the researcher in the coding process by creating containers for categorised text. These containers or nodes as referred to in the programme, can be grouped hierarchically to form sub-categories of broader concepts (tree-nodes). The programme proved particularly useful in that it allowed the coded text of a particular node to be browsed, edited (for example, adding additional contextual comments) and placed into its original context at any time throughout the study. Research memos and data bites can be linked to documents and nodes, which assisted the researcher in the process of abstraction. In addition, QSR NVivo does not take any control over the analytical process from the researcher. Once the author became familiar with the software, thanks in no small part to Bazeley and Richards (2001), the benefits of its use definitely outweighed the time spent learning and training to use the programme proficiently. Data display requires the coded information be presented in such a way as to allow for drawing conclusions. NVivo was useful in this respect as it concisely displayed all developed codes or nodes and allowed further arrangement into sets and parent/child categories.

Finally, drawing conclusions and verification involved the interpretation of data and the drawing of meaning in the form of a report or case. Ideally, the research case will be a rich, tightly woven account that “closely approximates the reality it represents” (Strauss & Corbin 1990). Here, these processes appear linear in nature and description, but in reality, they occurred almost simultaneously and repeatedly throughout the lifetime of the study.

3.4 THE QUALITY AND APPROPRIATNESS OF THE RESEARCH DESIGN

In this section, the appropriateness of the research design and the quality of the methods of data collection will be analysed. The necessity for a high degree of quality in any piece of work should be of great importance and this was true for the author in this study. A key characteristic of qualitative research design, however, is that judgements about usefulness and credibility are left not only to the researcher, but to the people who read the piece (Creswell 2007). In addition, Patton (1990: 485) discusses how the “pragmatic validation (of qualitative research) means that the
perspective presented is judged by its relevance to and use by those to whom it is presented: their perspective and actions joined to the (researcher’s) perspectives and actions”. This all points to the researcher and the reader sharing a joint responsibility for establishing the value of a qualitative research project (Glaser & Strauss 1967).

The credibility of a piece of qualitative research relies on the confidence readers have in the researcher’s ability to be sensitive to the data (the quality of the researcher). To this, Glaser and Strauss (1967) and Strauss and Corbin (1990) refer to what they call “theoretical sensitivity” of the researcher.

“Theoretical sensitivity refers to a personal quality of the researcher. It indicates an awareness of the subtleties of meaning to data. ... [It] refers to the attribute of having insight, the ability to give meaning to data, the capacity to understand, and capacity to separate the pertinent from that which isn’t.”

This is a useful concept with which to evaluate a researcher’s skill and readiness to attempt qualitative inquiry. Improved theoretical sensitivity comes from a number of sources, including professional literature, professional experiences and personal experiences. To this end, the author attended multiple research methodology courses on both research methods in general and on employing the qualitative methodological tools used in this dissertation. The research experience of colleagues also was drawn upon at various stages during the project, as was the Glucksman Library at the University of Limerick, which offered a large source of reading material throughout the entirety of the research.

3.4.1 Quality in Case-Based Research

There has been a growing confidence among the research community that the case study represents a rigorous research strategy in its own right. Yin (2009, 1994), in addressing the fact that there are “no operationally defined truth tests to apply to qualitative research” as with quantitative tools, devises alternative criteria by which qualitative outcomes, especially case studies, can be judged. However, Yin’s (2009, 1994) quality criteria have been dismissed by some, such as Guba and Lincoln (1985), as forcing positivist understandings of reality and simple linear causality on inherent complex interpretivist phenomena. Specifically, issues are raised in relation to validity and reliability constructs, which closely mirror their positivist counterparts. Other
measurements developed by Yin (2009, 1994), relating less to constructs and more to a holistic view of case studies themselves, are seen in this dissertation as important to the overall quality of the research. Indeed, according to Yin (2009, 1994), the main criteria for judging a case study to be exemplary are the following:

- Significance
- Completeness
- Consideration of alternative findings

Guba and Lincoln (1985) develop differing sets of quality determinants, and their interpretivist judgements for establishing the trustworthiness of qualitative research when paired with Yin’s (2009, 1994) three main criteria for quality assessment should, for this research, demonstrate that the quality standards have been adhered to in conducting this study.

3.4.1.1 Significance

The first of Yin’s (2009, 1994) main criterion is significance. For a case study to achieve significance it must fulfil one or both of the following criteria: “The individual case or cases are unusual and of general public interest. The underlying issues are nationally important, either in theoretical terms or policy terms” (Yin 1994: 147).

The case studies presented in this study fulfil the second of these conditions. Firstly at a national interest level, Ireland’s enterprise strategy board regards knowledge creation and diffusion as being at the heart of economic growth:

“Knowledge is embodied in people, and it is the quality of the human resources that will determine the success or otherwise of firms and economies in the years ahead. The challenge for Ireland lies in ensuring that we are at the forefront of this transition. ... We need to ensure that our knowledge system is world class and that we continuously build expertise.” (Knowledge Strategy Report 2004: 26)

The problem, as the report notes, is that for many Irish firms, building in-house R&D capacity is a challenge. They lack resources, not only to conduct research and
development (Knowledge Strategy Report 2004), but to assess the level of knowledge within the organisation (Lev & Daum 2003). Crucially, the two case studies presented in this dissertation are aimed at improving understanding of this key weakness within the context of Ireland’s medical device sector.

3.4.1.2 Completeness

The case also must be complete. Completeness may be defined in three ways. It is achieved where the boundaries of the case are defined in a clear manner that is logical and meaningful, rather than arbitrary, and where the researcher can provide evidence that he/she has exhaustively attempted to collect all relevant evidence. “This does not mean that the investigator should literally collect all available evidence – an impossible task – but the critical pieces have been given [complete] attention. Such critical pieces, for instance, would be those representing rival findings” (Yin 1994: 148). Completeness also occurs when the case study ends due to saturation rather than non-research constraints, such as lack of time or money (Yin 2009: 1994).

The case studies also fulfil all of the requirements with regard to completeness. The boundaries of each case study are defined on the basis of knowledge assessment with well defined indicators as discussed in Chapter Two. The Creganna case observed knowledge indicators within the “Inventory Management” project. All, bar two, of the group’s members who participated in the study provided a heterogeneous sample of the group in terms of their activities. This ensured that unusual or deviant search actions were not excluded (Creswell 2007). The DePuy case observed knowledge indicators within their Innovation Centre. All members took part in the study, and one member participated in a phone interview. No unusual deviations or actions were recorded throughout the fieldwork, except for delays in access midway through the fieldwork due to DePuy’s recall of the Acetabular System (ASR) product line.

The non-firm economic actors form part of each case in terms of an outer context for understanding knowledge assessment processes within each project. To ensure a complete sample, these contextual issues were obtained from interview data and supplemented by documentary sources of data and/or non-participant observation. The heterogeneous nature of the individual respondents in each organisation, the complete
defined nature of the boundaries in each case, and the qualitative aspect of the data collection process ensured that the data representing rival findings were not excluded.

### 3.4.1.3 Consideration of Alternate Findings

The case must consider alternative findings. The likelihood of this happening is enhanced where the researcher has collected all relevant evidence, and in analysing the evidence considers more than one interpretation of the data, particularly rival interpretations (Yin 2009, 1994).

To this end, the interview phase facilitated and enabled interviewees to introduce new topics, which they considered to be of importance and relevant to the issues being discussed; for example, in the Creganna case the importance of informal networks became one of the key variables in the sharing of knowledge. The author also displayed the data in a way that incorporated both challenging and supporting data; this should allow the reader to independently assess the validity of the researcher’s conclusion. In order to achieve this, the research also must be presented in such a manner that the reader can trace the logic of the interpretation from the research design, through data to analysis and conclusions. In this manner, any bias toward the non-consideration of alternative findings that exist in the study will be identifiable (Yin 2009, 1994).

### 3.4.1.4 Trustworthiness

The basic question addressed by trustworthiness, according to Guba and Lincoln (1985: 290), is simple: “*How can the inquirer persuade his or her audiences that the research findings of an inquiry are worth paying attention to?*” Guba and Lincoln (1985) have identified an alternative set of criteria that correspond to those typically employed to judge quantitative work; these are illustrated in Table 3.7. Smith and Heshusius (1986), however, have criticised Guba and Lincoln (1985), saying the researchers adopted comparable criteria not fundamentally different from the conventional material they aim to replace. However, Guba and Lincoln’s (1985) criteria have become an accepted choice for quality validation among interpretivist researchers, and as such, will be used in this research.
### Table 3.7: Trustworthiness in Qualitative Research

<table>
<thead>
<tr>
<th>Conventional term</th>
<th>Naturalistic (interpretivist) term</th>
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<tbody>
<tr>
<td>Internal validity</td>
<td>Credibility</td>
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<tr>
<td>External validity</td>
<td>Transferability</td>
</tr>
<tr>
<td>Reliability</td>
<td>Dependability</td>
</tr>
<tr>
<td>Objectivity</td>
<td>Confirmability</td>
</tr>
</tbody>
</table>

Source: Adapted from Guba and Lincoln (1985)

### 3.4.1.4.1 Credibility

Credibility is the naturalistic response to the conventional construct of internal validity. Internal validity, which refers to the extent that findings adequately describe reality, is critiqued in that to determine a study’s adherence to reality, one would have to know “the precise nature of reality” and thus there would be no need to test it (Guba & Lincoln 1985). Naturalistic researchers seek to represent multiple realities, and therefore credibility is determined by the richness of information gathered and the analytical abilities of the research (Creswell 2007; Patton 1990). The case studies in this dissertation are compiled using a between-method triangulation approach, thus enhancing the credibility of the study. Richness of the data was ensured through integrated use of in-depth interviewing, observation and documentation analysis. As advised by the literature, “member checks” also were used, in which participants in the study were asked to corroborate findings at various stages (Guba & Lincoln 1985); evidence of this is available in the chronology of access and data collection in Appendix J.

### 3.4.1.4.2 Transferability

External validity in the positivist sense refers to the ability to generalise findings across different settings; however, by its very nature, interpretivist research struggles with generalisability. Importantly, deeply contextual interpretations lose significant meaning if they become devoid of their locality or their particular conditions or contexts. According to Cronbach (1975: 125), “when we give proper weight to local conditions, any generalisation is a working hypothesis, not a conclusion”. Guba and Lincoln (1985) view these “working hypotheses” as transferable only if there is a high degree of similarity between the original situation and the situation to which it is
being transferred. Once again, the between-method triangulated approach used by the researcher to collect the data aided in the subsequent creation of information-rich and deeply contextual case studies. Thus, as cited by Guba and Lincoln (1985), the researcher has done all that any qualitative researcher can do in this regard to provide enough information so subsequent researchers can determine whether the findings are applicable in a new situation.

3.4.1.4.3 Dependability

Dependability is Guba and Lincoln’s (1985) repose to the reliability construct. In 1986, Kirk and Miller critiqued qualitative researchers for focusing on issues of validity over and above reliability. Guba and Lincoln (1985: 316) refute this, however, by stating, “since there can be no validity without reliability (and thus no credibility without dependability), a demonstration of the former is sufficient to establish the latter”. As proposed by Guba and Lincoln (1985: 317), the researcher conducted an “inquiry audit” with the aid of experienced colleagues and the research supervisors; these experienced researchers examined the research process and outcomes for consistency (allowing for feedback into the process) throughout.

3.4.1.4.4 Confirmability

Confirmability refers to the degree that the researcher can demonstrate neutrality in interpreting the data (Guba & Lincoln 1985). This, in essence, is akin to the positivistic cornerstone of objective research. However, even the existence of pure objectivity in quantitative methods is called into doubt by some researchers, such as Eisner (1991). To address the issue of confirmability, the author has established a detailed collection of all the raw data, field notes, interview transcripts and correspondence. Guba and Lincoln (1985: 320) refer to this as the “confirmability audit”. In this thesis, it is referred to as the RAD. Compiling the RAD was further aided by the use of QSR NVivo, which allowed for the storage and easy retrieval of all documents related to the study.
3.4.2 The Pilot Study: Lessons Learned

The pilot study was carried out before the initial field work began with Creganna and DePuy. In essence, its aim was to practice and experience the interview environment as this would be the researcher’s first time carrying out interviews. In-depth interviews discussing knowledge indicators were carried out with Respondent One from KPMG, Respondent Two from Accenture and Respondent Three, formerly of Dell. This practice helped the author hone the interview techniques used within the fieldwork at Creganna and DePuy. The main outcome of the pilot study was the omission of redundant questions and the honing of the flow, structure and timing of the interviews. It is clear the field work greatly benefited from the pilot study. For the purpose of the “confirmability audit”, the pilot interviews also may be located in the RAD file.

3.4.3 Limitations of the Research

The previous sections have outlined the processes by which data was collected and analysed, and the methods used to ensure high levels of quality. It also is important to note the limitations of any research project so lessons may be learned and research may be improved in future endeavours.

Researcher competence commonly is identified as a limitation of qualitative research (Easterby-Smith et al 2002) because often the researcher is “learning on-the-job” or learning-by-doing. The author attempted to address issues of “theoretical sensitivity” by minimising the effect a lack of experience might have on the outcome of the research; this was achieved by discussing the research with experienced researchers and the research supervisors, which included university and non-university personnel, at key junctures during the project to gain insights on the experiences of others.

Another limitation is the possible presence of bias. It could be argued that these two organisations were keen to participate in this study because they were extreme examples of a particular phenomenon i.e. either effective or poor in terms of KM. If this was the case then the findings emerging from these two sites would be biased as a result. While it cannot be stated with absolute certainty that these organisations epitomise a representative sample of Medical Device organisations, care was taken at the outset to understand the particular reasons each firm had for participating as
discussed in section 3.1 and 3.3.2.4.1. Reliability involves being certain that were another researcher to follow the same procedures they would arrive at the same conclusions and findings: a goal to aid this being to minimise biases and errors in the research (Yin, 2009; Cresswell 2007). To increase reliability a prerequisite is to document procedures, making use of case study protocol, making as many steps as possible operational and to carry out the research as if constantly being watched (Yin, 2009). As mentioned earlier, the researcher also completed both confirmability and inquiry audits (Guba & Lincoln 1985) in an attempt to maintain exemplar standards and to limit bias. The author also frequently attended qualitative and quantitative methodology courses, covering such topics as interviewing, qualitative data analysis and comparative analysis. However, researchers are more or less in agreement that perfectly reliable and valid third party performance ratings are unattainable since they are subject to a variety of biases, such as external conditions, the experience of the rater with the job being evaluated, or the ability of the rater to observe the ratee (Borman, 1978; Weekley & Gier, 1989). Furthermore, as noted by Myers and Newman (2007), a common problem with the qualitative interview is “elite bias” whereby a researcher may end up interviewing people of a certain status and therefore fail to gain an understanding of the broader situation. To avoid this problem, the interviewees for this study were specifically selected based on pre-defined areas of interest within the organisation as outlined in Table 3.6.

Another major limitation within interpretive research is the possibility of sampling error. Due to the perceived flexibility of purposeful sampling, three types of sampling error commonly occur. The first relates to distortions caused by insufficient breadth in sampling, the second from distortions introduced by changes over time, and the third from distortions caused by lack of depth in data collection at each research site (Patton 1990). In relation to sample breadth, qualitative researchers have a few strict guidelines for when to stop the data collection process. Criteria include the exhaustion of resources, emergence of regularities, and overextension, or going too far beyond the boundaries of the research (Guba 1978).

The decision to stop sampling in this case considered the research goals, the need to achieve depth through triangulation of data resources, and the possibility of greater breadth through examination of a variety of sampling sites. The research goals clearly
defined the exploratory nature of the work and its aim to improve our understanding of knowledge indicators in various contexts. Once both case organisations and the knowledge indicators within them had been identified, the aim was to cover all potential participants within each group. This was achieved in one of the case sites. In the first, Creganna, two members of the group were not interviewed. The author is satisfied that sampling errors were avoided early in this study through effective research design and the choosing of well-defined indicators of knowledge for the study, which meant the resources were manageable.

A fourth limitation of the research is the lack of comparative contexts. While this was not cited as an aim of the study originally, it would have been another possible outcome to pursue based on the multiple-case nature of the research. The exploratory nature of the research and the varying contexts within the knowledge indicators and knowledge activities were investigated in each of the case organisations. It did not, however, facilitate a more level playing ground, which would have enabled more generalisability from the study’s findings. These varying contexts are a result of the purposeful sampling used by the researcher to identify two varying situations within which to understand knowledge indicators used in the framework. However, the author is satisfied that, as the aims of the study are exploratory in nature, choosing differentiated environments in which to study and test knowledge assessment is the optimal way to develop better initial understandings in the area. The author believes further research in this area also would be fruitful.

3.5 CONCLUSION

This chapter has discussed the philosophical and methodological stances taken throughout this research. It also discussed the methods used to carry out the research. The chapter also discussed the access gained with the case organisations, the need to foster and develop strong relationships with the organisations and key personnel within them, and the inherent confidentiality issues that surround one of the studied industries in particular. Overcoming these challenges took considerable time and effort on the author’s part, but was more than rewarded by the time and effort put in by the respondent groups studied. While acknowledging the limitations these obstacles have placed upon the research methodology, such as the inability to generalise from findings, the design and methods of analysis employed have attempted to adhere
closely to best practice.

Qualitative researchers must understand the special responsibility they have to participants and readers of the research. Since there are no statistical tests for significance, the qualitative researcher bears the sole burden of ensuring that the high levels of quality are upheld and that all of the important findings are discovered, interpreted and presented. In addition, plausible connections must be made between the observed data and the conclusions drawn. In this research, the author has gone to great lengths to ensure the possibility for error has been significantly decreased through the application of quality determinants at all stages of the research. This began with the selection of an appropriate research strategy and continued to the selection of case study organisations, data collection, analysis, interpretation and presentation. The prudence in selecting in-depth interviewing as the primary method of data collection was confirmed by the quality of the data obtained in each case. The participants spoke at length and in detail about the topics proposed by the interviewer, displaying a high degree of salience for the area in general. Although they only were asked for thirty minutes of their time, the majority spoke for far longer, with interviews averaging an hour to an hour and a half in length. The data retrieved also proved useful in creating a descriptive profile of the companies under study, over and above what could be determined from just supporting documentation alone. The case studies presented in the following chapter are both detailed and complicated. They report a great deal of technical, personal and organisational information. This is a sign of successful multi-level investigation. Each case is structured depending on its content and context. This is reflective of exploratory research studies in general. Next Chapter Four and Five presents the case studies in this dissertation. Chapter Six simply offers analyses and discussion and Chapter Seven; concluding remarks.
CHAPTER 4: CREGANNA CASE

The purpose of this chapter is to present the primary data of the Creganna case study in light of the framework developed in this dissertation. The chapter will begin by presenting the Inventory Management project. It then will describe some of the KM initiatives at Creganna\(^6\). The DePuy case will be presented in Chapter Five.

4.1 Introduction to Inventory Management

Field work began at Creganna in January 2009. Open access was allowed to projects that were ongoing and others that were in the initial stages. One of these projects was the Inventory Management Project (IMP). The goal of the Creganna case is to test, develop and operationalise the framework and gain a deeper understanding of the knowledge indicators and knowledge gaps. The issues raised within Creganna’s IMP were a means of gaining trust to obtain more access and to analyse KM issues from a ground-level perspective in a project that was going to start and finish while fieldwork was being conducted. This also would prove invaluable as some of the KM issues discovered in the IMP are issues analysed further under the KAF in Chapter Six.

4.1.1 Design Principle Issues

The purpose of the IMP was to highlight and improve issues that Creganna had with tracking and storing inventory. This would involve trying to enhance and improve four key design principles that would strive to achieve the following:

1. **Materials more easily identified and quickly retrieved**
   The purpose of this was to ensure that engineers, product builders, inspectors and stores personnel spend the minimal amount of time searching for and retrieving materials and that material can be identified by anyone, even without specialist knowledge of the material type.

2. **Materials should be traceable throughout their lives in Creganna**
   The purpose of this was to ensure that, when a product graduates from Concept Generation/Prototyping to requiring the introduction of Lot Control and Inspection, it was easy to accomplish and a full history of the raw materials

\(^6\) Creganna-Tactx Medical is referred to as Creganna throughout the research.
was provided to facilitate an efficient recall if required.

3. **Ensure rapid procurement of urgently needed materials**
   The purpose of this was to ensure that materials could be purchased in small volumes and/or from unknown suppliers quickly and efficiently.

4. **Facilitate the reduction of inventory levels**
   The purpose of this was to ensure that Creganna’s entire inventory holdings are “known” and can be better managed both financially and physically.

Respondent Seven, IT lead, describes the joint effort between management, the ground engineers and third-party contractors to meet the business needs within Inventory Management.

“We got them to do the requirements. I talk with the third-party guys, ‘OK, this is what the business needs’. ‘They say they want this, can it be done?’ ‘Yes it can and no it can’t’. And it’s basically just holding them and carrying them together.” (Respondent Seven, RAD 7)

Creganna’s concern was that the optimum solution for some of the design principles may be the opposite to what is required to support the others; for example, not tracking “samples” on inventory at all would facilitate their rapid procurement, but would not help achieve any of the other principles. The drive of projects in the past had been management’s prerogative but the IMP was the first push at the “coalface” staff to drive the project. “We’re a key part of it but we’re only part of the team. We’re not the drivers of it, and that works best for us and probably works better for them because you say, ‘right, you want it, you own it, you drive it.” (Respondent Seven, RAD 7)

The work on the IMP was directed in large by a core group of experts within Creganna. Respondent Twelve was responsible for the overall planning of the project and summed up the day-to-day goals of the project as having “to go through everything else and get your processes up to date and get the systems to reflect your process” (Respondent Twelve, RAD 12).

The IMP was affecting so many different departments within Creganna that an approach to implement the design principles was taken from the ground up involving the coalface engineers; “We literally brought groups together and said ‘this is what we
want to do and this is why we want to do it.’... It was very interactive” (Respondent Twelve, RAD 12).

This interactive approach to tackling the IMP was a very effective way of using the ground engineer’s experience to inform management and relay management’s initiatives in a very synergistic fashion. “If they’re testing, for instance, ... at the sections where we score the severity of the issue, we tell them that this is going to be addressed later on at our daily meeting, and we delegate and action.” (Respondent Fifteen, RAD 15)

4.1.2 Design Principle Outputs
After the implementation of the aforementioned design principles, certain outputs were expected for each. The outputs as per the design document (Creganna 2009a) are as follows:

- **Materials should be easily identified and quickly retrieved.**
  - Introduce a Creganna label.
  - Every purchase requires a Purchase Order, which can be identified when the materials arrive.
  - Ensure that all storage areas are well organised and signposted.
  - The location of all materials should be recorded and tracked when the materials are moved.

- **Materials should be traceable throughout their lives in Creganna.**
  - Introduce a Creganna lot number.
  - All materials require an Item Master and Supplier setup
  - All materials purchased need to be booked-in.
  - Establish a separate sub-inventory for inspection.
  - Materials should have an Item Master and Supplier setup for their very first purchase.

- **Ensure rapid procurement of urgently needed materials.**
  - Allow immediate purchase by credit card, prior to Item Master, Supplier or purchase order creation.
  - Speed up application of new Item Masters.
  - Speed up creation of new suppliers.
• Facilitate the reduction of inventory levels.
  ❖ Ensure all raw materials are known “on inventory”

From June 2009 to September 2009, these project initiatives were to be implemented. These were tangible changes in process that were going to happen in Creganna while research was ongoing, but there were several issues uncovered that needed attention, outlined as follows:

Creganna’s most recent physical inventory count (November 2008) had a lot accuracy of 58%. In addition, there was a significant proportion of materials not tracked as inventory on Oracle, Creganna’s Enterprise Resource Planning system. The combination of poor inventory accuracy and “invisible” (from a systems point of view) inventory are two contributory factors to Creganna’s unnecessarily high inventory holdings, which currently is calculated to be more than €4 million. An industry benchmark suggests organisations have inventory holdings of €2.5 million (Creganna 2009a).

Neither boxes nor storage locations were organised or labelled in a standard way site-wide to allow stored material to be found quickly. Prototyping engineers, R&D engineers, inspection staff and stores staff have spent a disproportionate amount of time searching for materials. This lost time is estimated at around ten worker days per month (Creganna 2009a).

There already was an understanding that some of the areas needed to improve within Inventory Management. Creganna’s effectiveness at tracking materials through their full evolution, from Concept Generation/Prototype to volume production, was tenuous. In addition, for materials that were procured at the Concept Generation stage (which requires a much higher level of traceability); there were an abundance of cumbersome administrative tasks involved in retrospectively recording the materials into inventory, which again is inefficient. Another process problem was that the “history” of traceable material does not reflect its actual history. As it appears on inventory, surplus materials did not appear on stock, which resulted in the ordering of additional materials even though they already existed on site.
4.1.3 Inventory Management Project Goes Live

When the IMP went live on 21 September 2009, the design principle outputs were implemented successfully. This was an opportunity to understand what other “intangible” outputs were observed after the project was implemented. “I mean right now, because we didn’t really have a testing methodology or anything to change it, we kind of have to say, ‘Well this is what we do and this is how we do it’” (Respondent Twelve, RAD 12). Prior to the IMP, there had been no testing or implementation methodology. This is a way of putting structure on future projects and lends itself to tracking and planning the entire implementation of a project; “your testing is your main thing. ... if it goes live and it works. ... Then you have a feature methodology of ‘this is what we did, we did a report saying this is what we wanted. These are the changes, this is expected results. We did one level of testing to see if it worked for us, we did the second level, the acceptance testing, we updated the procedures, we did the training, we went live’” (Respondent Twelve, RAD 12).

This highlights one of the main tangible outputs from the IMP, but respondents were keen to stress that the IMP was not a stop-gap measure intended only to fix minor problems. It was the beginning of a shift in management practice throughout Creganna; “inventory is just one step on the whole changing the practice” (Respondent Twelve, RAD 12). There are many more areas of the organisation that are going to be analysed and possibly restructured, for example, “we’ll look at shipping and how we do shipping, and it’s kind of pretty much the whole framework again” (Respondent Twelve, RAD 12). This will lead to the individual restructuring of these business areas. and with the successful pilot of the IMP the organisation as a whole may be analysed and restructured to better fit Creganna’s needs; “We have to look at how we issue out the material and how we do materials onto the floor. ... It all links together” (Respondent Twelve, RAD 12). Table 4.1 and 4.2 show the tangible and intangible benefits of the IMP project success after the project goes live.
Table 4.1: Tangible Benefits post IMP

<table>
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<th>Type</th>
<th>Description</th>
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| Inventory accuracy    | - With a new monthly Knowledge Performance Indicator (see section 4.5.2.1), inventory accuracy rate has increased from 58% to 85%  
- Accuracy now is more strict with materials required to be correctly labelled and have their physical location stated on Oracle (section 4.5.1) record |
| Inventory value       | - Was reduced by €400,000 by year-end 2009, €150,000 of which can be attributed to this initiative alone, and an additional €250,000 that was facilitated by the initiative  
- New less abstract metric “Inventory Days on Hand” replaces old metric “Inventory Turns”  
- Days inventory is held reduced from 136 days to 119 days (reduction in €417,865) |
| Pick-time             | - The time from walking into a storeroom to seeing the specific box required is an average of less than one minute |
| Tracking              | - All material is “on inventory” and traceable throughout its life at Creganna |
| Inspection            | - Able to view on the system all materials currently in Inspection (broken down by each Inspection Zone)  
- An Inspection Zone manager will be able to use the system to prioritise the items currently awaiting inspection |

Source: Creganna (2009a)

Table 4.2: Less-Tangible Benefits post IMP

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence</td>
<td>- Creganna staff have confidence in the Goods Inwards and Warehousing team and processes</td>
</tr>
<tr>
<td>Ownership</td>
<td>- The stores supervisor is an effective end-to-end “process-owner”/subject matter expert who understands how Creganna handles materials, the detail of the process steps involved at each stage and all the related Oracle-specific fields and reports</td>
</tr>
<tr>
<td>Methodology</td>
<td>- This is an attempt at a Systems Development Methodology covering Project Concept Design, Business Requirements Definition, To-Be Design, Technical Solution Design, System Unit Testing and Business Acceptance Testing</td>
</tr>
<tr>
<td>Framework</td>
<td>- Developing an over-arching business process framework</td>
</tr>
</tbody>
</table>

Source: Creganna (2009a)

Organisationally, the IMP is considered a success. Respondent Four, the supply chain manager at Creganna and one of the few subject matter experts, summed up the success of the IMP as a few simple initiatives that utilised better communication with those who would be involved with the project at the ground level while tapping into that pool of knowledge.
“... What we’ve done is a hell of a lot of communication to everybody involved and even to those who are not involved. But who we need to be involved, for example, purchasing, (should) say, ‘Look, we’re going live with this project on the third week of September. Here’s what we need you to do: Purchasing, we need you to minimise the deliveries coming in from suppliers; QA, we need you to do whatever it takes.’ So in other words, we mapped that out two months ago and said, ‘Right, this is the date, and here’s what you all need to do.’ So if you like, communication’s key. And that’s something I suppose that would be different than previous in terms of involving people.” (Respondent Four, RAD 4)

4.2 KM Initiatives in Creganna
Shortly after the beginning of the IMP, it was discovered that problems that manifested themselves in the IMP were being caused by wider KM problems companywide; so the research focus shifted to an analysis of other initiatives within Creganna.

Prior to the improvements made after the IMP, Creganna had been trying to improve and implement KM initiatives for some time. With the installation of Oracle (ERP System), this has been more evident in the last few years. In this section, the types of KM initiatives deployed by Creganna will be discussed as a prelude to the analysis using the KAF in Chapter Six.

4.2.1 The Introduction of Oracle
On Oracle: “That was quite scary. This is my fourth implementation.” (Respondent Twelve, RAD 12)

Oracle is a relational database management system produced by the Oracle Corporation. Oracle was introduced in Creganna circa 2007 to help the company effectively manage information and knowledge within its continually growing business units.

4.2.1.2 Issues with Oracle
The issues with the Oracle system in Creganna, it could be argued, warrant a separate study in themselves. For the purpose of this research, they help the reader understand some of the issues before the analysis in Chapter Six. The Oracle expert in Creganna, explained extensively the problems of the current system in operation. “We never future-proofed it or kind of looked and said, ‘Right, well where do you want to be?’.”
This pushed the team backward, causing them to work out of Excel spreadsheets because they had not utilised the system. In addition, because they put so much bad information into the system, they were just getting bad information out. “So therefore, nobody trusts it and nobody uses it because it’s not giving us what we need” (Respondent Twelve, RAD 12).

There are huge risks when implementing an ERP system (Holland & Light 1999), most of all an overreliance or an attitude that it will address problems it cannot. Some of these include lack of planning or future-proofing and the linking of the organisational needs to the operational outputs of the ERP system. To combat the issues with the use of the Oracle system, Creganna hired experts with previous industry experience in ERP implementation. “This is my third in ...so yeah, I’d be fairly up to speed on how things would be just because of different places I’ve worked” (Respondent Twelve, RAD 12).

The expertise hired externally had certain goals that hinged on implementing the Oracle system with a greater success than it earned in the initial installation. Respondent Eight, storage supervisor, subject matter expert in stores and expert in Oracle, however, identified a shortfall in the training and new employees’ understanding of what the system was meant to do. “The problem with it is if you’re not familiar or haven’t worked in it, haven’t been trained in it, you won’t be able to understand what they’re saying” (Respondent Eight, RAD 8).

It would become evident that Respondent Eight was quite sceptical about the level of awareness and training at Creganna. However, more forthright when asked about the implementation of Oracle, he explained that coalface engineers at Creganna fundamentally lacked understanding of the ERP system’s purpose within the larger organisational picture. “There’s still one piece missing here that we’re going to have to address, and that is that in a world such as ERP, you can do all the internal training and all the internal procedures you want, but there’s an underlying philosophy as to what an ERP system does and what you’re trying to do. And in my view, [Creganna] haven’t brought that to the well” (Respondent Eight, RAD 8). Mahon further explained, saying the “overriding understanding of what an ERP system does and what we’re trying to do has never been done” (Respondent Eight,
So Creganna is dabbling in the detail, but not many truly understand where it fits into the organisation.

The information technology functional expert in Creganna, Respondent Thirteen, also posited that Oracle, though “essential” to the business, had some issues. “The Oracle system's all over the place and it's reviled by half the place” (Respondent Thirteen, RAD 13), which supports other accounts of the problems with Oracle.

The lead on prototypes at Creganna, who also has experience with Oracle, found that even though time has passed since the original implementation of the database, most people still were struggling with the system. “I worked on setting up that whole ERP system here ... brought in Oracle, which was a huge change to a lot of people, and I think that in itself, people are still struggling to come to terms” (Respondent Six, RAD 6). Others shared similar views: “It's been there more and more on-and-off. I won’t say it just suddenly started happening. It is happening now for a while” (Respondent Nine, RAD 9).

Respondent Fifteen is the lead human resources and training development coordinator and was the primary contact throughout the field research at Creganna. After learning Oracle had been having issues, he was asked about his role with the system: “I came in as the HR training development coordinator, and the first task was we had a problem with Oracle training” (Respondent Fifteen, RAD 15).

He found when he joined Creganna that his experience with ERP implementation would be vital, as the understanding of what the system was “meant” to do was missing. He also was confronted with the presence of an underlying ideal in Creganna that if an engineer was lacking knowledge, he or she could be sent on a course to up-skill. “Part of my ethos would be to get people to understand where the knowledge is, and I found that there was a problem with people thinking 'I don't know something so I’ve got to go on a course’” (Respondent Fifteen, RAD 15).

Further descriptions suggested Oracle issues were becoming information technology problems. However, rarely is the system at fault; “Almost every business unit has got to interact with the thing [Oracle] all day long, every day. And if they hit a road block
where they kind of go, ‘Look, I was trying to transact this and it just gave me an error and it won’t do it,’ or, ‘When I transact this, it’s giving me the wrong number,’ it’s kind of ‘Who do I tell?’ Invariably it becomes IT. And invariably you find, well it’s nothing wrong, the systems working exactly as it should” (Respondent Thirteen, RAD 13).

The outstanding issues, it seemed, were either lack of training or a lack of understanding of what the ERP was meant to do. It seemed that somewhere in the original planning of the ERP, what senior management expected Oracle to do and what it was supposed to do was not communicated effectively to the coalface engineers, and thus disparity and problems continued to arise. “It’s garbage in and garbage out. If you track down the guy then through audit logs and so on and say, ‘Who’s the guy who put this in?’ You kind of go, ‘It was you,’ and you go, ‘Yeah, I was never trained properly’” (Respondent Thirteen, RAD 13).

Whether a lack of understanding or awareness was a problem, it was observed that “they’d taken a lot of short cuts. They hadn’t really analysed their business processes. So the system that they implemented and installed was based on an awful lot of assumptions that people had that weren’t strictly accurate in retrospect. And then they didn’t really document what they did” (Respondent Thirteen, RAD 13).

What was being said for the most part was accurate. There seemed to be a fundamental underestimation or an under appreciation of the fundamental business processes at Creganna. So the issue of misunderstood or assumed process knowledge seemed to be counterproductive to the “undocumented processes”. It was recommended to completely re-map the organisation’s processes, which was not an uncommon theme. “And you go, ‘No, no, lads, you need to step way back from it,’ the Post-its on the board, on the craft deck around the wall, that type of thing, you know – walk through and draw out and talk through what is it you’re actually trying to do. ... Problem is, you don’t tend to understand what you want to do” (Respondent Thirteen, RAD 13).

Oracle is heavily depended upon and trying to change the system at this point would be difficult. Changes in ownership or in process may be where the real issues lie. “Are you sure it’s the system that needs to change? Maybe it’s procedures, processes,
training, ownership, accountability – maybe that is actually where you could figure things out” (Respondent Thirteen, RAD 13).

Respondent Fourteen is an engineer (reporting directly to Respondent Ten) from the Design Services business unit at Creganna. She was asked about Oracle’s weaknesses: “When Oracle was introduced first ... I think there wasn’t a whole lot of training given to people or there wasn’t enough planning put into it” (Respondent Fourteen, RAD 14).

She also described Oracle’s initial planning stages and said a lack foresight existed at Creganna as to what Oracle would do; “we were going along and we were being trained, but then things were changing and you’d have to say, ‘but I thought we were doing it this way.’ And no, ‘we’ve changed that now and we’re doing it this way,’ you know. I mean, OK, you can’t spend years; you need to bring stuff in. But I think sometimes we rush too fast to bring things in” (Respondent Fourteen, RAD 14).

Moreover, consultants were being used to pinpoint the problems in the Oracle system and found that the issues were not primarily with the system. “It’s not the system that screwed people over really; it’s their approach to it. ... There is no mentoring. At the time, there was no training. [The Consultant] said there’s no training material, there’s no work instructions. It appears the system was never tested right, so there’s no test scripts, so there’s no one who really understands whether it works or whether it doesn’t. There’s no way of telling new hires or even the existing staff how to work with it properly. ... Then when you dig even deeper back into the company, there’s a whole level of culture that’s wrong here around it. It’s assumed that this technical, installed software was going to manage the company ... that this thing is going to do their job for them” (Respondent Thirteen, RAD13).

These descriptions raise questions: What was the ERP system supposed to do? Are the fundamental processes at Creganna understood by management or, more importantly, by the engineers?
Lean manufacturing was originated by Taiichi Ohno and has been used by Toyota since the 1940s. The principles, practices and tools of lean as a management initiative within Creganna have been deployed since 2004. Respondent Eleven, the driver of Lean within Creganna, described the venture as “a philosophy built around time-based competition and things, so it says the faster, or the shorter, the time you can get your project made through your plant, the lower your cost is going to be and the more opportunities ... you're going to identify” (Respondent Eleven, RAD 11). At Creganna, the main focuses of the business are the customer and their wants. Lean dictates customers want quicker response times, competitive prices, more variety, excellent quality and better service. Through the application of Lean, Respondent Five explained that some of these goals can be reached.

“There’s a couple of different satellite approaches to knowledge sharing and knowledge development. ... There’s one group of people here — it’s an unofficial loose group of people, it’s not a defined team or anything — that have this, it’s kind of a kaizen-led approach, which originally was brought in here as it was from its foundations in Toyota or wherever in Japan, to look at issues on the manufacturing floor, and as all relation to Lean and six sigma” (Respondent Five, RAD 5)

The basic principles of Lean for Creganna (Creganna 2009a) aim to deliver:

- Define value from your customers’ points of view.
- Identify and eliminate waste.
- Ensure a continuous and even workflow.
- Provide product or service only to customer orders.
- Start implementing change and always pursue perfection.

Respondent Five spoke about Lean as a way to deal with problems within Creganna. He described Lean as unsuccessful at solving Oracle issues, however, “essentially just that type of approach was great for solving those kind of problems. ... This was very successful down on the manufacturing floor and stockrooms and stuff, so maybe we should apply this to other problems we’re having in business” (Respondent Five,
This did not work well because it was more of an engineering-style approach to a business problem.

Within Creganna, Lean is still finding its feet; and though it is actively pursued as a genuine initiative, it could be better. “It’s actively pursued. It could be bigger. ... They do quite a bit of work on it. They wouldn’t be anywhere near ... [the] level that Boston Scientific [had] in November 2002. We would do a kaizen and work out a line balance, and people would work to that line balance. But typically, it’s not strictly adhered” (Respondent Six, RAD 6).

He added that Creganna probably would benefit from pursuing Lean on a larger scale, but pressures from customers makes this difficult to implement. “It’s a lot more difficult for them to do it because they’re at the mercy of customer forecasts and they’re not hugely accurate. I’m not saying that you can’t do it, but it gets a little bit more difficult” (Respondent Six, RAD 6). He also is the head of Process Excellence at Creganna. He was asked about the Lean initiative at Creganna and where it was being implemented. “It’s on the product side predominantly. Now we have done some in the likes of income inspection, which is almost like an administrative process as much as anything else” (Respondent Eleven, RAD 11).

Lean is vigorously used to improve flow on the product end. He added that training also is an area where Creganna is looking to implement Lean. “We implement it so the production areas have been rearranged to get the flow. It’s all about flow at the end of the day. So we’re trying to get the product to go through almost one piece at a time if you like, through each of the steps. Even if you go down to shop floor, the person you were put beside to train on the step, it’s a huge issue in manufacturing companies” (Respondent Eleven, RAD 11). Training is an area Creganna could examine. On training, Lean follows *Training Within Industry*, which was used by the United States military during World War II and highlights (1) how to instruct, (2) how to improve, and (3) how to deal with people. “They obviously had to support their military efforts, so they wanted to do it effectively and quick. So there’s three different programmes of it. One of them is how to instruct, so that’s how to instruct a new person how to do the job. One of them is in job method, so it’s how to improve, which is something that’s
Respondent Eleven also proposed that Lean techniques could be used to improve the knowledge capture process at Creganna. “The approach lean takes to training maybe could be fed back in ... maybe the way we’re trying to do the documents. I’m sure it’s the same thing for Oracle. There’s a few key points in each screen that you need to get right, and if you get those right, and what we do when we identify a key point, we explain why so that the people can see, ‘Well, why is it important that I put the decimal point here’” (Respondent Eleven, RAD 11). He also was asked about initiatives to apply Lean to KM. “The theory, you can apply it anywhere. There are models for it in the administrative areas, in service providers” (Respondent Eleven, RAD 11).

4.2.3 The Knowledge Performance Indicator (KPI) System

This section will discuss the role of KPIs at Creganna and how they are being used. KPIs are broken down into lead KPIs and lagging KPIs. Each affects indicators differently. Appendix O shows Creganna’s KPI organisational overview.

“We’re trying to link what KPIs we have to our critical success factors, if you like, like the KM stuff, developing staff, providing a safe work place, efficient volunteers. Then our measures should be measuring our ability against delivering those critical success factors, rather than just picking whatever KPIs you want, maybe putting a little bit more science behind it. There needs to be some critical success factor that you’re measuring, basically with your Level Two KPIs. As well ... you’ve got your strategic measures going down to your business ... into your value stream and then onto the process itself.” (Respondent Eleven, RAD 11)

4.2.3.1 Critical Success Factors

Respondent Eleven explained that in determining KPI, the critical success factors ensure the measurement of something important. Ideally, the measurement would be only what is critical to Creganna’s success. The KPI is just straightforward, that’s a hard measure usually. That was the idea behind the critical success factors. So the

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7 Also see Appendix N for Creganna’s KPI Datasheet
measure should be measuring something that’s important, because you can’t measure everything ... just to link it to what’s critical” (Respondent Eleven, RAD 11).

Behavioural measures for managers also exist and are linked to the service measure KPI. “The idea of the service measure is your KPI. You might be the owner of it, but you won’t be the only body who contributes to it, if you like. You need a response from IT or a response from HR to get you decent people to start with or a decent computer system” (Respondent Nine, RAD 9). The service factor allows employees to rate the service provider, such as the HR group. It is a clever concept because “a leader’s behaviour does impact on how their people respond” (Respondent Eleven RAD, 13).

Behavioural measures for managers are measured with DCOM, direction competence opportunity and motivation. “Basically, they score me one to five. There’s twenty questions in total ... and when you see the questions, you know that if I’m doing well in those, I’m managing my people very well. So I’m measured along that grid.” (Respondent Nine, RAD 9).

Managers need to be within a certain range or meet certain criteria. “If they’re not [meeting the criteria], we start working on development. For example, that’s where I come in again, if we have a manager who is down here and ... they’re manager behaviour is not right, I then start coaching them” (Respondent Nine, RAD 9).

4.2.3.2 Key Competencies
Key competencies are sets of skills needed for job competence. A set of competencies would be linked to a job, such as the quality engineer position at Creganna. “There’s probably six or seven key competencies ... [involved with] our development plans for those people” (Respondent Eleven, RAD 11).

4.2.3.3 Lagging KPIs
Lagging KPIs can be used to indicate the motivation of the workforce. “Lagging KPIs are kind of where the damage is done. ... Lagging KPIs is absenteeism, which is a really good indication of motivation of a workforce” (Respondent Nine, RAD 9).
Attrition and absenteeism can occur and are good indicators of morale. Respondent Nine explained that management style and employee development are critical at Creganna.

“If absenteeism is suddenly high, there’s something wrong with the morale or the motivation in the work force. If attrition is high, if people are leaving, there’s something wrong. And usually what’s wrong is either people’s performances are not being managed right ... people not getting properly communicated, or their training development plans are not. It’s usually one of those. Three primary reasons why people leave in industry, generally, is not pay, believe it or not, it’s way down the list; it’s either they’re not getting developed. It's usually management style or attitude that makes people leave the organisation. And it’s usually ... they’re not getting developed or how they’re being managed by their manager.” (Respondent Nine, RAD 9)

4.2.3.4 Training and Development Plans
Training and development plans are used in Creganna to develop employee skills, deliver employee progression using transparent milestones, and trace career paths. Respondent Nine is directly responsible for the plans in Creganna and explains that he links the training and development plan to the business KPIs “Training development plan is basically ... in very simple terms, you have your KPIs, ... you have your performance against those KPIs and then you have the skills and competence to deliver that. There are two levels of development. One is development of competencies or skills to improve performance and improve your KPI” (Respondent Nine, RAD 9).

It is the manager’s responsibility to identify gaps that may stop an employee from realising his or her potential. Anything that may stunt the performance of the employee must be identified because it negatively affects the KPI; “so a manager should be constantly looking at the performance of the individual to improve the KPI. And then what are the gaps that are stopping that person from delivering that?” (Respondent Nine, RAD 9).

In theory, closing these gaps is how active KM should happen, but this is quite different in practice.

“There’s also development of people into careers that they might be best suited, because you’re constantly moving maybe an engineer into..."
an engineer management position or something else. So if somebody shows an actual attribute towards a particular career move, then you might be looking at their development to something else all together, because quite often, a large percentage of your people are sitting. ... There's a book called “Good to Great”, and it’s all to do with five levels of leadership and having the right people on the bus, and the other one is having the people on the right seats on the bus. Probably 90% of my time was spent either getting ... their own people on the bus in the first place and getting the right people on it. But then even when you had them on, you had good people who are not in the right rows. So [the] majority of my time is making sure that people are being steered in the right direction as regard to careers and getting the optimum out of them. ... A lot of that is through coaching of managers, and it’s managers’ responsibility to make sure that they are doing development plans with their people and delivering that.” (Respondent Nine, RAD 9)

In addition, these development plans are weighted accordingly. He explained that the KPIs that the plans are trying to achieve are weighted. “It’s very focused. So the KPIs ... [are] evenly distributed, even though you could argue there’s weightings within the ultimatums. But not on these, they’re evenly distributed” (Respondent Nine, RAD 9).

The development has to be for the right reasons and often incentives offered to employees may not improve it. “I think if you can’t understand the importance of it [a development] then an incentive’s not going to make it any better. I have to know that if I’m developing you, it’s for the right reasons. The incentive should be that you’re going to get a KPI” (Respondent Nine, RAD 9).

However, indirect incentive is linked to the aforementioned managerial behaviour measures. In this way, managers are seen to manage their employees efficiently or inefficiently. “Every manager is measured on two dimensions on a grid, and this happens every six months now. They’re measured on their KPI. And you’re measured on your behaviours across here [the grid] as a manager. We outsourced it to Stanford University [in California, U.S.] and they come in. So what happens is the KPIs are measured — straightforward enough, we measure it every month. ... Every one of my direct reports are asked twenty questions about my management style. ... If I’m rating high in them, it means I’m managing my people well” (Respondent Nine, RAD 9).
4.2.3.5 KPI Issues
There also are minor issues with KPIs. For example, Respondent Six described the previous month in which several managers took annual leave. This caused a drop in the amount of monthly communication meetings, which directly affected the KPI (in this case, Respondent Six’s KPI dropped). “Last month when all the managers were on holidays, only half the communication meetings happened. My KPI dropped below the target. But in general, the score has to be up at 95% or something like that to make it happen. So if any of these drop, if the training development plans are not happening, if the performance reviews are not happening, communication meetings are not happening, any one of them drop, my KPI drops” (Respondent Nine, RAD 9).

Whether the KPI system is effective at measuring the level of collaboration at these meetings is questionable. If the measures of collaboration, for example, go into the red three months in a row, an explanation and measures to counteract the decline are required. “[There are] what I call leading KPIs and lagging KPIs. There are six of them that make up the KPI. If that KPI goes in the red, I have to present to the board as to what am I doing with it” (Respondent Nine, RAD 9).

4.2.4 Knowledge Cards
The User Productivity Kit (UPK) system will be discussed in the subsequent section, but the system that preceded UPK must first be acknowledged. Knowledge Cards, though still in use at Creganna, is the precursor to the UPK system that showed a lot of problems from the outset.

Knowledge Cards are a way of gaining more knowledge about an area. For example, the card would give a brief summary of the area and subsequent information. The system required time to use and was largely rudimentary. As there was very little documentation (a problem that also will be discussed) on Knowledge Cards, the analysis for this study was done through one-on-one interviews and note-taking.

Respondent Seven and Respondent Thirteen are the leads in I.T. and deal with the functional side of applications. The knowledge card system was described as follows: “Enthusiasm for those type of things tends to wane very quickly” (Respondent Seven,
RAD 7). Respondent Thirteen said, “I don’t think anybody uses the Knowledge Cards to be honest” (Respondent Thirteen, RAD 13).

When asked if there was a system used to find information about a specific area, Respondent Ten answered, “No, it’s more, talking to people, networking. I know they’re doing stuff around Knowledge Cards, but ... do people use them? No” (Respondent Ten, RAD 10). From an observatory standpoint, employees either did not have the time to use Knowledge Cards or did not consider them to be useful.

The question arose as to why the Knowledge Cards weren’t used. “[They’re] a great idea. I suppose, just speaking for our group, guys just probably don’t have time to be going in there” (Respondent Ten, RAD 10). Many employees were not aware the cards existed. This may be a management issue (lack of awareness also could be seen in ERP and the objectives of UPK). As with the ERP system, lack of awareness or understanding seemed to be an issue. Respondent Ten was asked if it was a requirement to know about these systems. “No, the majority of people that I’ve ever asked about Knowledge Cards, they wouldn’t be used that much, no.” (Respondent Ten, RAD 10).

Incentives were not in place at Creganna to facilitate the use of the Knowledge Cards. As Respondent Six’s job includes having links with all the business units, his level of exposure would enable him to offer a deep strategic insight on the system. “The culture of the organisation lends itself to the sharing of knowledge, but ... there isn’t a formal KM system end to end” (Respondent Nine, RAD 9). In some cases, a post-mortem is conducted after a project’s completion, which documents the lessons learned, but there is not an end-to-end system.

For Creganna, Knowledge Cards seemed more like an underused “extra” accessory rather than an essential tool that makes or breaks each working day. “For our business, Knowledge Cards are nice to have, or for engineers, it’s nice to have. They’ll get by without it, [but] the Oracle stuff and UPK stuff, they need to have that” (Respondent Ten, RAD 10). UPK is needed at Creganna. The UPK system will be discussed in the following section as a response to lack of training and learning needs at Creganna.
4.3 The User Productivity Kit (UPK) System

Creganna Training Division to Senior Management: “We previously recorded all transactions performed on Oracle on UPK and just train staff on these; most other companies pay Oracle two or six grand for a generic weeklong course” (Field Notes 2009)

The UPK system is part of Oracle and is a collaborative development environment used to create system-related assets. It uses “people-to-system” technology documentation and has the ability to produce multiple outputs through a single recording session, for example, the recording of a process or procedure ([Accessed online] http://www.Oracle.com/applications/tutor/user-productivity-kit.html). UPK was introduced by HR, under the supervision of Respondent Fifteen, at Creganna at the end of 2007. Its function was to aid the 70-20-10 learning philosophy that will be discussed in the subsequent section. It was used to help with the implementation of Oracle and other minor functions; “it was used for the ERP implementation. And UPK was primarily bought for MRP processes, but we were starting to use it for other things. ... If you're using a process only, at most, every three months, and you forget it, you can go back in there and actually it [UPK] will actually guide you through it” (Respondent Nine, RAD 9).

4.3.1 UPK as a Training Requirement

“It’s just for training, but at least you get some competency out of it. At least there’s a test at the end of it.” (Respondent Ten, RAD 10)

Besides the Creganna handbook, a new engineer coming into Creganna will partake in the UPK training programme on Oracle. This is part of Creganna’s formal training and its function is to familiarise new engineers with processes in which they will be involved. Respondent Five, a senior manager, explained that the idea is for employees to be comfortable and knowledgeable in the space in which they are working, “in essence, to be knowledgeable in what you’re doing in that space so you don’t screw up the system. But it had a dual purpose, and while the steps in the process have Oracle elements to them, [with] most of the processes you know where you find the information and what you do with it when you get it” (Respondent Five, RAD 5).
Senior management seemed to have a firm grasp on UPK’s function. However, when analysing its impact with other personnel, including senior Oracle leads, the general attitude is of distain toward UPK. “I think it’s useful, but it’s overly used here as the be-all-of-end-all to training ... It certainly has its part to play, but now things might be starting to change...But people thought, ‘great ... we have this training tool and it’s automated and it’s brilliant and this is the way to go. No paper and files on G drives, and this kind of thing. This is a one-stop shop to getting people trained.’ And like that, it failed to do that” (Respondent Thirteen, RAD 13).

Respondent Thirteen specialises in answering queries about Oracle and dealing with the problems. These queries are supposed to be avoided by the knowledge imparted by UPK’s training. He described the reality of the situation: “He’ll go, ‘I wasn’t trained’, and you go, ‘but you did all your UPK and you passed?’ And he goes, ‘yeah, but I wasn’t trained.’ UPK is a click-click job. ‘Yeah, I looked at all the screens, I clicked on it, I passed in the end, the test, but I still don’t fundamentally understand what I’m doing because no one has been able to tell me. And nobody else knows when I ask either. They kind of go, I don't know, I think you click on that, I’m not sure, chance it, sure’” (Respondent Thirteen, RAD 13).

4.3.2 Prior to UPK Implementation
Senior management recognised that as Creganna grew so did the need to become more efficient at capturing and recording information. As described, process capture took longer to recording on paper. “Before, they said, ‘What do I do with all of this.’ ... But obviously the more complex it is, probably more time goes into evolving what it might look like in terms of a process, and then capturing that on paper” (Respondent Five, RAD 5). With the growth in Creganna, new measures had to be introduced to record processes that were now numbering in the thousands. Before UPK, processes were maintained in an ad-hoc way. The importance of the process was still paramount, but there was an attitude of “if it wasn’t captured it wasn’t seen”.

“I’d argue that it’s probably paid for itself already three times over in terms of just new people coming in, being able to sit them down in front of a terminal, as opposed to hit and miss, ‘wonder what I should teach them today’” (Respondent Five, RAD 5).
Respondent Fifteen was tasked with this initial recording and capture of the current processes at Creganna. This was the first attempt the organisation had made to actively capture their processes and locate them in one archive for storage and UPK training.

“I thought the main problem is that ... there’s no process transparency, they don’t know how the transactions are performed on Oracle. And since they didn’t document the implementation of Oracle to a degree, that would be from a training materials point of view, there was inconsistencies. So they were cascading the knowledge, which is fine, but ... there wasn’t great documentation or no one really knew who knew the answer. So in order to address that, rather than sending people off on courses ... we could build on it and develop what I call functional experts. So I went about recording every single transaction using UPK” (Respondent Fifteen, RAD 15).

The recording of the processes in Creganna basically meant Respondent Fifteen would shadow functional experts in each area and record each step of what they did. This was to create a repository of knowledge in Creganna, and to use this as the pool of training material. “That’ll be a repository for all the knowledge, and that’s how we’ll actually figure out, you know, how to store and capture and maintain knowledge. I won’t say it worked; I won’t say it didn’t work. It worked to an extent” (Respondent Thirteen, RAD 13).

4.3.3 UPK Issues Post Implementation

On UPK: “All it is, is really ... recording processes.” (Respondent Nine, RAD 9)

UPK’s function, as discussed, is to better implement training initiatives through accurate recording and process capture and to implement an interactive approach to training. In practice, this was more difficult to reproduce. I.T. lead Respondent Thirteen would have increased exposure to UPK, not just the front end, but at the back end, when dealing with the engineers post-training. He described UPK as a tool that had limitations. “Here’s a tool. This tool basically is an automated screenshot taker, and that’s really what it is, but it’s nice, animated, you know, lessons and so on. But it fundamentally does nothing you couldn’t do with Microsoft Word and screenshots and copy and paste anyway. It just puts it together nicely” (Respondent...
Thirteen, RAD 13). Respondent Ten also described the system’s limitations. “When you have 500 people working in the place and you only want them to do CCOs, and it works 99 per cent of the time, that 1 per cent of the time they’re just stumped. Well, then you have to find someone” (Respondent Ten, RAD 10).

The lead on the process-capture, liaised with IT in formulating a way of capturing the business processes. However, the issue of ownership became a problem as initial experts in the particular business process no longer worked with Creganna:

“He [Respondent Fifteen] came to us and said, ‘where do I start? There must be 100, 200, 300 tasks which people interact with in Oracle every day that I need to record.’ I said, ‘... there is none of these business ... owners who can actually work with you. So you’re actually in the awkward place of having ... to go and work with the end users and try and reverse engineer this.’ So literally, he went around and identified every one and said, ‘right, well your job is what? You issue stuff from stores to the manufacturing floor. I want you, with UPK switched on, to go through everything you do and I’ll make notes and we’ll capture that. And then that will be it, the issues from stores forever. And the next person that comes in the door that we hire to back fill you or if you’re leaving and we hire a replacement for you, we’ll have it ... we have it captured, this is what you do’. ‘You’re assuming that what they do is correct’ (Respondent Thirteen, RAD 13).

After solving the issue of how to record and capture processes, Creganna now faces the issue of ensuring what they record/capture is correct or representative of what is perceived to be correct.

4.3.4 Training Issues

“The people who are probably best positioned to train are the ones who are doing the job day to day.” (Respondent Seven, RAD 7)

Though UPK is Creganna’s formal training system, there was not subsequent training to supplement the system. Respondent Six, from the prototypes department, explained: “For training people ... no. The only training system that’s around is the UPK thing that Respondent Fifteen has. I’m not a huge fan of it, I have to admit” (Respondent Six, RAD 6). This suggested there may be a reliance on formal training at Creganna.
The primary issue for Creganna is that the process knowledge needs to be built from the ground up. “It’s very basic and the people that put it together didn’t particularly know much about what they were putting it together on” (Respondent Six, RAD 6). It is difficult to build from the ground up by recording tasks that are very context based. “It’s context-based, and how do you build up that process knowledge? To a very large degree, I kind of think that just some simple flow charts on how processes work and how they interact with each other would be a huge leap forward for Creganna, just simple process mapping. I think some simple procedures around that would be the next step” (Respondent Six, RAD 6).

There are various issues with the accuracy of the content within the UPK system; (1) the content is old and outdated; (2) the expertise within Creganna does not exist to update the content; (3) the people who are being used as subject matter experts until this point were nominated on seniority rather than on levels of know-how. “We’re going to write down, record what people are doing in their day-to-day jobs, and let that be the training for everyone else. ... Because I knew that what people were doing in their day-to-day jobs was so far off the mark in terms of what they should have been doing, I didn’t see it as all that fruitful an exercise to record it” (Respondent Six, RAD 6). The variety in the engineers’ work is not compatible to UPK’s method of interaction, which does not offer enough variety. “It’s all right if somebody had to press button one-two-three, one-two-three, one-two-three over and over and that was their job, it’s grand. But the nature of what we do, it’s just always variations” (Respondent Six, RAD 6).

The issue of finding the solutions does not seem to be the primary concern either. There is no underlying issue of finding and applying solutions that are hidden from ground engineers. Some of the problems on the ground seem to be a fundamental misunderstanding or lack of awareness as to how the process was carried out. “Whether it’s UPK or some other system, or some sort of a centralised repository of knowledge, so that all of the people in that group can start looking into it and kind of start going, ‘oh, so I was supposed to be doing it this way all the time’. It’s not rocket science, none of these things are that I’ve come across. I rarely ever come across a problem in here that there wasn’t a very simple solution to, it was just that whoever
happened to be looking at it had absolutely no idea that such a thing ever existed’’ (Respondent Six, RAD 6).

Though UPK has some pronounced issues, it also has advantages and potential to be effective for Creganna. With regard to training, UPK is seen as a way of delivering information to new engineers. Though the effectiveness of this delivery is in question, Respondent Nine describes it as a way of saving time in delivering the material. “Instead of me having the knowledge to transfer onto somebody else, you’re talking about maybe for the volume of process knowledge that has to be transferred and you’d be talking about having an army of people delivering it” (Respondent Nine, RAD 9).

UPK is seen as enabling “self-learning”, but the effectiveness of this is in question. However, the “experts”, as previously mentioned, were not present in Creganna, so there was an issue of recording what the “experts” deem as the accurate process method. This also brought the suitability and integrity of the material that was used on UPK into question. “You get an expert, you record the processes, or you’re the expert to record what he’s doing. And that’s done so there’s kind of three stages of you practice it. You do it and it measures, so once the expert is done and now it’s recorded, and then you sit down and basically it ... actually scores you with it. ... So basically, [Respondent Fifteen] can have several people learning all these processes without needing other people to do it. So it’s self learning” (Respondent Nine, RAD 9).

The perception of lack of expertise and process ownership was an interesting observation. As HR manager, one would assume Respondent Nine has his finger on the pulse of the talent within Creganna. In particular, the question arose as to how these experts were recording or capturing this process knowledge. “That was a problem actually to do with — and quite a lot of the cases — what we had was so-called experts, but we deemed them the people who are most knowledgeable. I’ll take back the word expert. We would have the people who were most knowledgeable recording the instances” (Respondent Nine, RAD 9). The recording of processes onto UPK for training purposes was done by those deemed most knowledgeable in the area, rather than experts that may have had the required process knowledge. This
raised questions as to the structure and level of process accuracy at Creganna, not just within Prototypes or Design Services departments, but across all the business units.

### 4.4 Formal Training

“If you’re currently an engineer and you need responsibilities that are outside of that ... then you go through a formal training process.”

(Respondent Five, RAD 5)

“It gives you the confidence ... in terms of ‘I know now this is how to approach this and how to deal with it’.”

(Respondent Four, RAD 4)

In using the framework to explore formal training at Creganna, two approaches were taken: (1) exploring the people who provide and do the training and, (2) exploring the people being trained. Firstly, this section will approach training from the trainers’ points of view. Senior manager Respondent Five explained that every engineer who comes into Creganna has “Oracle responsibilities”. “There’s basically a series of exercises, learning exposures, in essence, that you need to be exposed to. So if you come in as a young engineer, then basically there’s a menu there that you need to wade your way through to say ‘I’ve been trained’” (Respondent Five, RAD 5).

Respondent Fifteen, the person in charge of training within Creganna, explained that when staff “go through the ... formal bit, they feel unsatisfied, and they feel, ‘I don't really know it’. But the focus really should be learning on the job, and people value it less” (Respondent Fifteen, RAD 15). The smallest proportion of Creganna’s overall training is described as formal and is completed on UPK.

After this, recruits engage with nominated experts and on-the-job learning. An issue with the nominated experts or Creganna’s ad-hoc mentoring is “you meet with a manager, they write down training needs under three different categories, and then the onus is on the trainee, the learner, to own it and follow it through and have the support of the manager.” It is often up to the recruit to follow up on these needs, but, as discussed, it is not happening. “When they would fill it out, a lot of the time nothing happens; and we mark it down as being filled out on HR KPIs” (Respondent Fifteen, RAD 15).
Training at Creganna is an “investment in people, in the business, and it should be thought of [as] that” (Respondent Fifteen, RAD 15). Often a part of the process is uncompleted. “Every six months, you’ll find the same course not done” (Respondent Fifteen, RAD 15). Furthering the formal training at Creganna, Respondent Fifteen tried to focus “on courses that are kind of going to be really obviously a value, so the person even would not be doing a paperwork exercise” (Respondent Fifteen, RAD 15). He explained that he “worked with the managers and if a person needs to improve their report writing, don’t send them on a report writing course for 350 [euro]. We have an internal champion, and just measure their email, tells them to CC you occasionally, and it’s an in-house thing that you have learned through people, and there may be some tips on the intranet” (Respondent Fifteen, RAD 15). Respondent Fifteen’s suggestion is a far more tangible way of training and it increases the master-apprentice relationship that was discussed earlier. It also is more cost-efficient. “So I have saved a lot of money for the company ... and now they’ll see a lot of this is internal learning” (Respondent Fifteen, RAD 15).

Some of the formal courses have been described as “very beneficial” and that “consultants coming in and then just sitting with them and understanding different things is actually good” (Respondent Twelve, RAD 12). “We just rate it one to five. As crude as it is, it’s actually effective, because quite often, when I went on that thing, it was absolutely useless’’ (Respondent Nine, RAD 9).

From I.T.’s perspective, “people do formal training but that only gives you kind of a starting point” (Respondent Seven, RAD 7). “We give people a small level of formal training, and there’s an element of hit and hope that you’ll know what to do. Definitely, there’s an area we’re concentrating now at the minute. We have the people properly trained and we’re doing it for selfish reasons” (Respondent Seven, RAD 7). However, contrary to the purpose of the nominated experts function, often experts “don’t want to be bombarded with phone calls” (Respondent Seven, RAD 7).

To facilitate the provision of mentoring scenarios, Creganna brought managers “through some development programmes as regards how to do training development plans with people” (Respondent Eight, RAD 8). However, many of the managers or senior people expected to deliver mentoring or coaching training did not have the
required skill set or knowledge. As Respondent Fifteen admitted, this was an issue. “I was trying to develop them by some of them going through my ‘Train the Trainer’ course ... to building on their expertise” (Respondent Fifteen, RAD 15).

When people are put in a training position, “they tend to know the details a lot more, so it puts them on their toes. When they’re recording something or creating the knowing, people are going to read, they’re also thinking a lot about it” (Respondent Fifteen, RAD 15). After the implementation of “Train the Trainer” courses, it is hoped that Creganna will have developed more experts. Also an issue is the lack of validation of the training material. “[The] next phase was to look at the material and have it validated by the experts, the people who would have a process brain ... to gain the process transparency” (Respondent Fifteen, RAD 15).

The major issue with formal training is the effectiveness of UPK as a tool. “The testing for it is very ‘monkey see, monkey do’. You can pass the test by knowing what buttons to press. [This brings about the] need to get in and really know it and know the system. ... It’ll get the majority of engineers ... with the skill sets they need. But I suppose what happens is when they’ve come to a different scenario [they don’t know what to do]” (Respondent Ten, RAD 10). However, “it’s always one of those kind of barbed questions where people kind of go, ‘right, how do you do it better?’ Because you look at that and you kind of go, ‘this is not quite crap, but you know, this is not what we're looking for. It’s not the final answer’” (Respondent Thirteen, RAD 13).

Respondent Eight argues that UPK is “fine as a tool”. However, “it’s a flawed logic to think that just because somebody can do it on UPK, they can do the job”. “It’s not training; it’s giving you the first instruction, if you like, of what to do. But the knowledge to know what every one of those fields does ... I don’t think UPK gives you that. It’s just the mechanism, like ‘hit that box, that box, that box’” (Respondent Eleven, RAD 11). Others refer to UPK as a “sub-optimal process that they’re struggling to keep working. They put all their time and effort into keeping it working and rarely ever go back and actually learn how to do it properly” (Respondent Six, RAD 6). Respondent Nine argued in favour of UPK. “If I want to learn, it actually brings it and goes through it and actually scores you with it. It scores you and tells you how long it took you to do it, and all that sort of stuff. So basically [Respondent
Fifteen] can have several people learning all these processes” (Respondent Nine, RAD 9).

4.4.1 Informal Training

“It’s the rising tides scenario: Basically, bring everybody’s level of knowledge up, so we can take more ownership of stuff.” (Respondent Seven, RAD 7)

On the 70-20-10 Learning Strategy: “The 20 per cent is sharing and getting it ... from those experts around. ... And the 70 is experience, throwing people in at the deep end” (Respondent Nine, RAD 9)

The informal side of Creganna’s training encompasses nominated experts in coaching or mentoring roles and on-the-job, hands-on learning. The issue with nominated experts, in the Oracle instance, for example, is a lack of appropriate training. “We’ll say new things are introduced, for example, when Oracle was introduced first, and I think there wasn’t a whole lot of training, enough training given to people ... companywide to say how are we going to use it” (Respondent Fourteen, RAD 14).

The ad-hoc nature of the informal side of training also can be a problem. “In terms of learning and training for people, I see it as a huge issue. And I’ve been just looking at the structure of that whole group and I’ve suggested to various people how it should be structured.”... [However], there is a reluctance to go spend money in terms of putting in some overhead there that inevitably I think would pay off in the longer run” (Respondent Six, RAD 6).

One acquires informal training through one-on-one contact. “You ring up, ‘I have an issue’. Right, the first point of contact, you come down, they’ll walk through with you. That’s informal training” (Respondent Seven, RAD 7). One of the fundamental ways to improve this is to create a knowledge expert in each area and “let them then try and put together the training material for other people and try and build on it from there, in that you’d have more than one knowledge expert in each area” (Respondent Six, RAD 6).
This could be achieved by singling out senior people, for example, and stating “‘you’re not the expert.... Go away, learn what you can about it and when you figure out what you don’t know, we’ll find somebody that will come in and get that knowledge, or we’ll send you off for training some place, and just get that basic process knowledge’. ... You could refer to them as a process expert’” (Respondent Six, RAD 6). The advantage of the ad-hoc approach to nominated experts as is that the expert is a key part of the knowledge process; however, it is the employee who then owns it. “You want it, you own it, you drive it” (Respondent Seven, RAD 7).

One of the issues with training, both formal and informal, is the lack of trained or skilled senior people (trainers), which leads to “garbage in and garbage out” (Respondent Thirteen, RAD 13). Someone who had not been adequately trained in the nominated expert category resulted in the following situation: “Someone put garbage into it, you know, yesterday or last week or something, that’s why you’re getting that result out of it” (Respondent Thirteen , RAD 13). In effect, instead of senior trainers spending time coaching and doing their own jobs, there is a case of fire fighting many little problems throughout the various departments. When Respondent Thirteen arrived at Creganna four years ago, just after they went live with a big system, “there was no trainer at all...There was no UPK, there was nothing. So I was asking the same questions, ‘how did you train the users if you didn’t have a trainer?’”. (Respondent Thirteen, RAD 13).

This led to a situation where Creganna “hired a guy from the UK, he came over here for a week and he gave a couple of lectures, basically, to a large audience with PowerPoint presentation, going ‘there you go, you sign the sheet, you were in attendance, you were trained, and away you go. And that was training. And obviously that didn’t work out too well”’ (Respondent Thirteen, RAD 13). Invariably, what happened was the beginning of the ad-hoc fire fight where “we just go down together, you know. You go down and you spend an hour with them and say, this is blah, blah, blah, and they go, ‘oh yeah, well if I was told this in the beginning’” (Respondent Thirteen, RAD 13).

It is established that the informal nominated experts are unable to provide adequate training either due to lack of skill or not enough experts to begin with. This also is
supported by the fact that “managers are still suffering from classroom training. The easiest thing to do is send them off on a course. It’s a little bit harder work to think about; ‘we’ll expose you to a bit of experience here’ or ‘go work with Joe Bloggs for a while there because he’s an expert’” (Respondent Nine, RAD 9). This indicates that the 20 per cent segment of the 70-20-10 Learning Strategy is faltering because “the training was really unofficial, ad-hoc training that was given by us in the absence of anyone else being able to deliver it to them” (Respondent Thirteen, RAD 13).

Unfortunately, the effectiveness of the formal 10 per cent also is not performing or producing the desired outcomes. The new engineer or recruit must do the UPK lesson. “And still, you have these problems. ... UPK is a click-click job. ‘Yeah, I looked at all the screens, I clicked on it, I passed in the end, the test, but I still don’t fundamentally understand what I’m doing because no one has been able to tell me’” (Respondent Thirteen, RAD 13). This relates to the issue of locating knowledge. “Nobody else knows when I ask either. They kind of go, ‘I don’t know, I think you click on that, I’m not sure. Chance it. And then if you don’t know, ask I.T.’” (Respondent Thirteen, RAD 13).

4.4.2 Testing the User

Another issue with UPK is its limitation in how it tests the user. Respondent Thirteen explained that the programme is more like a memory test than a learning tool. “No one ever goes back and looks at UPK either. ... I’ve heard the same expression come back from countless people at this stage. But people have said it’s a memory test. You click here, you click here, and you click there, and then you’ve got this test. And if you can remember the clicks and they’re in the right order, you passed and you’re trained, apparently. And that’s how it works; it’s a game, like a computer game. And if you pass, you get a high score” (Respondent Thirteen, RAD 13).

Respondent Nine explained that UPK was the only capturing tool available to Creganna. “You have to capture it on UPK because ... it’s our only method of capturing it really that we have” (Respondent Nine, RAD 9). Respondent Eleven pointed out that UPK had some merits as a capturing tool, and he also realised its role as a facilitator. “It’s excellent in what it does, but it just needs to be recognised that it
can only go so far. It’s like you go to a training course for two hours, you’re told why something is. But [you’re not fully knowledgeable] until you go and practice it and do it and get a bit more competency in it” (Respondent Eleven, RAD 11). UPK had not been considered to be part of the Inventory Management project, but its role was confined to capturing process and formal training. “It was used for the ERP implementation. And UPK was primarily bought for MRP processes” (Respondent Nine, RAD 9).

The same issues that were highlighted during the Oracle implementation could be seen with UPK. There was a fundamental lack of understanding as to what the system was about or expected to do and this caused issues of fire-fighting, especially for people in I.T., who highlighted the lack of awareness and training. “It was, yeah, it was [misunderstood]. Like that time when I arrived here, just after they went live with a big system [Oracle], basically there was no trainer at all” (Respondent Thirteen, RAD 13).

The lack of human interaction could contribute to the level of distain toward UPK. “I hate UPK. I think it’s absolutely useless. Well for me, it’s too slow. You don’t gain knowledge out of it because all you’re doing is clicking and reading. Whereas if you had a question of ‘why is it doing that’ or ‘what if it was this’, you don’t have that human interaction at all” (Respondent Twelve, RAD 12). Respondent Twelve, the business lead on the IMP and primary Oracle expert at Creganna, does not see UPK as an adequate training system and said more value is gained in spending time with others. However, there is no formal mentoring programme at Creganna. “It [UPK] is not training. It’s just a paperwork exercise as far as I’m concerned. ‘I clicked a button and now I know how to do this’, and I haven’t a clue how to do it. ... I’m not a fan of UPK at all because five minutes with a person is worth three hours on UPK” (Respondent Twelve, RAD 12).

There are many things that can be done to supplement UPK as a training tool. Respondent Thirteen explained UPK is not the final answer to training, but it is a step in the right direction. “You look at that and you kind of go, ‘this is not quite crap, but you know, this is not what we're looking for. It’s not the final answer.’ It’s half an answer to the training problems. How would you do better? How do other companies
do it, and they do it in a million different kind of ways to suit them and how they've grown up?” (Respondent Thirteen, RAD 13).

UPK also can be hindered by its ability to keep the user’s focus. UPK can be detailed to the point of information overload. This alludes to a support structure for engineers who want follow-up queries about UPK answered by the person with the relevant knowledge. “We had really good training material, which would have included UPK, but also would have included other workshop-style training and say work instructions as well, because UPK can be very long winded and people fall asleep before they’re half way through one lesson on it, because it is an ultimately boring tool. Now, it’s very precise, but it’s incredibly boring” (Respondent Thirteen, RAD 13).

There was a time when there was not an expert or a knowledgeable person available to supplement UPK. Respondent Nine said Respondent Fifteen is available when the engineer is doing the UPK training, but there are not enough resources to provide the expert or person-to-person help. In addition, Respondent Six said that since the processes are quite clinical, there is no need for a facilitator. “The volume, you just couldn’t cope. For the amount of movement of people in the organisation, it just wouldn’t be practical. The amount of process steps that have to be done, how to raise a requisition, and to be able to teach that – and then if there’s a change in the processes, you have to go around and teach everybody. I don’t know how you’d manage without it [UPK]. So from that point of view, I think it’s OK not to have a facilitator there” (Respondent Nine, RAD 9).

Respondent Nine also described his experiences with content accuracy. “I know if you’re expert is not an expert. If the expert was doing it personally, person-to-person, then he’s teaching them wrong. I mean, it forces a discipline. If I’m an expert and I’m teaching somebody, and then I don’t have UPK. And I’m teaching you today and then I realised, ‘oh gees, was that right? Maybe I shouldn’t have been doing that’. Now I’m teaching somebody else tomorrow” (Respondent Nine, RAD 9). It was observed that the “most knowledgeable” person was not decided on seniority, selection was based on a managerial awareness of whose processes would be most suitable to record. “It wasn’t really seniority; it was more just through awareness. ... The organisation is small enough to know who’s learned them all [Creganna will capture what has not]
been approved through the test process yet, which is dynamite right. But they’ll be 99 per cent right … We know that that was wrong. So now we know if we put twenty people to do it, we have to bring those people back, get it through. So it’s a good control; whereas if you didn’t have that, I’m not too sure how good of control you have” (Respondent Nine, RAD 9).

4.4.3 UPK Suitability

The suitability of UPK as a training approach often is doubted. Many employees give insight from the engineer’s perspective: “It’s fine as a tool, but I think it’s a flawed logic to think that just because somebody can do it on UPK, they can do the job. But as a tool to be able to see how to do something, it’s excellent, the way you can just log in and see. But it’s not training; it’s giving you the first instruction, if you like, of what to do. But the knowledge to know what every one of those fields does and all this kind of stuff, I don’t think UPK gives you that” (Respondent Eleven, RAD 11).

In addition, UPK has a rigid nature in that there may be several ways to arrive at the same result, but UPK only allows a single sequence, “Whereas if I were on UPK, I have to do it in the UPK sequence. That’s the expert’s input and that’s not right either because it’s making you do it one way when you know you can do it another” (Respondent Eleven, RAD 11). Respondent Eleven alluded to a situation in which the system was cheated by an engineer who opened two screens to facilitate signing off on the training. “I’m sure you’ve been told that the person has had the two screens open at the same time. So watching UPK and doing it on one and the transition on the other and they get signed off” (Respondent Eleven, RAD 11). Respondent Eleven also added UPK is missing procedures.

Finally, though UPK has an important role, it cannot be the complete solution to Creganna’s training. “It has a role; it has an important role. … [But] I know people who’ve been signed on when they still don’t know what they’re doing” (Respondent Eleven, RAD 11). On a positive note, attempts are being made to improve the content within UPK to improve training. “Just trying to get the documents better down the line and then get the training better then, so when new people come in, they’re trained to the better document” (Respondent Eleven, RAD 11).
4.5 The 70-20-10 Learning Strategy

“Creganna has to be able to link together and learn together.”
(Respondent Fifteen)

There are many current strategies in Creganna, such as Lean strategy, business strategy and HR strategy. “Link Together, Learn Together” is the tagline for the new learning strategy that will be implemented in Creganna. “There’s a lot of great work and talent within Creganna and this learning strategy is intended to build on your current good practices where we can easily link our knowledge together and learn from one another” (Davis 2009).

One of Creganna’s main KM initiatives is its push toward the 70-20-10 Learning Strategy. In the learning cycle for a new quality engineer in Operation, for example, they would need to perform at 100 per cent as soon as possible. The learning strategy is based on a formula of 70-20-10, which represents how an adult learns. Typically, according to Respondent Fifteen, an adult learns in the following ways: “10 per cent is based on formal classroom-based learning or online courses; 20 per cent is based on learning from peers, social networks, shadowing and KM (informal); ... and 70 per cent is based on on-the-job learning (informal)” (Davis 2009). Respondent Fifteen explained the strategy in more detail.

“My process would require a function expert, so one person would be the go-to person for that. And then there would be business KPIs put against it, and a small, sharp formal part, but delivered by an external party. So that’s where you get this 70-20-10. So that the 10 would be the formal bit; the 20 will be the nominated experts as well as the backup material, and then the linking to some sort of KPI (like how many successful negotiations and so on set by the managers), that’s learning on the job. But I think there’s a bit of a perception that when they go through the 10, the formal bit, they feel unsatisfied, and they feel, ‘I don’t really know it’. But the focus really should be learning on the job, and people value it less” (Respondent Fifteen, RAD 15).

Paradoxically Jennings (2009) has shown in a corporate environment an astonishing 80 per cent of learning effort and resources are invested, where only 10 per cent of the learning happens, such as formal training. Creganna has tried to reverse this trend and develop an improved knowledge sharing culture. “So we can focus on the areas we get the most benefit from, the 70 per cent or the on-the-job area and the 20 per cent
learning from peers, social networking and shadowing” (Respondent Fifteen, RAD 15). However, within Creganna formal training also has an important role and has “a crucial role to play in all learning activity. ... Applying the 70-20-10 approach will put the knowledge gained into practice sooner in a more beneficial way” (Davis 2009). The 70-20-10 formula is mapped in Table 4.3 and Creganna’s learning strategy is mapped on Figure 4.1.

**Table 4.3: The 70-20-10 Formula**

| 10  | This is a defined path with 10 per cent of employee time (and learning) spent on online training (this satisfies Creganna’s quality department for their need of a quality record).  
This officially gives them access to Quality Module (UPK) on Oracle. (Note: Usually this training is perceived as not enough with poor feedback; “unhappy sheets”.)  
- All employees received an overview of the process  
- Employees had to view a recording (and pass a test) of every transaction a quality engineer in Creganna does on UPK (72 in total)  
- Employees could see a picture of the process owners. (They have more information than they realise.) |
| 20  | Employees get a username and password and log onto Oracle to do one of the 72 transactions. This UPK application has four playback modes.  
Three modes are used before access is granted and the fourth is called “Do It” playback mode and is used as a help window, which walks a learner step by step through a transaction he or she needs and is vaguely familiar with. They also may contact the person in the picture regarding any questions they may have. (Their questions are usually qualified and they find themselves using the correct terminology.) This process owner’s time only is used to clarify what the online training lacks or something the learner missed (reduces time wasting). |
| 70  | The user repeats the process (on-the-job training) for the first time they do anything new on the Oracle system until they are weaned off using the “Do It” playback mode.  
The amount of knowledge a quality engineer, who is performing at 100 per cent, is expected to know is a great deal. The output of this training approach is that engineers know who to ask and have a general idea of where to find the answers to all questions a Creganna quality engineer asked in the past. This will allow them to perform at 100 per cent before their learning is at 100 per cent. (Note: Most do not realise, but “happy sheets” get back at this stage, from both managers and staff.) |
“Training is an investment and like any investment Creganna makes, we need to measure return. ... The best metric for measuring return on investment in training is to measure performance improvement.” (Davis 2009)

**The 70-20-10 Formula**

Typically, an adult learns in the following ways:
- 10 per cent – formal classroom-based learning or online courses
- 20 per cent – learning from peers, social networks, shadowing and KM (informal)

**70 per cent – on-the-job learning (informal)**

80 per cent of learning effort and resources are invested where only 10 per cent of the learning happens for example, formal training.

Creganna aims to reverse this trend and develop an improved knowledge-sharing culture so the focus can be on areas that Creganna can benefit from the most – the 70 per cent or ‘on-the-job’ area and the 20 per cent learning from peers, social networks and shadowing. Formal training is very important, too, and has a crucial role to play in all learning activity. Applying the 70-20-10 approach will put the knowledge gained into practice sooner and in a more beneficial way.

**Source:** Davis 2009
4.5.1 Learning Management System
The culmination of UPK and the 70-20-10 Learning Strategy is Creganna’s move toward a Learning Management System (LMS). Respondent Fifteen said he is dissatisfied with how the business units start solving an issue from scratch. An LMS would provide a starting point with which to tackle issues, and Respondent Fifteen said he aims to “put together a case for a learning management system, which would have a, what I call an e-catalogue, which would be exactly for that. If you have a business opportunity, it would have a talent management suite, which would be able to find out, first of all, have we got the guy? Can we do it? Have we got the guys to do this?” Then the guys who are given the job would be able to up-skill themselves on the particular knowledge that they may not have. … If it was done before here, we would have had a lessons learned database and it would be there” (Respondent Fifteen, RAD 15). Respondent Fifteen said he trusted Creganna would choose the appropriate path regarding the endeavour despite the apparent animosity toward Oracle and UPK. “If it doesn’t suit, if they don’t see an obvious, then it’s failed. There’s a perception that that things like this are forced on the business. Yeah, but if it’s not, if there’s a certain selling, obviously, I need to do because it’s a different way of working. But if it pays for themselves and they see the value, then there’s nothing more I can do, only take in the requests. But if they don’t see the value, then it probably isn’t a value, you know. I trust them, you know. I work in a support organisation, and ultimately they’re the customers” (Respondent Fifteen, RAD 15). The LMS is not currently in place, and UPK is the primary training tool for start-up engineers and new employees.

4.6 Knowledge Activities

4.6.1 Capturing

“How we would have done the knowledge gathering: formalise it, put it down on paper. It becomes our requirements. … Build from it.”
(Respondent Seven, RAD 7)

Capture within Creganna depends largely on the need to capture from an industry perspective. “I am sure they would need to have something formal because of the nature of their business” (Respondent Four, RAD 4). The purpose of formal capture at Creganna is to obtain knowledge and make it explicit for future use. The formal methods in place, such as issue logs, knowledge cards and UPK are the main avenues
for capture. When employees need to access a particular piece of knowledge, they can go down one of these avenues. That is the way it should work. “There’s no reason then why somebody coming into a project can’t pick up that document, read into it, and say ‘right, I know what this is supposed to be doing.’ That’s the theory” (Respondent Seven, RAD 7).

During the course of fieldwork, however, it became apparent that making knowledge explicit was an issue. Following the formal structure and putting the information on paper was being avoided. Employees were using a more ad-hoc, informal approach.

“For but what we were finding was issues would come up and say ‘well sure we talked about that. Do you remember the meeting we had on the 26th of February? We discussed that; we decided’. ‘I don’t remember that.’ And then it’s just reinforcing, ‘look, you’ve got to put everything down on paper.’ You’ve to basically say, ‘OK, if you signed up to something, that’s what we’re working towards. If you come up with another great idea in two months time, OK, we might entertain it but we’ll have to formally bring it into the project or it ain’t going to be in there. And there’s a huge maturing exercise to go on there’” (Respondent Seven, RAD 7).

With approximately 60 per cent of Creganna’s formal capturing programme in place, the explicit knowledge is documented as best it can. “We have improvements to do but we had our requirements document and said ‘this is what we want’. Then we brought out what our to-be design would be, so this is what it’s going to be like. This is how it’s going to be implemented. So, from a knowledge point of view, we have it all written down as best we can” (Respondent Seven, RAD 7). An industry requirement forces the need for explicit documentation, and it allows new employees to have a base from which to work. “Will we have it 100 per cent right? Probably not, but we should have it in such a way that if somebody came in off the street, they’d have a good handle on it. And certainly what you want to do is get away from the power struggles where people keep it up here [in their heads]” (Respondent Seven, RAD 7).

The industry requirement drives capture at Creganna, rather than a burning KM fire. However, for Creganna strategically, the knowledge captured would lend itself to a culture of continuous knowledge capture. “It was about getting the process captured and understood and given as a base on which to build further learning, further
knowledge capture” (Respondent Five, RAD 5). The capture process in Inventory is important and it can achieve increased efficiency. “In the whole area of inventory, the IMP, new procedures have been written, detailed procedures are being written. They’re being written by the people who are doing it. Now, you don’t write ten pages for the sake of saying ‘look at the great procedure I have’. But you capture all of the key stuff in one page or two pages. ... If you walk into my area and you say, ‘what do you all do here’, and I say, ‘well there’s what we do, there’s our procedure’” (Respondent Four, RAD 4).

However, Creganna’s inability to capture the tacit knowledge that is “critical to the operation” can be alluded to. “I won’t lie; there’s lots of tribal knowledge as well, you know, the kind of knowledge where it may or may not be captured. The likelihood is it isn’t captured, but is it critical to the operation?” (Respondent Five, RAD 5). Creganna is trying to capture this “tribal knowledge”, but problems are caused by the informal nature of the content. “I’ll say the tribal stuff is usually informal anyway and probably came about as a result of some one incident or whatever it is, which may or may not reoccur” (Respondent Five, RAD 5).

The capture happening at Creganna also is producing a knowledge output in itself, in that the knowledge captured would be re-used in a “lessons learned” approach. Respondent Five stated that as well as lending to the lessons learned at Creganna, each capture builds on a previous iteration of that particular captured knowledge. “If the lesson learned points to a need to change something, then we’ll change it”. Once the active capturing takes place, “in essence is ... where you’re going to add to the detail of that captured process” (Respondent Five, RAD 5). This approach is meant to “capture if they know something better, if they know something we don’t know or some engineer didn’t know two years ago when they first developed this, now is the time to capture it because ... he or she might go tomorrow” (Respondent Five, RAD 5). There also is a fear of losing knowledge through attrition at Creganna, and the capture purpose is to try and decrease this loss. “It’s about capturing the document” (Respondent Thirteen, RAD 13). Creganna also are doing a lot to try to “improve the process” of capturing, but many of the issues “are just simple, clerical things”, (Respondent Six, RAD 6).
4.6.1.1 Problems with Capturing

“Capturing the processes might not necessarily be mirroring the reality.” (Respondent Seven, RAD 7)

“We have it captured. ... The problem is you're assuming that what they do is correct.” (Respondent Five, RAD 5)

As shown, there are problems with the way in which Creganna captures; namely the capturing processes not being fully operational, knowledge lost to attrition, inaccurate knowledge being captured, and feeding this knowledge back into Creganna. The problem of inaccurate knowledge being captured is one of the more serious issues. Tracing the root cause of the issue, evidence shows the problem would be dealt with but not properly understood. The solution would be recorded even if it was incorrect. “The processes were really starting from the beginning, and what’s happening between them two years ago and now was that whoever was dealing with a particular issue at the time just dealt with it as best they could and moved on. ... [Then the] next person would have the same issue, but they’d deal with it a different way, ... But nobody actually stood back and said ‘well how should we deal with this?’ And ‘this is how we deal with it’” (Respondent Twelve, RAD 12).

The capture of incorrect knowledge is aptly described in the following example:

“Something that popped up on my desk the other day where we had recognised a shortcoming. We put through a change. We’ve ticked a box to say the operator has been trained, which they were and they accepted they were. But then ... when we go to build the product out again, we find that the operator has built it to the last revision because while they have been trained and accept they were trained, they still had the revision one, we’ll say, in their head. And as it turned out, they recorded data but basically had been told that they don’t have to record in the new revision, and of course stuck out like a sore thumb when they went to review the paperwork because there you had information captured that wasn’t supposed to be captured. So are they following procedure? Clearly not, you know what I mean? But at the same time it shows ... the system wasn’t been adhered to.” (Respondent Five, RAD 5)

The capture of knowledge at Creganna could be much improved. Many procedures are outdated and irrelevant and there is a need for renewal. “Some of the SAPs [procedures] are quite old. Nobody really ever uses them, but they’re not relevant”
(Respondent Twelve, RAD 12). Things work well only “if the person who’s in charge drives it well enough”. If it is not captured, “the project is driven in such a way, if it ain’t on the issues list, it ain’t discussed. So then you know, ‘OK, to get this discussed, I’ve got to get it on.’ The other mantra we tried to bring in but didn’t work very well, if it isn’t written down, it didn’t happen” (Respondent Seven, RAD 7). This fosters a situation where processes, procedures and relevant knowledge are not captured or documented. “I would say 99.999 per cent of the time, they won’t, you know. It just happens by pure luck that if you happen to be talking to somebody going, ‘did you ever come across this?’ ‘Oh yeah, I do it this way’” (Respondent Six, RAD 6).

The lack of progress in this area has left a void for employees to go and find knowledge or explicit knowledge around a problem or procedure. There is no formal system other than UPK, though some attempts have been made, ending in failure. “There’s nothing like that [system]. There are various people around that have made a few attempts at trying to put issues logs up and owner against them and action, that kind of stuff. The best of intentions, but we just would have a desperate track record in terms of keeping them up to date, live and actually doing any of the actions” (Respondent Six, RAD 6).

Moreover, it is left to the “good people” in the company to make decisions that proper codification of explicit knowledge may aid in the accuracy of the content. One of the major issues with the capture processes at Creganna is the accuracy of the content. The lack of subject matter experts has lead to a situation where the integrity of the captured knowledge comes into question. “We’re going to capture instances that haven’t been approved through the test process yet, which is dynamite” (Respondent Nine, RAD 9).

An outdated view within KM (Dimattia & Oder 2000) involved blending a company’s internal and external information and turning it into actionable knowledge via a technology platform. However, the idea of KM has been paved by organisational analysis through organisational learning and organisational culture. There is a division between those interested in technological aspects, and those emphasizing the “people” side of KM. It encompasses any processes and practices concerned with the creation, acquisition, capture, sharing and use of knowledge, skills and expertise (Peng et al 2012; Loria 2008; Alvesson & Karreman 2001).
4.6.2 Documenting

“We need to be able to go back through our records; we need to have traceability all the way back.” (Respondent Four, RAD 4)

The philosopher Ryle (1949: 25) describes explicit knowledge as the “knowing that”. Explicit knowledge is that which has been codified and refers to knowledge that can be transmitted in formal, systematic language. The documenting procedures at Creganna enable employees to “know what it is” that they should be doing when on a project, or should at least give them the option of searching for information that can explicitly help with an issue. Explicit knowledge is that which has been articulated (disembodied) (Nickols 2000). It provides explicit examples of how a line technician may approach an issue or how a new employee may be trained “so that everybody knows what they’re working to. And then there’s no reason then why somebody coming into a project can’t pick up that document, read into it, and say right, ‘I know what it is I’m supposed to be doing’” (Respondent Seven, RAD 7).

For example, on the IMP, they were “documenting all different scenarios and what needs to be updated and that kind of thing” (Respondent Twelve, RAD 12), whereas the issues log was used practically to prevent an abundance of emails throughout the project. “What you want to avoid is the emails back and forth. ... If there’s five people on the team, you go through so many different threads of emails and no record of stuff. So we made the effort to have an issues log” (Respondent Seven, RAD 7).

During the IMP, issues sometimes would be discussed informally and then would be forgotten. This lead to important items being left out or undocumented. A huge maturing exercise is needed in this area. Leading this maturing exercise, Respondent Seven and his I.T. group were implementing simple documenting procedures that benefit not only his group, but the capture and documenting initiatives at Creganna. “If you take my group at the moment, we’re doing acceptance testing. So that’s a published document. ... These are the scenarios we’re testing. If any issues come up during testing, people log it on paper, and then it gets transferred into a niches log. The log is there for everybody to see. It’s very visible. So again, if the problem comes up, we address that, ‘here is the solution’” (Respondent Seven, RAD 7).
However, “not everybody will get involved to the extent they need to get involved. So do you say that’s a failure on knowledge transfer or is there a failure of willingness to get involved? It’s a fine line” (Respondent Seven, RAD 7). Indeed, tacit know-how would not be documented at Creganna. “I’m not sure how well some of that would be documented if it wasn’t associated with a device” (Respondent Four, RAD 4). As far as the organisation as a whole, documenting is “definitely happening” because “it needs to happen”.

There also is the “historically captured information ... that’s there too, and then there’s the maintenance and revision control and the revision of that information in turn”, but the most important documenting is the new relevant knowledge. “The fresh stuff is definitely happening in the spaces that it needs to happen in, and it’s typically in prototyping and device manufacturing and design services, where, in essence, they’re at the coal-face” (Respondent Five, RAD 5). However, there also are alternate observations, as a different story emerges that “it’s improved a small amount, but it’s still very lacking” (Respondent Thirteen, RAD 13). Other observations allude to the ad-hoc nature of documenting in Design Services because a formal documenting system is not present. “You’d have your notebook there and you’d write down everything and then we do up reports. So we include either processes, procedures on how we’ve done things and that, or else we might have to write up a manufacturing procedure and include that in it” (Respondent Fourteen, RAD 14). These are some of the observed issues with regard to documenting knowledge.

4.6.2.1 Documenting Problems

“What would have tended to happen in the past is fix the problem, move on. It happens again, ‘oh God, how do we do that?’ And you go back to this whole running in circles thing. ... We’ve been very good at charging in and going hell-blazing at stuff and coming out as heroes. My attitude is why waste the energy doing that? If you fixed it once, record it.” (Respondent Seven, RAD 7)

There are several documenting issues at Creganna highlighted by the KAF. These include knowledge simply not being documented, outdated explicit knowledge, time lost due to personnel’s ability to find relevant information, and inaccuracy in the documents. A regulation within the industry requires documenting at Creganna. To
counteract the problems in documenting, “what we’re trying to promote is ‘this has happened six times. OK, what’s the fix to that?’ Next, the seventh time happens; it’s already documented, we know what the fix is. We’ve been very poor at basically documenting resolutions to problems” (Respondent Seven, RAD 7).

After documenting is complete, “we just don’t save it consistently in the same place. But that’s just one example. I’m sure that’s right across the place. I’d say there’s a heap of time lost when you’re trying to find things” (Respondent Eleven, RAD 11). However, a larger issue is that “if somebody figures out how to do something today, they’ll use it today, forget about it in two months time, and they’re doing the same thing. They’re going, ‘oh ****, I did something like this before, so now how do I do it?’” (Respondent Six, RAD 6). This leads to the first issue of knowledge not being documented. It is clear from the discussion that documenting is poor. “It’s usually not documented as well as it could be, would be my experience. It’s dealt with and you move onto the next. ... A lot of it would be going on an informal basis, it wouldn’t be documented as such” (Respondent Four, RAD 4).

To tackle the issue of outdated explicit knowledge, Creganna introduced the concept of functional experts and subject matter experts. Functional experts are nominated by senior management to be the practical hands-on or process experts on the floor, and subject matter experts would be the content experts on a process from end to end. “I required them to nominate these functional experts. And they weren’t experts, but they were the people who would be training the people, so they might as well be the experts in Creganna. So I recorded their transactions” (Respondent Fifteen, RAD 15).

To supplement this, “there’s probably some number of iterations first before somebody says, ‘OK, I’m happy now that I know how to put the end on the ten or whatever it is so I can actually write about it’” (Respondent Five, RAD 5). The functional experts, many of which are the project managers, are “trying to get the project managers to get up and teach others quite a bit. And yeah, ‘I’m having a problem with this’, and then somebody should be able to say, ‘well, just talk to this guy because ...’” (Respondent Ten, RAD 10). However, it is hugely beneficial if what is being taught by the functional experts is consistent. “You’re teaching exactly the same stuff. It’s recorded and it makes the expert far more conscious because he knows
that what he’s entering in there is going to be used maybe for 20 or 40 or 50 people. So it really disciplines them. I would argue it disciplines more accuracy” (Respondent Nine, RAD 9). The issue with the functional experts, however, is that there is a question of how knowledgeable the “expert” is, as previously discussed. These experts have been appointed and do not necessarily have the required skill set. “What we had was so-called experts, but we deemed them the people who are most knowledgeable. I'll take back the word ‘expert’. We would have the people who were most knowledgeable recording the instances” (Respondent Nine, RAD 9).

With regard to the accuracy of explicit knowledge within the documents themselves, there is “a way you should be writing your procedures and identifying what’s the key point in it. Because in every step, there’s usually only four or five real key things”. The inaccuracies then lead to inconsistencies in training because “if you don't identify them, you don’t know if the trainer you have gets them across or not. That’s what it all comes to, and your training becomes inconsistent. And it’s thought that up to 80 per cent of quality problems can be traced back to inconsistent training at the start” (Respondent Eleven, RAD 11).

On the lean side, Creganna tries to get people to “write down what they did. Like one of the things we’re said to be good at on the lean side is we do record before and after every time we go in somewhere, and we keep recordings of both. So I can now give you a three-year history on production line one, if you like. If you look back, if they asked me for that for six years ago, not a clue. It’s nowhere. We wouldn’t know how they were running” (Respondent Eleven, RAD 11). Lean only is implemented in a small area within Creganna, and organisation wide, the documenting issues remain at large. “If it’s you or somebody else that comes in the second time it happens, it’s a non-event. So if you’ve invented the wheel, you don’t have to reinvent it” (Respondent Seven, RAD 7).

4.6.3 Locating Knowledge

“So that’s kind of the bigger challenge for me, trying to figure out who has a bit of knowledge about this.” (Respondent Six, RAD 6)
“I suppose one of the things that people would say, there’s a difficulty knowing who’s the owner of a problem. ... ‘Jesus, if I could just get an answer. But who do I get to get the answer?’” (Respondent Seven, RAD 7)

“They find it difficult to find out ... who knows about moulding, who’s our moulding guy?” (Respondent Fifteen, RAD 15)

KM also recognises the importance of locating knowledge (Pujol & Sangüesa 2002) because it originates and is used within a community of people inside an organisation with a common set of goals. Any KM process has to incorporate some aspects of leveraging, sharing and distributing existing knowledge to relevant people within the organisation. It helps decide who may be interested in new knowledge generated in the community, and even more importantly, it helps decide which people may cooperate in a given area. It is this social aspect that growth theory often ignores within its models for knowledge (Pack 1994). The issues raised by the framework in both capturing and documenting show there is a definite problem for employees in Creganna trying to locate knowledge.

“It’s better to have locators and these kinds of things” (Respondent Twelve, RAD 12). It can be easier for employees the longer they are at the organisation. “I’m here seven years, so ... I know who’s who” (Respondent Ten, RAD 10). Again, Respondent Eight, Respondent Eleven and Respondent Five agree. “I do at this stage, yeah, but it wouldn’t have been easy when I started” (Respondent Eight, RAD 8). “I’m told it’s difficult. ... I’m here nine and a half years, I don’t have a problem getting anything. But I’m told it’s difficult” (Respondent Eleven, RAD 11). “The hardest point is the starting point. You’re a day in the organisation or a week in the organisation and you haven’t got a clue how to find such and such” (Respondent Five, RAD 5).

Further discussion also suggests that the people with the knowledge “do want to tell people, but to know who they are and where and what expertise — because if you look across this, you’ve got a number of different businesses, and if you’re working in metal shafts, you’re wondering ‘what do these guys over in design services do?’” (Respondent Four, RAD 4).
Respondent Thirteen also has issues with locating knowledge. “I think it’s difficult enough. I mean, as long as I’m here, I do know a lot of people and that, but I’d actually find it hard enough sometimes. I’d have to make a whole series of phone calls and informal approaches to people and can’t even look up who do I ask about this” (Respondent Thirteen, RAD 13). The following example highlights the problem of locating knowledge: “He was like, ‘I never heard of that’. And you think, so I just said, ‘look, go over. ... I don’t have time to be talking to you, but if you go over, what’s his name over there did one last week. Sit down with him and do it’. I don’t know how many hours that guy was wondering around looking for me before I told him that” (Respondent Six, RAD 6).

There is an issue around “trying to mine that information back out. You could do it, but you’d be there for a while” (Respondent Eleven, RAD 11). The issue of wasting time causes problems when trying to get at explicitly stored knowledge. Employees, even when searching for a particular piece of explicit knowledge, cannot locate the information. “If you have a database full of solutions and people even know what kind of things you’re looking for, probably not. I’m not saying that if you had a much better educated group, they would kind of go, ‘oh yeah, well that’s going to be in this area’. They wouldn’t even know where to begin to look right now, and that’s the way I see it” (Respondent Six, RAD 6).

For the most part, the procedures in Creganna are “on a shared drive. But you’d have to know the procedure number or do a word search and be lucky with your word search” (Respondent Fourteen, RAD 14). Part of the reason for the inability to find explicit knowledge is it isn’t stored in the correct area in the first place. “We have a G drive where it’s in, but I’d be the world’s worst now at saving stuff into that, and I sometimes can’t find what I put into there three months ago” (Respondent Eleven, RAD 11). Some of these problems possibly could be tackled by the LMS system discussed earlier. “This is where an LMS system would come in. ... So if there’s an expert in it, everybody knows who that expert is” (Respondent Nine, RAD 9). It is a mistake to think that the problem could be solved through I.T. applications alone.

Getting this formal system is “purely through knowing, there isn’t a formal process in that sense, and that’s where we’re hoping to get to” (Respondent Nine, RAD 9).
formal system will help the root of the problems described. Another part of the problem is that people attend formal courses to attain knowledge rather than finding where the knowledge already is within the organisation. “Part of my ethos would be to get people to understand where the knowledge is and I found that there was a problem with people thinking that, ‘I don’t know something so I got to go on a course’” (Respondent Fifteen, RAD 15). Indeed, formal training often cannot achieve that which is learned in the attempt to problem solve. Arrow (1994: 8) states that “information that is privately produced for private gain contributes as an unintended by-product to the pool of information. This in turn is an input into both production of goods and creation of new knowledge”. He offers that learning is the product of doing (Arrow 1994).

This UPK training approach forms around the understanding of “the knowledge was there for them to tell me if it’s good or bad and make the changes. So the way they would make the changes was identify an issue, look through the material, talk, find out the people. Now how they know who people are because we have the pictures up of each person” (Respondent Fifteen, RAD 15). The system then “gives you the process overview in a flow chart that’s standardised amongst all the areas”, which provides the employee with a catalogue of who knows what and where they are. “The guys who are given the job would be able to up-skill themselves on the particular knowledge that they may not have but if it was done before here, we would have had a lessons learned database and it would be there” (Respondent Fifteen, RAD 15). Unfortunately, this system is not working, which has a lot to do with the dependence on informal networks at Creganna. These will be discussed in Chapter Five.

4.6.4 Mentoring

“There isn’t the mentors to begin with.” (Respondent Six, RAD 6)

“If they wanted to implement a mentoring system, the people wouldn’t be at the skill level to actually provide that anyway.” (Fieldnotes 2008)

It has been argued that explicit knowledge can be used to help acquire tacit knowledge. It cannot by itself enable one to grasp the knowing action, and it does not by itself enable the decision-making of the knower (Cook & Brown 1999). Polanyi
(1996) offers the example of a person’s ability to recognise a familiar face in a crowd as testament to the nature of tacit knowledge. “We know a person’s face and can recognise it among a thousand ... indeed a million ... yet we usually cannot tell how we recognise a face we know” (Polanyi 1966: 4). Tacit knowledge can, however, be communicated in situations of close physical proximity over a long period of time, such as in master-apprentice relationships. However, it is questionable if in fact the actual version of the master’s tacit knowledge or an interpreted version of the master’s tacit knowledge is being transferred. This “individual” focus also is represented in Simon’s (1991: 125) statement that “all learning takes place inside individual human heads”. However, others would argue knowledge is socially constructed and embedded in the social relationships between individuals (Kogut & Zander 1992), and is distributed across groups or collectives of individuals who develop and possess social relationships. Work on thought collectives by Fleck (1935, 1979) is another source of the sociological perspective.

This section will discuss the state of mentoring at Creganna, as one of the major issues highlighted by the framework, as a possible reason for knowledge gaps. Within Creganna’s learning strategy, 20 per cent of the learning is to come from nominated experts or mentors in particular areas. However, the provision of this formal mentoring is not readily available and, at best, is a haphazard activity. “It’s certainly not formal. If it is, it needs to have some weight behind it; it needs to have some backing. I think the worst thing you can do to somebody is say, ‘here’s your mentor’, and the mentor teaches you nothing. There’s a huge amount of cop-on in it, too” (Respondent Seven, RAD 7).

In addition, Respondent Thirteen stated that “there’s maybe some ad hoc, but there’s no formal, structured approach to that, which I think is an awful pity because that could be very good”. A mentoring programme would be very beneficial because “there are a lot of people who know a lot of stuff here, obviously, because there’s people who were actually very good in their jobs and have been maybe here for quite a while and have been involved in various projects and workshops. ... There are quite a few people who could contribute a lot”. Unfortunately, there is no actual structure to capture “their contribution and to roll it out to other people. And it’s how you identify those. I mean, there’s people been working here for maybe ten or fifteen years, in
purchasing and in accounts and manufacturing. And they know a ton of stuff, and usually no one ever asks them” (Respondent Thirteen, RAD 13). Respondent Five explained mentoring “isn’t necessarily a general offering, if you want to call it that. ... There isn’t X number of reports. I’m happy because I’m mentoring all of them, you know. And I’ve got X number of reports; one or two of those require perhaps more direction, directing, mentoring, whatever way you want to put it, than others, and I take it on to make sure that they get advised accordingly” (Respondent Five, RAD 5). This analysis suggests the lack of a formal mentoring programme and recordings.

Respondent Seven explained that when he worked with other multi-nationals, he had a mentoring role in which he would ensure that “if you don’t know what to do, come to me, and if we can’t figure it out we’ll find somebody who can – probably something that should be done here” (Respondent Seven, RAD 7). The I.T. department started its own mentoring initiative, albeit a small step on the mentoring ladder. “One thing we’ve kind of tried to start doing in our own group is saying, you know, even if we just take an hour on a Friday afternoon and let’s say I came across a piece of work and here’s an easier way to do things. Or if I know how to do pivot tables in Excel, why not show the other three or four? Load-balance everything; bring everybody’s level up” (Respondent Seven, RAD 7). Informal mentoring also occurs within the I.T. group. “There’s a girl working with us and I’ll take her under my wing a little bit in so far as I make sure that she’s up to speed or if I find a solution and say, ‘look, this is what we’ve done here’. Yesterday, for example, she said, ‘God, I don’t know how to do pivot tables in Excel’, and I said, ‘sure, come here and I’ll show you, give you ten minutes’. ... It’s an informal sort of thing, but it’s not formally driven” (Respondent Seven, RAD 7). This informal mentoring is happening throughout Creganna, but not everyone is aware of who the subject matter or the functional experts are, as discussed in previous sections.

“There’s no formal mentoring programme as such. Some people do it, others don’t” (Respondent Four, RAD 4). Respondent Fourteen explained that “there’s no real mentoring programme. Now, it would be great to have it, definitely” (Respondent Fourteen, RAD 14). The mentoring support Respondent Fourteen described is offered through “your training development meeting with your manager ... and you can state in that what you’d like and then maybe they might identify somebody that would have
Respondent Four said there is no formal mentoring programme, so “you do it as you go along.” He also described the mentoring relationships at Creganna; “you’re talking to your people every day. If you spend a couple of those minutes in a talk mode or a conversation mode of mentoring, you’re doing it” (Respondent Four, RAD 4). However, this is not formal and “you don’t do it obviously in a threatening or a putdown type of way. You do it in, ‘look, I’m here to offer you help. I can’t make you accept it but I’m prepared to give you advice’” (Respondent Four, RAD 4).

Another issue with regard to mentoring is the problem that the managers or senior personnel who are deemed suitable, or as Respondent Fifteen dubs them nominated experts, do not have the required skill set or knowledge to offer mentoring. “The supervisor [often] is seen as the mentor. And the supervisor therefore has to be, in terms of the skill in the area they’re working in, has to be high-skilled” (Respondent Eight, RAD 8).

However, in some cases lower-level employees have more relevant knowledge than the senior member. “Usually it’s just a clerk, a guy in a blue coat down there or something. It’s the managers who run the place. And you’re kind of going, ‘your man knows ten times more than any manager in here’” (Respondent Thirteen, RAD 13). “Pick any function and ... look through the list of names and how many of them actually had a mentor when they came in here that showed them how to do their job” (Respondent Six, RAD 6). Respondent Eight stated that a mentor would have “to have the ability to train the people that are working for them to do the job as they would see fit”. However, that is another “exposure I would see, that’s here. I don’t think that team leads and supervisors are at that skill level that they would be expected to go in and train people” (Respondent Eight, RAD 8).

A formal mentoring programme is in development, however. Respondent Fifteen stated “the senior managers mentored. ... There is a mentoring policy. And so, a lot of the senior managers are mentored externally, and also internally, and have mentors as well.” The reason it is not being implemented is that it is “really reserved at the
moment for the top end. ... I don’t think it’s fair to roll it out to all the engineering levels until you’ve trained the mentors” (Respondent Fifteen, RAD 15).

Within the frontline staff at Creganna, (the systems users such as ground engineers) a need for mentoring is obvious. “I think it could definitely work a lot” (Respondent Thirteen, RAD 13). Respondent Thirteen recommends that knowledge owners be identified first “and actually hands on owners, at some kind of lower- or middle-management level to kind of tie the whole thing together. Because otherwise you will get people who go out of the way to be really good mentors or buddies for the new people, and there’s others who kind of go,’ sure it makes no difference to my job and my salary whether I make an effort or not. I’m already busy, you know, its extra work”’. It is worth noting the programme needs to be somewhat formal because “people can’t think ‘this is extra work for me and I’m not going to get extra pay for it”’ (Respondent Thirteen, RAD 13). Respondent Twelve said that when she puts together a team for a project, “they always kind of pick the best people, which is fine, but they also need to pick like a spare, another person to go on the team that may not have that knowledge. ... As soon as they’re on the team, they will gain that knowledge, so the next time you’re not depending on the one person. You have a backup that can go on the other team”, (Respondent Twelve, RAD 12). She added: “I suppose it’s who you mentor, it’s figuring out who are the people they’re mentoring because ... there’s determining who has the most potential. Because then it makes, the person who’s doing the mentoring, their life so much easier because they can just say ‘I want you to do this’”’ (Respondent Twelve, RAD 12).

For Creganna to get to the necessary level of mentoring and to launch a formal mentoring programme, the organisation will require more training for the nominated experts. Often, the best mentors are the people who “are the ones who are doing the job day to day. ... And that’s where I would be kind of in favour of these informal sessions. ... But it should be part of the older person’s job, basically, to mentor them and bring them on” (Respondent Seven, RAD 7). As senior management describe Creganna, from a HR perspective, there are “mechanisms there to support that type of stuff”. From a time-management perspective, as Respondent Five explained, “do I sit down with five people every week and say, ‘I’ve been kind of watching over your shoulder and I think it would be good if you did this, that and the other thing’?”
(Respondent Five, RAD 5). Collins admitted there is a lot less mentoring compared with other organisations. “And we argue the tosses to how beneficial it would be. I think the people that need mentoring, so to speak, get mentoring.” (Respondent Five, RAD 5).

Creganna “can get to that level” and for the company “it would be a big improvement ... We’re probably looking at trying to ... let them people then be the mentor for new people coming in and start to build a knowledge base of some sort” (Respondent Six, RAD 6). Respondent Fifteen explained the mentoring programme at Creganna eventually will be rolled out; however, he explained “I think it’ll just be wishy-washy stuff. ... We didn’t go for that accreditation because we didn’t meet the criteria of measuring the training. ... We failed on the technician side of things. We didn’t have enough training in that way ... and the decision was made to roll out the mentoring policy, the KM policy and all the different principles outside of looking for the Engineers Ireland accreditation because there’s a lot of good practices there anyway” (Respondent Fifteen, RAD 15). The training problems in Creganna highlighted the need for the mentoring programme.

4.6.5 Re-Use and Lessons Learned
One of the goals on the IMP project was to create more awareness about the larger Creganna community and more specifically about inventory, around “the importance of it, the value of it” (Respondent Four, RAD 4). For example, on the Inventory Management Project, one of the knowledge outputs identified was a methodology framework, which would be re-used for shipping and so on. The lessons learned from the Inventory department forced the company to look at how it issues material, how it handles materials on the floor, and then “look at the whole business planning and it all links together” (Respondent Twelve, RAD 12). One could argue that this may benefit only Inventory or Supply Chain, but the re-use was beneficial companywide for other issues, such as in finance or with the Oracle system. These issues never were changed before, but now they could be looked at. The methodology also improved focus around future projects in that now there is a requirements gathering, solution definition, implementation and testing, which leads to a more effective end product. This came from utilising the lessons learned and re-using the knowledge from an
The advantages of knowledge re-use encompass more than a single project methodology. It enables Creganna to find solutions to problems and make sure the information for solutions is readily available so solving the problem the next time it occurs is not as person-dependent. At the most basic level, knowledge re-use coupled with proper capture makes “the next project easier” (Respondent Five, RAD 5). For new projects, knowledge re-use is able to identify the pitfalls so they are avoided, which increases efficiency.

The case have already has highlighted the informal nature of the networks at Creganna. This has lead to poor capture and documenting within the organisations. Another issue with knowledge re-use at the organisation is that it is not a formal process, which may cause problems. For example, if a group in Design Services is working on a project, it may not have visibility of the pitfalls that the last group encountered because re-use is not properly formalised and diffused cross-functionally. “Unless you get burned on a project ... it’s getting stuff from that lesson there and from that paper into people’s methodology” (Respondent Ten, RAD 10). The case shows that time is another factor to consider. An initiative like knowledge replication strategy might aim to improve knowledge flow within the knowledge lifecycle, but if Creganna is not meeting customers’ deadlines “things are not delivered” (Respondent Ten, RAD 10). This shows a commitment to customers at the expense of knowledge re-use. “It’s just a case of getting the project done. It’s not particularly the right way to do it” (Respondent Six, RAD 6).

Regarding formalised training, at times, the lack of buy-in by employees into certain initiatives is a problem. Re-use at Creganna is not at the top of employee agendas. It is all about getting to the next goal and hitting the next target, discounting re-use and lessons learned. The main consequence then is that projects encounter problems again and again that could be prevented rather than solved. Lessons are not being learned; even when they are completed, it is treated as a documentation exercise. “It’s like the knowledge cards; it’s up on the Internet somewhere and gone” (Respondent Ten, RAD 10). There is no commitment to re-use and there needs to be. One way in which this could be achieved is by linking lessons learned to performance indicators on
projects; if they are not completed, the project is not deemed as successful. Re-use is not properly captured. A knowledge output, such as lessons learned, is only helpful if engineers look at them when the issues happen again. If it is not being captured in a medium where this can happen, then that preventive measure previously mentioned cannot be achieved.

The case highlighted another interesting issue: knowledge hoarding. It is a cultural issue, but is interesting to note that “there are certain people that learn and figure something out, certainly it ain’t getting shared” (Respondent Six, RAD 6). This happens to a large degree around what are described as “gems of knowledge”. The framework shows this is linked to knowledge networks previously discussed. Those middle managers and project leaders who are the experts and champions of knowledge hold the knowledge because it makes them more important. This also causes less knowledge re-use. If they impart this “gem of knowledge”, they lose some of their importance. The framework suggests lessons learned need to feed back into the knowledge lifecycle. It is important to be able to re-use and improve it. Though many managers state they are “all for the easy life. ... If you’ve invented the wheel, you don’t have to reinvent it” (Respondent Seven, RAD 7), evidence shows this is not happening.
4.7 Conclusion
This chapter has explored in depth the Creganna Case. The following table highlights the issues discovered in this case and can be linked with Figure 5.2 in Chapter Five.

Table 4.4 Creganna Case Issues Summary

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<tr>
<th>Knowledge Indicator</th>
<th>Knowledge Activity</th>
<th>Issue Observed</th>
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| Knowledge Acquisition | Capture Documenting Locating Knowledge | ➢ Capturing only about 60% operational  
➢ Ability to capture before knowledge attrition occurs  
➢ Outdated procedures  
➢ Problems knowing who the owner of a problem is |
| Knowledge Networks/Sharing | Formal/Informal | ➢ Few knowledge experts: Functional Experts/Subject matter experts  
➢ Huge dependency on informal network  
➢ Formal network bypassed in favour of informal network  
➢ Contractors not integrated into networks |
| Knowledge Learning | Training Mentoring | ➢ Dependence on Formal UPK training  
➢ Complete lack of formal/informal mentoring |
| Knowledge Re-use | Lessons learned | ➢ Post IMP, a new focus on lessons learned for new projects. This was not done before |

This chapter has presented an overview of the Creganna case. The chapter began by introducing the IMP project and unearthed some of the early KM issues. This was followed by a comprehensive description of the case study. This provided a synopsis of the organisation in its current state along with detailed organisational breakdown. Discussion then flowed into the main area: current KM initiatives. This discussion took the form of a narrative, process-based description. This was done to allow the reader to immerse him or herself in the richness of the case, while having access to commentary on each issue. Other initiatives explored by the case were Creganna’s introduction of Oracle, the use of Lean Manufacturing and the KPI system, and the Knowledge Card initiative. The primary areas highlighted in the case were IMP, the introduction of Oracle, the use of Lean, The KPI system, Knowledge Cards, UPK system and the 70-20-10 learning initiative. In Chapter Five, the Depuy Case will be presented.
CHAPTER 5: DEPUY CASE

The purpose of this chapter is to present the primary data of the DePuy case study in light of the framework developed in this dissertation. The chapter will begin by presenting the Innovation Centre. It then will describe some of the KM initiatives at DePuy. Analysis will follow in Chapter Six.

5.1 The Innovation Centre
Within Ireland, Johnson & Johnson has a very clear presence with more than 2,500 people employed by its subsidiaries, DePuy, Janssen, Centocor, Vistakon, Cordis, Alza, Johnson & Johnson Medical & Consumer and Janssen Cilag & Tibotec. Although, these organisations span diverse sectors of medical devices, pharmaceuticals and biologics, they come together to form Campus Ireland, an entity that leverages the combined strength of these companies and promotes best practice and knowledge sharing.

Commercial benefits are gained through common procurement and service-provider contracts in the areas of energy, utilities and facility services. The sharing of best practice is generating tangible value by allowing common functional groups to share their experience and skills for the benefit of the entire campus. One such example is the Campus Ireland energy management group, which focuses on the challenge of reducing energy costs and works to implement long-term sustainable energy solutions. DePuy (Ireland) recently became the first company in Europe to be accredited to the new energy management directive, EN16001. This success is being shared among other Campus facilities to allow all sites reach this important standard. The Campus also is involved in the Competence Centre initiative, established by the IDA and Enterprise Ireland, to undertake market-focused strategic R&D for the benefit of industry. Johnson & Johnson plays a leading role as an industry partner in two competence centres, energy and manufacturing.

Recently, the Campus established a Research Council to strengthen links to Irish universities and research institutes. The objective is to leverage the combined competencies of the Campus with the internationally recognised pool of research talent available in Ireland. For the Campus, this provides access to highly skilled
scientists to help solve complex problems being unearthed in developing healthcare solutions. For the research community, the forum provides an opportunity to engage more closely with industry to generate a commercial output for the benefit of Ireland. An innovation workshop was organised in the summer of 2010 at DePuy with key leaders from Ireland’s top research bodies, including University College Cork (UCC), Trinity College Dublin (TCD), University College Dublin (UCD), University of Limerick (UL), National University of Ireland Galway (NUIG) and the Tyndall Institute. This provided an excellent opportunity to establish new partnerships, and already several accords have been initiated through government-supported schemes, such as IRCSET and FUSION.

According to Respondent Twenty Two, director of R&D and Advanced Manufacturing Technologies at DePuy (Ireland), continual professional development (CPD) has played a critical role in the company’s development. “As an organisation, we embraced CPD activities as an important element of our strategy, and it is an essential foundation in the success of DePuy (Ireland)”. Previously, education and training led to new technology, but now with the accelerating rate of technological change, timely development of education is critical. Engineers Ireland’s CPD framework assists DePuy in keeping pace with that rate of change.

One of the first steps in the creation of DePuy’s Development Program was the generation of a competency model to identify current and future knowledge competencies. This allowed for the mapping of a comprehensive training and development plan to the strategic objectives of the business. Some of the discrete technical and leadership courses supported by the organisation include:

**Technical**

Fundamentals of Anatomy; Advanced Geometric Dimensioning & Tolerance; Digital Manufacturing Technologies, including advanced CAD, CAM, CAE, PLM, Six Sigma-green belt and black belt; Statistical Engineering; Lean manufacturing; Asset Management; Project Management.
Leadership
Management Fundamentals; Situational Leadership; Social Styles; Coaching, Mentoring; Constructive Feedback; Emotional Intelligence; Giving Recognition.

This investment has resulted in significant commercial return in the form of continuous improvement projects, and it has benefited people’s personal development. Many of these courses are delivered by globally recognised experts involved in the development of industry standards. DePuy personnel regularly have the opportunity to attend and present at global technical conferences in their respective fields.

Further education also is a key element of DePuy’s Development Program with numerous employees pursuing post-graduate diploma and MSc courses in bio-engineering, technology management and lean manufacturing, as well as MBA programmes. Recognising the need to widen its skill base in order to work on the next generation of product and process development, the company hired seven doctoral graduates in 2009 alone from a diverse range of disciplines, including bio-engineering, materials, computer simulation, chemistry and clinical science.

The graduate development programme at DePuy provides graduates with the opportunity to not only rotate among different functions within DePuy, but to undertake rotations at other Johnson & Johnson companies in Europe. This provides the graduates with invaluable experiences and rounded development. In recognition of its commitment to personal development, DePuy (Ireland) is accredited with The Excellence through People platinum award.

DePuy (Ireland) positions itself as a high-performance organisation, with a goal of consistently delivering on its commitments. The foundation of any such ambition is an organisation’s culture. As part of the Johnson & Johnson family of companies, DePuy (Ireland) is guided by the principles of its credo. The credo challenges everyone in the organisation to put customers first, honour any commitment to employees, and support the community in which they work.
The organisation embarked upon an ambitious change programme in the last year aimed at creating a culture of high performance that would support the long-term vision of the company. This began with a series of workshops that asked all 600 employees to identify challenges that would prevent the organisation from achieving its vision. Members from each workshop selected a representative to form part of a focused team tasked with developing a core set of behavioural standards.

Five behavioural standards were agreed upon as the basis of developing a culture of high performance in which everyone can provide input and hold each other accountable to these standards. Following the formation of the standards, managers received practical, hands-on training in key leadership skills to embed the standards in people’s way of doing things. The programme has had a significant impact with large improvements being achieved in productivity and employee engagement.

The concept of innovation can take many different forms, from product innovation to process and service innovation. Within DePuy, innovation is viewed simply as the commercial return of ideas. The company’s innovation management system is very focused on providing a commercial benefit and is carefully assessed at each step of the process, from idea generation to evaluation, project management and closure. At each stage, project financials are carefully reviewed, at which point the project may be cancelled if conditions have changed to impact its return.

### 5.2 Knowledge Management at DePuy

“It’s very busy, but I would say it’s more than that. It’s a culture of fire fighting as opposed to a culture of pro-activists.” (Respondent Twenty Seven, RAD 27)

This section will introduce KM at the Innovation Centre at DePuy. Field work began at DePuy in August 2010. Upon entering the Innovation Centre, it became evident that KM awareness was in its infancy, compared with that of Creganna. Respondent Twenty Four, the lead in the I.T. department, stated that “people don’t have a clue what it means, and I would say a lot of people would think, ‘oh yeah, we have a KM thing and it’s Agile’, but sure it’s not, it’s way off” (Respondent Twenty Four, RAD 24).
“The huge area for focus for us between now and 2014 is increasing the efficiency of our support staff. So it is through areas like KM, standard work implementation in the indirect areas we’re moving with, from processes and so on. So I would say it’s definitely going to become a much bigger focus ... making sure people are working smarter and not harder and all that kind of good stuff. And we’re now saying we need to do the exact same in all the indirect areas, but because so much of it is tacit knowledge and individual processes, it’s a much more difficult process. But that’s certainly one of the key ways we’re going to be able to adjust to this by 2014” (Respondent Twenty Seven, RAD 27).

In addition, Respondent Twenty Four described the “need to get people understanding the importance of it. And then you got to get people capturing it, classifying it right, putting it up there. You got to get people using it, so that it becomes a part of your daily life. And then I think we’ve got to get the collaboration and teaming side of it in there as well” (Respondent Twenty Four, RAD 24).

Obviously, being positioned within the medical device sector, initiatives are closely linked to cost. “Because of the changing dynamics in the business, we’re heavily focused on cost. ... Obviously, primary concern is quality in terms of maintaining and driving risk out of our business” (Respondent Thirty, RAD 30). However, “It’s not a term that I’ve heard used an awful lot now within the organisation” (Respondent Seventeen, RAD 17).

The lack of success around KM also is recognised by the manufacturing plant manager, Respondent Twenty Seven. “Throughout the entire organisation I would say KM is something we typically haven’t been good at in the past. There’s a lot of tacit knowledge locally held and we find we have huge gaps when people go on holidays” (Respondent Twenty Seven, RAD 27). In addition, “DePuy has six manufacturing sites worldwide. There’s very little KM sharing” (Respondent Twenty Eight, RAD 28). “Some of the key areas are obviously retaining that key technical knowledge, but not only that, the personnel we already have. I mean, we haven’t a clue what we actually know” (Respondent Thirty Two, RAD 32).
5.2.1 Knowledge Management Systems at DePuy
This section will present some of the systems at DePuy that are being used to create, acquire, share and re-use knowledge. The I.T. lead offered that DePuy could be doing a lot more in the KM systems arena. “I think it’s a direction that we should be going. Look, we’re a huge company. J&J is a huge company, like Accenture, so why shouldn’t we be doing stuff like that? But I think we’re way behind in terms of technology” (Respondent Twenty Four, RAD 24). The DePuy I.T. group uses Microsoft Communicator. “Is everybody in this plant using it? Not at all. They don’t even know what it is or how to use it. We’re just not progressive enough” (Respondent Twenty Four, RAD 24). The following are some of the systems currently used at DePuy:

5.2.2 SharePoint
The use of strong project management principles also is seen as essential to successful project implementation, and DePuy recently revamped its project management system to incorporate a leaner approach and employ more efficient toolkits. All major projects now operate through dedicated Web portals using Microsoft’s SharePoint technology. This provides a mechanism for teams to better collaborate and share key project information.

5.2.3 Talent Navigator
Talent Navigator is a Web-based knowledge location tool used in DePuy’s Innovation Centre. The system provides individuals a way to explore other roles in the organisation, highlighting gaps that may exist between the current level of skills, qualification and experience and those required by the role. In DePuy, where internal movement is highly competitive and roles are highly sought after, those using Talent Navigator can identify how they can improve their chances of being offered a promotion by acting on the gaps identified. It also is used by management to locate particular skill sets throughout the company, and “they use it as well for trying to move somebody to another J&J. They look at the skills sets there and it’s reviewed by senior management” (Respondent Twenty One, RAD 21). “We do a talent review ever year, so what I do as a director and what the managers do, down to manager level, team leader level, we actually review the high-potential people in our organisation. What
are their gaps moving to the next level? How are we going to give them the development opportunities, the training, to close those gaps to move?” (Respondent Twenty Two, RAD 22).

5.2.4 Link

Link is an experimental Web-based system used at DePuy. It acts as a social network, very similar to Facebook or LinkedIn. “There’s this thing called Link that we have, this kind of knowledge network, the kind of sharing ideas, people post things on there. If you say, ‘I’ve got a problem with X, can anyone help?’ I don’t know how well it’s used in DePuy, if anyone’s mentioned it” (Respondent Thirty, RAD 30).

“This whole infrastructure is supposed to be post a problem on there. ... So for example, my profile in Link, there’s things around supply chain and certain skills and experience I’ve got” (Respondent Thirty, RAD 30). For the purpose of confidentiality, the researcher was not permitted to use Link. However, enquiry into the use and awareness of Link showed some interesting results, which will be highlighted in Chapter Six, section 6.2.5

5.2.5 Agile

“The other issue, too, with Agile is I wouldn’t even classify Agile as a KM repository.” (Respondent Twenty Four, RAD 24)

“It’s a formal sort of a document control system that’s used a lot, and it’s a necessary part of our quality system.” (Respondent Seventeen, RAD 17)

“It’s a world of pain. ... It’s down half the time.” (Respondent Sixteen, RAD 16)

Agile is an Oracle application that provides companies with a multi-stage, collaborative, project-management solution to streamline and accelerate product development and introduction. Its primary function is to enable users to manage experimental formulations, compliance and quality, but in essence is a glorified database. “We have certain systems here. I suppose we’ve got Agile, we keep all our procedures and all that kind of stuff on it” (Respondent Sixteen, RAD 16). From a quality perspective, Agile is used to document the processes and procedures at DePuy.
The nature of knowledge acquisition at DePuy is hugely dependent on two things: (1) the nature of the problem dictates the knowledge required, and (2) the way in which the person acquires that knowledge.

This section will discuss some of the issues highlighted with the Agile system. Agile is the system that documents most of the Innovation Centre’s procedures, validations and protocols; however, it is has been described as a “nightmare.” “You can go into Agile and it can take you ages to find the document you want” (Respondent Twenty Four, RAD 24). The querying ability of the system is described as slow. “There’s too much in there. There isn’t enough classification of the data” (Respondent Twenty Four, RAD 24). This leads to a general distrust of Agile because it is not being updated properly or used effectively. “Would I go in and try and search it to find information or to find a validation that was best practice? No way” (Respondent Twenty Four, RAD 24).

There also seems to be a misconception that Agile is a knowledge repository and is the best solution for documenting the Innovation Centre’s explicit knowledge. This has been described as a strategy that will codify knowledge to achieve scale in knowledge re-use and growth in the business (Minonne and Turner 2009; Hansen et al 1999). However, barriers exist. “We don’t have a proper system for knowledge sharing. We don’t have a repository. Agile is not a repository for knowledge sharing. It’s just a document retention system for FDA and audits. So I don’t think we have a system for KM, knowledge capture and best practice capture at all” (Respondent Twenty Four, RAD 24). Agile has a number of purposes but it is primarily used for procedures and forms, or “standard operating procedures that they need to understand” (Respondent Seventeen, RAD 17). However, “the search functionality of it isn’t great. They’re talking about replacing it eventually” (Respondent Seventeen, RAD 17). So DePuy employees do not necessarily see Agile as long-term solution to documenting.

Some of the negatives aside, however, Agile is “very handy for certain things. Like for me, all the raw material specs for R&D are up there, which otherwise I would have to ring someone and say ‘can you fish out that raw materials spec for me from
your drawer and scan it and send it to me? Instead I can just go onto Agile and look it up. ... [However] you kind of need to know where to look. ... It’s a bit convoluted’ (Respondent Twenty One, RAD 21).

Respondent Eighteen, in Quality explained Agile is extremely “hit and miss. Again, it’s like anything. It’s like more use of the system; you get cuter in your pointed searches. But for newer people ... it’s very frustrating to try and find” (Respondent Eighteen, RAD 18). One of the other problems observed was the inconsistency with how documents are named and structured. “What I might be thinking of searching for, maybe somebody else is calling it something different anyway, so it mightn’t even be in that realm. ... What was meant to be categorised as document Type A was actually categorised as document Type B” (Respondent Eighteen, RAD 18). The following scenario gives a practical example concerning the functional issues with Agile:

“If you wanted to just randomly pull out ... the last five, ten, twenty protocols or something ... you’d have to be searching specific areas so you’d have to know what projects were gone through. It’s not straightforward to get exactly what’s there, especially for someone who’s new. And different types of projects, certain ones can be done certain ways, but overall not clear. I mean, we have procedures on the way you’d put these documents together, protocols, and there’s templates, and the way you set up a protocol as well. And I’ve seen that to my own pain sometimes. If you say you’re going to meet something, you have to meet it, otherwise essentially you’re failing it. So the wording you put into your protocol is very critical.” (Respondent Sixteen, RAD 16)

The newest employee at the Innovation Centre, Respondent Thirty One, explained that “you will be able to find the actual area the document is stored ... but you will have to have a reference ... [for] the specific document you’re looking for” (Respondent Thirty One, RAD 31). Even if the procedure or piece of knowledge exists, “a lot of them are not particularly good. They’re very long and drawn out; they’re seventeen pages. ... There is no process flow. You actually have to read a procedure. You have to read fifteen, twenty pages of text” (Respondent Twenty Three, RAD 23). If what the person is looking for is documented, “Agile is where you go. If it’s a work construction or validation or something like that, Agile is the place. It’s not a place to go for tacit knowledge; you will not get anything” (Respondent Twenty Three, RAD 23). Again, tacit knowledge is misrepresented here.
Finding documents and information on Agile is a key problem with the system. One of the things that could be done to make Agile more functional would be to “block the procedures into folders so there’s sections of folders ... [because people] have to be familiar with the structure of the data to be able to get in at it” (Respondent Twenty Three, RAD 23). “You go into it and Agile is just a glorified hard drive. ... You’ll find that you still can’t find the [expletive] stuff after” (Respondent Sixteen, RAD 16).

One of the opportunities for Agile going forward is that “if it was very easy to operate, it would probably mean that you might be more inclined to go in and say, ‘oh yeah, let’s have a look at this one’, or ‘let’s have a look at how they did that’” However, this opportunity is not being tapped into. For example, finding what you need “a lot of times is difficult unless you know the exact number of the document. Lots of times you don’t know the exact number of the documents. You’re trying to search certain reference words and stuff like that; it can be hard to find it” (Respondent Sixteen, RAD 16).

5.2.6 Compliance Wire

“The formal training is now half-a-day induction, and then you do everything else on the Compliance Wire.” (Respondent Twenty Four, RAD 24)

“It’s a bit of a pain when you start off because you’ve got about seventy or eighty procedures to get through.” (Respondent Seventeen, RAD 17)

Compliance Wire, which is driven by regulatory requirements, is the first part of the formal training process at DePuy. “A lot of it’s just you need to be following procedures, basically” (Respondent Seventeen, RAD 17). It is used to provide procedural knowledge to employees and operators. As a training tool, however, it is suggested that DePuy “[relies] too much on computer-based training”. This was observed during field work. Respondent Twenty Four, head of I.T., said when she first started that DePuy she noticed the organisation is “so tight at doing instructor-led ... not wanting to spend the money. ... [They] don’t do enough instructor-led or classroom; it’s all computer-based. ... So for example, if I have something in Compliance Wire and I have to close it out ... I can open Compliance Wire, I can
open Agile, I can close it straight away” (Respondent Twenty Four, RAD 24). Procedures sometimes are read and signed off as understood or done, perhaps without actually being fully understood. A similar situation existed at Creganna.

With regard to how effective it is as a training tool, again it was newer employees who were most affected. “Anyone that starts off here, they’re doing Compliance Wire for the first week to two weeks nearly. ... Compliance Wire is an ongoing thing. It gets updated continuously. You have standard procedures and stuff you have to read through and sign off on. But at the very start ... I think in the first week or two I went through about a hundred and something documents”. Those procedures were not currently understood. Compliance Wire seems to be a menial task with little value, rather than an active attempt to problem solve, which is the best way to promote learning-by-doing (Young 1993; Lucas 1988).

From the managerial perspective, Compliance Wire is seen as quite good and is a way of gardening “knowledge from a procedural standpoint on how people need to be trained on how to do their job is actually pretty strong” (Respondent Thirty, RAD 30). However, this can be juxtaposed against a new employee’s description: “Basically when you’re reading, some of these documents are up to 64 pages. That springs to mind now, that there was a 64-page one. And like it’s just size 12 font. ... It’s not interesting. You’re not going to take in anything, really” (Respondent Thirty One, RAD 31).

This paints a more realistic picture. However, there are some benefits to Compliance Wire, such as when someone is working on a project and they need to look up a particular document to follow procedure. “You would realise, ‘oh I’ve seen that somewhere before’. You go back, all your training records are saved and you have access to those documents again, so you’d go back and just read through that document again when you need it” (Respondent Thirty One, RAD 31).

Compliance Wire focuses the employee on the “the hard procedures and what’s the hard knowledge” or explicit knowledge they need to do his or her job (Respondent Twenty Seven, RAD 27). However, some wonder “how effective are the procedures, to read something and then go out and do it?” (Respondent Nineteen, RAD 19).
5.3 Knowledge Activities

5.3.1 Training

Training at the Innovation Centre is “linked into Agile”. Compliance Wire is very similar to Creganna’s UPK, and users will “read the routing document and then you confirm that you read it and understood it” (Respondent Seventeen, RAD 17).

5.3.1.1 Formal Training

“A lot of times it would be formal, as in they’d bring in someone from outside to do the course.” (Respondent Sixteen, RAD 16)

Some of the other initiatives include instructor-led internal training and instructor-led courses. “New training courses and that kind of thing, we’re quite strong on that, I think. It’s quite good if you identify a course that is of use” (Respondent Seventeen, RAD 17). DePuy also sends employees on formal training courses. Respondent Twenty One did a “Six-Sigma course last year, so ... I did a black belt in Six-Sigma because I had no background in that type of stuff” (Respondent Twenty One, RAD 21). It is positive that DePuy is eager to up-skill employees.

Both systems based on training others and formal training systems have positives and negatives. One of the negatives of formal training could be that “there’s too much of it. ... Like I’ve just gone through an eight-hour course yesterday on ... effective coaching and constructive feedback. I have nobody working for me. Who am I going to give coaching to?” (Respondent Twenty Three, RAD 23). Formal training unfortunately is not tailored to the individual. “All they’re doing is just going, ‘we’re a really good company, we do loads of training’. ... They’re firing out lots of courses, and they’re not really going ‘does this group need this course? Does this person within this group need this course?’” (Respondent Twenty Three, RAD 23).

If this is representative of the situation in the Innovation Centre, the Foundry (metal casting department) paints a different picture. The formal training within the Foundry is a more tailored experience. “I did project management through the IPMAs, but like I’m fully certified now as a project manager, and they recognised that straight away after I came in that they were running a programme and they put me on it for the
nature of the projects that I’m doing. ... Their formal training is quite good. I mean, they are very open if you have a suggestion” (Respondent Twenty Five, RAD 25).

Within the Innovation Centre, training is “very weak”. What is available is “a lot of training, like external training and kind of developing and bettering people on-the-job training”. However, the following is a prime example of where the Innovation Centre falls behind: “We do a lot of validation, ... We do machining, we do review of drawings, understanding of drawings, a lot of that is kind of hands-on learn. We give you a procedure; now go do your validation. We don’t necessarily have a formalised training programme for these key job functions we do day in and day out” (Respondent Nineteen, RAD 19). The capture difficulties were highlighted earlier, and now some of those consequences are laid bare.

To combat this, many support the addition of more instructor-led or lecture-type trainings that could highlight more local procedures. “[I would] like to see product information and things like that where, at the moment, like I said, you can only read so much before you shut off and don’t remember” (Respondent Nineteen, RAD 19). “Hands-on stuff is better for me, to be honest ... which we probably don’t do a lot here” (Respondent Sixteen, RAD 16). The lack of hands-on training lends itself to the way mentoring is handled at DePuy. This will be discussed in later sections.

The yearly development plans include a specific section on training and development. “So it’s part of the training and development, the responsibility is all on the individual as well as the manager to identify where there are gaps”. This can be explained as if there is a gap in the employee’s skill-set. “This is something that will close that and you work with them as to what that degree, masters or Ph.D., would be. And that gets funded and supported by the company. So in the formal company courses, we’ll pay for the course when we run it” (Respondent Twenty Two, RAD 22).

One of the other issues that was raised is the distinction between training received by contractors as opposed to permanent staff. “In the Johnson & Johnson space in DePuy there was an awful lot of further education and training you could get if you were
permanent. But if you were a contractor, it’s just ‘forget about it, because you’re here, it’s your job, that’s it’ (Respondent Twenty, RAD 20).

5.3.1.2 Informal Training
On-the-job training is quite ad-hoc in the Innovation Centre. As in Creganna, there is very little structure here, and awareness of what is available or what is happening also is quite hit-and-miss. It is clear that on-the-job training is seen “as being probably the more important side of it”. However, as discussed, DePuy offers several “supplemental courses ... but really on-the-job is where they’re going to really accelerate” (Respondent Twenty Two, RAD 22). The focus at the Innovation Centre seems to be in “developing a certain amount of our leaders”, but how good are they at the 70 to 80 per cent, which comes from long-term memory and learning (Jennings 2009) that “comes from on-the-job” (Respondent Twenty Two, RAD 22).

Because of the non-private nature of knowledge (Romer 1990), the success of on-the-job training relies on the scenario; when an expert leaves DePuy that his or her “successor fill my shoes ... so someday I can go. That’s kind of how we look at it and we progress it. I can’t leave tomorrow unless there’s someone that can back fill me. ... I’m always working and trying to get that spot filled. That’s formalised, but I would say it’ not effective” (Respondent Nineteen, RAD 19). This currently is ineffective at DePuy. Knowledge through intentional actions (Romer 1990) can lead to “increasing returns to scale of knowledge-based goods” (Romer 1990: S72). As established in the literature, knowledge is non-rival and could be simultaneously used by many people, so this should be possible at DePuy.

The Innovation Centre, however, is attempting to track the deployment of on-the-job informal training. “You have a gap in business plan ... knowledge of the business plan, how the business plan is developed and the consequences of getting it correct. And we really need to do that because currently I’m doing that today, I’m the only one who does it. So you really need to do that to run your function better, take more ownership for your budgets. So we’d actually give them an on-the-job task, which is in their development plan, which says ‘initiate, develop, manage, submit’. ... You'll measure and rate them, what they've achieved successfully or not and what the gaps were. So
you can close out that and say ‘yes, achieved’. But the responsibility is on the manager to support that then. But it’s not for the manager to say ‘have you done that course yet?’” (Respondent Twenty Two, RAD 22).

Respondent Twenty Two acknowledges that DePuy formally does the training reasonably well and it “puts on-the-job into development plans as well. How good do we really do that? I’d be interested to see that actually and what is best practice and what would the opportunities be. Because if it’s 70 per cent, that’s where we should be” (Respondent Twenty Two, RAD 22). From observation of the manufacturing site, it was easy to extrapolate that, coupled with mentoring; formal training is used to provide an experience that benefits the site floor. “When you go to training ... you’re depending on the person’s experience and you’ve got the work instruction to tell you, so tacit knowledge comes in here. These [work instructions] are generated, so the JEC is to get what we talk about as the one best way of doing the job. ... That’’ generated from the tacit knowledge and also from documentation. So you’re getting the one best way” (Respondent Twenty Eight, RAD 28). Again, here we see the distinction between tacit knowledge and implicit knowledge.

5.3.2 Mentoring

“There’s nothing formalised ... there’s no buddy system or anything like that.” (Respondent Twenty Six, RAD 26)

“We’re not as good as we should be and I’m definitely not as good as I need to be.” (Respondent Nineteen, RAD 19)

This section will discuss mentoring initiatives within the Innovation Centre at DePuy. There is a large dependency, as discussed previously, on formal training; however, the formal training strategy is missing a formal mentoring approach. It is unavailable or is largely ad-hoc in nature. “I don’t think it’s a thing we do very well ... I don’t think it’s structured enough. It’s too casual” (Respondent Twenty Four, RAD 24).

5.3.2.1 Goal

Within the Innovation Centre, there is a formal mentoring programme called Goal, which provides for “high-potential individuals” (Respondent Thirty, RAD 30). This,
however, is more “kind of career mentoring rather than knowledge transfer” (Respondent Thirty, RAD 30), which functions as a transfer of high-potential individuals to various sites and disciplines around J&J. It is provided for those who are seen as the “next leaders of the business” (Respondent Nineteen, RAD 19).

Apart from Goal, informal mentoring does occur. “You’d go to a lot of senior guys, and of course that’s the way it works – nothing formalised though” (Respondent Nineteen, RAD 19).

Respondent Twenty One, who works with the Innovation Centre but is part of the Foundry, receives mentoring from R&D. She explained that her role is unique in that sense. “Whereas for other roles, there would be three or four, six or five, ten other people may be doing the same thing, so I suppose it would be easier to find a local mentor for those type of people”. However, she said, within the Innovation Centre “it’s not something I’ve seen particularly happen. But I think it would probably be a good idea” (Respondent Twenty One, RAD 21). Indeed, there did not seem to be any form of mentoring. Employees keep to themselves within their cubicles, which was strange considering the open atmosphere.

Many of the Innovation Centre employees interviewed agreed mentoring would be useful to have someone there to “ask all the dumb-ass questions”. “I’m in the company about three and a half years. ... I don’t think there’s anything structured there” (Respondent Eighteen, RAD 18). Respondent Eighteen used the following example of a co-worker: “He’s within our group but I wouldn’t have huge interaction with him anyway ... only on a small level. But I reckon the project leader’s overseeing his work, but he’s just paddling his own canoe, trying to get up to speed with things. ... I’m not aware of anybody who’s actually formally mentoring” (Respondent Eighteen, RAD 18).

Outside of the Innovation Centre, formal mentoring occurs within the manufacturing site as operators who were brought up to the Innovation Centre “would have been definitely mentored by the project leader, the first guy on the use of CAD. And then another guy was brought on subsequently, and the guy that was mentored and brought up to speed, he would have spent time with that individual. ... It’s informal
and probably varies hugely from function to function” (Respondent Eighteen, RAD 18).

Mentoring in the Innovation Centre is “probably not as formal at the engineer-project manager level. There’s the ability to have it there for team leaders, leaders and managers who are what we call high-potential (GOAL), who need to accelerate through the organisation. ... We have talked about trying to do more of a formal mentoring programme for people with a view to that development. It’s not very formal and it probably is an opportunity that we could leverage off in some way” (Respondent Twenty Two, RAD 22). The potential in the master-apprentice relationship to capture technical knowledge is there, but “the tacit knowledge is not captured in a mechanism unless the person was being developed by that person. So in the scenario ... you would be able to capture that tacit knowledge truly by on-the-job development, by the person saying ‘I remember how Eddie used to do that’ or ‘I remember how Ray used to do that’” (Respondent Twenty Two, RAD 22).

Another mentoring issue is that training has been achieved at middle-management, however “top-level management are not providing any coaching to middle management, and middle management are supposed to provide coaching to the operators and associates”. So this suggests problems with mentoring are systemic in that “DePuy have gotten into a thing where they’re trying to improve the accelerated-improvement model, and they believe that effective coaching of these things are a way to do it. If you’re trying to bring in that type of stuff, what do you do? Do you bring it into your middle management so your operators now are being coached and constructive feedback? Or do you bring it into your top-level management, and that’s where you seed it from? So now your top-level management, every time they interact with your mid-management and your lower management, they’re effectively teaching them and saying ‘this is the way we do it, this is the way we do it’” (Respondent Twenty Three, RAD 23). This has lead to a possible disconnect between top-level management and mid-management, which has lead to a general lack of awareness as to what is available in mentoring or what is happening in that arena.

Also, there seems to be a lack of understanding as to the differences between a mentor and a supervisor. “In terms of when they assign people in projects, they’re assigning
someone who’s senior, and that person is put in on tasks with someone that is more junior. And they’re responsible for making sure that new person is trained up to work on it, besides doing the Compliance Wire stuff” (Respondent Twenty, RAD 20). The duties of a supervisor include ensuring formal training procedures are adhered to rather than constructive mentoring.

Mentoring seems to be ad-hoc and driven by individuals. “We’ve one guy who’s dedicated a bit of time to that now. ... We realised he was spending an awful lot of time coaching other people and that was costing us too much. So we decided to try to capture it on video now and those are archived for people to watch” (Respondent Twenty Six, RAD 26). This capturing would allow employees to watch the processes; however, it will emerge that time constraints make this is an unreasonable expectation.

Going forward with formal mentoring at the Innovation Centre, “as part of the behavioural standards, there’s a coaching module which is very strongly reinforced” (Respondent Twenty Six, RAD 26). “DePuy has done mentoring training with Engineers Ireland for Rory, Eddie and Ray and a few folks in the AMT group, and that was with the aim to try and improve our mentoring programme. ... But when I say we don’t have a formal one, I couldn’t actually say what we do after that. We’ve done the training, we support it, but how do we actually review the success of it?” (Respondent Twenty Two, RAD 22). Apart from the lack of knowledge and awareness as to what is available in the arena of mentoring, another issue that arises is that time is a huge obstacle. “To be honest ... I personally don’t have time for mentoring” (Respondent Seventeen, RAD 21).

One of the findings has been that most employees do not have sufficient time to carry out tasks, be involved in initiatives or use certain systems. However, Respondent Seventeen sees mentoring as a very useful initiative. “it’s just that you need to have someone who has the time to do it properly. ... You need time to do that and I don’t have time to do that at the moment” (Respondent Seventeen, RAD 17). “Would I have time right now? Probably not. But it would certainly be something I would be very interested in and very interested in furthering my skills set” (Respondent Twenty Five, RAD 25).
5.3.3 Capturing

“There’s a good basic level of structure there, but that only captures project knowledge. I still don’t think it captures ... some of the tacit knowledge.” (Respondent Twenty Two, RAD 22)

This section will discuss capture activities at DePuy and some key issues highlighted by the framework. There was a plethora of issues with knowledge capture at Creganna, and a similar situation was apparent at DePuy.

Knowledge capture at DePuy highlighted several issues worth reporting. A lack of a capture culture or a structured system for knowledge capture was seen across the Innovation Centre, Global Supply Chain (GSC) and the manufacturing site. “We need a system for capturing it and then, too, you’d need some kind of reward system for if you do put up something that’s best practice, how does that get recognised and rewarded” (Respondent Twenty Four, RAD 24). Respondent Twenty Four, the lead in I.T., asked the question “do we even classify best practice? I don’t think we do because do you systematically go through stuff and say, ‘yes, that is best practice, put it out there’?” (Respondent Twenty Four, RAD 24). Respondent Seventeen, an AMT project leader, admitted that he does not know “if there is anything formal there”. The situation regarding the capture of knowledge at DePuy is “fairly informal” (Respondent Seventeen, RAD 17).

On a personal level, some employees would capture knowledge for independent processes on complex projects. “It depends on the complexity. It’s not something you’d do for a very basic piece of equipment. But it’s this thing of doing a deep dive on a process. It’s a knowledge-capturing method as such”. It also was remarked that capture documents are “a funny document because it doesn’t really live anywhere within the quality system. Normally, those kind of documents, they live within the quality system somewhere” (Respondent Seventeen, RAD 17). This further highlights the lack of a formal capture structure. Often it is up to the individual whether he or she is capturing knowledge, but Respondent Seventeen can see it being “a useful way of capturing your knowledge on a system” (Respondent Seventeen, RAD 17).

Respondent Twenty One, DePuy’s metallurgist, recalled how her predecessor very rudimentarily captured knowledge as DePuy had him “do a kind of a transition plan
Respondent Twenty One explained that some individuals create their own means of formally capturing knowledge. “The way it’s captured at the moment is ... formally ... through the documents that I’d write” (Respondent Twenty One, RAD 21). In her own area, she has put in place a formal method. “So in my lab I have a project folder and, literally ...you cut it up, you analyse it, I give it a project number now and I give it a report number that matches that project number. So for everything I analyse, it’s organised. ... [Before] you could walk into the lab when I arrived and there was probably 400 of these that you put in a black mount, so you cut the part up and you put it in a black mount and there was about 400 of those black mounts in the press, and nobody knew what any of them were like or anything” (Respondent Twenty One, RAD 21).

Thus, she created her own system of formal capture; “in that sense, if I analyse something, I capture the outcome of that analysis in a report” (Respondent Twenty One, RAD 21). Again, this was observed as something that was an individual departure. “That’s just something I’m doing ... as I’ve been going along. I’m learning, ‘oh the same thing happened six months ago, oh and look I can go back to Project 17 and there it is’” (Respondent Twenty One, RAD 21).

The way in which DePuy captures knowledge in the manufacturing arena is through “work instructions”, so the organisation did not have so many work instructions. Instead they had a standard operating procedure (SOP), which was a high-level document on general practices. In the interim, DePuy is trying to get away from SOPs and move toward work instructions, which describe each step of a process. So if anyone left the organisation, someone could come into the labs and be able to follow the instructions.
Respondent Twenty Eight, a manufacturing engineer, added “standard work is a new thing for us and I think it’s really a way to go. It’s ticking all the boxes; it’s capturing the best practices. ... So let’s capture the best way of changing out a spindle. We standardise that and we train everyone to that standard. And that’s where we need to go to. And this is where we as a company will go to over the next couple years” (Respondent Twenty Eight, RAD 28). Respondent Twenty Seven, the head of Manufacturing, explained DePuy is trying to standardise its processes as much as it can in order to implement “standard work throughout the organisation, so we’re doing it in the manufacturing floor. So that will ensure the process will force people to go a certain way rather than necessarily having you doing it one way and I doing it a different way. And if I’m covering for you tonight, I’m not sure where to pick it up from. From a technical engineering perspective, I guess that’s the biggest challenge” (Respondent Twenty Seven, RAD 27).

Respondent Thirty admitted there is no way of “capturing the kind of more subtle stuff that people have in terms of knowledge. So, yeah, there’s risks there. ... If they walk, that would be a problem” (Respondent Thirty, RAD 30). There is a divided approach here by the manufacturing and innovation sides. “You have the manufacturing operations section, and then you have the innovation, GSC section. There is work happening here in the manufacturing section. They have their standard work specifications, only just started, right, which is the concerning thing. But it seems to be really good. They’re going down gathering tacit knowledge off operators about ‘why do you do this and what happens when you don’t do this?’ They’re putting that up there for people” (Respondent Twenty Three, RAD 23).

Again, a systems approach (Moffett and Humphreys 2012; Miller et al 2011; Hansen et al 1999) is offered as the solution to the capture issues at DePuy. “We need to look at potential, better manual systems to capture that data, or better automated software solutions that pretty much make it a lot easier to update”. These systems alone serve a purpose; however, “they’re not integrated. And you know, rather than saying a software solution is the ultimate aim, but I think something better and integrated would help us” (Respondent Twenty Two, RAD 22).

Respondent Twenty Two asked the question, “Do we really capture their [employees]
knowledge?” He answered this by stating “I think we started to capture some of it through project history ... albeit maybe difficult to get the data sometimes” (Respondent Twenty Two, RAD 22). Respondent Twenty Seven agreed they are “the best company in the world for setting up I.T. solutions” (Respondent Twenty Seven, RAD 27). However, when trying to capture true in-depth tacit knowledge, “we don’t do that very well. We don’t have good, simple, intuitive systems that capture to go from one project to the next. We should in theory, if we have the right systems and processes, be able to take a project ... and take a similar project and say ‘right, you haven’t worked in this before; but you know what, you’re going to get off the ground running pretty fast because there’s lots of good templates, tools, lessons learned” (Respondent Twenty Two, RAD 22).

This is a critical misconception of DePuy’s knowledge of what they are trying to achieve and what is achievable. It is argued throughout the literature that tacit knowledge is untranslatable and only through a close master-apprentice relationship that a version of that tacit knowledge may be diffused, and even this is often called implicit knowledge (Spender & Scherer 2007; Cook & Brown 1999; Brown & Duguid 1998; Taylor 1993; Polanyi 1969, 1966). Polanyi (1966: 4) states “we know much more than we can tell”. This was a common misconception in both cases. Tacit knowledge, that which can be articulated, was being mistaken for implicit knowledge, that which is unarticulable. In this vein, Respondent Twenty Six described “there’s nothing formalised to capture what they would know. And ... anytime we try to set up a new process or anything like that, we obviously get the official documentation around it, and I try to get somebody to write a work instruction around it just to document how they did it” (Respondent Twenty Six, RAD 26).

As Respondent Twenty Seven explained, if they need their direct staff to be more efficient “we definitely need to try to capture this in a more structured manner” (Respondent Twenty Seven, RAD 27). Going forward, Respondent Twenty Two, as leader of the Innovation Centre, wants DePuy to improve “our method of capturing all that data and making it more intuitive, easier to use, easier to capture, easier to search, easier to find data, find risks, find lessons learned without having to go out and depend on people would be a major help”. Respondent Twenty Twenty Two believes employees think “there is better ways of capturing how Eddie went about,
when he went, let’s say when he went across to the Leeds project, how did he even start his process of thinking? How did he even know that that’s an area he needed to focus on?” (Respondent Twenty Two, RAD 22).

However, “there’s no other system or ... even like a Wiki-type thing where you can just throw in a certain problem or search word and find comments from some of our senior people” (Respondent Twenty Two, RAD 22). “There’s definitely a requirement for some kind of a data capturing or data warehouse or something like that where people can actually go and query” (Respondent Twenty Seven, RAD 27). This shows the push to capture the tacit knowledge will continue at DePuy.

5.3.4 Documenting

“Lacking ... daily knowledge and having that documented? No, it’s probably not real clear.” (Respondent Nineteen, RAD 19)

“Without taking the procedure and putting it into a real-time environment, you won’t really get a true understanding of it.” (Respondent Twenty Five, RAD 25)

This section considers documenting activities. Primarily, documenting at DePuy occurs in the arena of recording processes and regulatory procedures. Often, very little is done with regard to making that implicit knowledge accessible. Respondent Seventeen suggested documenting within the Innovation Centre is “getting better. ... I’m thinking about studies and that sort of thing that are happening, people are trying to formalise them a little bit and it’s mostly been driven by regulatory requirements” (Respondent Seventeen, RAD 17). However, much of this knowledge is “all in people’s head. It’s all on their C drive. It’s all on the L drive, maybe in a department folder. And I only have access to my I.T. department folder” (Respondent Twenty Four, RAD 24).

There is a lack of diffusion here. Concerning documented know-how as opposed to documenting because of regulatory requirements, it was admitted “unless you’re talking about specific studies that are used to this support, design history or something like that, I think we’re very weak ... unless that gets translated into a standard work procedure or something like that, standard operating procedure. If there’s good work
going on in terms of refining a process or something like that, and they want to make sure that that process is followed, then it would be developed into a working structure or something like that. But no, I wouldn’t say we’re particularly strong ... in terms of non-routine. I wouldn’t say that we’re very good at documenting” (Respondent Seventeen, RAD 17). This is exemplified by the description of how documenting is done on the manufacturing site: “From an intangible perspective, [what] is probably reasonably good would be maintenance, our Maximo system. So you know, when a piece of equipment goes down on the floor, the maintenance guys record what they actually did to fix it” (Respondent Twenty Seven, RAD 27). This shows a gap between the two sites.

In the Innovation Centre, however “for the vast majority of procedures, there is no process flow. You actually have to read a procedure. You have to read fifteen, twenty pages of text” (Respondent Twenty Three, RAD 23). Respondent Thirty wants a situation where that routine knowledge is “preserved”. “I'm expendable. That's a good place to be” (Dave Poter, RAD 30).

The language of the documented procedures is poor and the way procedures are written are in many ways “very ambiguously so that they can be interpreted in different ways so that we have a lot of freedom. But that means you don’t get much direction from the procedure about exactly what you should do. ... [Employees] would have read the documentation that told how to do the validation. [They] would have gone over to the super-user engineer and asked him how to do it and [they] would have pulled out several historical copies of validations that [they] had seen. And between all three sets of information, [they] would have produced the validation” (Respondent Twenty Three, RAD 23).

Most of the documented knowledge that is available can be located in one of three areas: on SharePoint portals, Agile and people’s personal hard drives. This highlights a need for better ways to get at this data. A universal naming system also is needed. “A lot of our stuff is saved under very cryptic, nonsensical names that only the project manager will ever understand. ... We’ve got a project management system in place now but that doesn’t prescribe naming conventions or metadata for the documents that are saved. It’s potentially something it should do” (Respondent Twenty Six, RAD 26).
Through SharePoint, the goal is to “link all of the relevant documentation around a particular project ... So on that portal would be a summary of what was achieved in the week just gone by, and then underneath that would be the tasks associated with each team member on the team, and we could track exactly their activity, what they had done to date and what was expected of them for the next week” (Respondent Twenty Five, RAD 25). The other main system available to document implicit and explicit knowledge is Agile. It enables the reading of procedures. “But if you read the procedures here, from my perspective, a lot of them are not particularly good. They’re very long and drawn out, they’re seventeen pages. Well I would much prefer to see a process flow chart at the start of every single procedure” (Respondent Twenty Three, RAD 23).

5.3.5 Locating Knowledge

On locating knowledge: “So it was just very slow.” (Respondent Twenty Three, RAD 23)

“Difficult; it would take a few phone calls.” (Respondent Nineteen, RAD 19)

“You’d have to know someone who could point you in the right direction.” (Respondent Twenty Seven, RAD 27)

“It was a nightmare.” (Respondent Twenty Three, RAD 23)

This section will discuss the issues around locating knowledge at DePuy. The questions and probes used during research focused on how difficult it is for employees within the Innovation Centre to locate relevant knowledge. Many explained it is quite difficult to locate knowledge; however, if a system that could propagate this existed, one would wonder “if that system was there, would I be employed to consult it, or would I still go through the traditional route of ... picking up the phone and saying, or running into someone in the corridor” (Respondent Seventeen, RAD 17). This highlights the dependence on that informal network that the analysis previously discussed.

There are huge inefficiencies regarding the time it takes to find knowledge. “It would take you forever. You’d be talking to different people; you’d be waiting on them to
email you back a document. ... You come in the door and you start to learn over time, which isn’t the most effective way” (Respondent Twenty Four, RAD 24).

People have a partial and biased awareness of the social structures around him or her (Sanguesa & Pujol 2002); however, knowledge can be located and shared through proper internalisation of that knowledge (Minonne and Turner 2009; Nonaka 2007; Akamavi & Kimble 2005) and dynamic interaction (Spender & Scherer 2007). When observing how one would locate knowledge at DePuy, it generally is that dynamic interaction with the informal network. “You know who to go to ask, so people who have been here the longest. You go to talk to somebody and find out who the best person in finance to talk to is ... just chasing around through a loop. ... I’ve been here a couple of years. ... I know my way around” (Respondent Seventeen, RAD 17).

This implies that one learns over time “who to go and talk to about stuff and how to go about finding out about stuff. You’ve got to get to know people. I know that that’s probably not an ideal scenario because that’s very personality based” (Respondent Seventeen, RAD 17). There is evidence that the longer the person is at DePuy, the easier it is to informally locate knowledge. “I can always find a path to what I need to know, because I know most of the DePuy board. So if something comes up...I may go and talk to Gary, but if it’s something out of his space, I know the worldwide VP of R&D, I pick up the phone to him and have a conversation with him and say, ‘well where do I go?’ Here's what I want to find out. So I think because of that connectivity to the people who would know, I wouldn't find it difficult” (Respondent Thirty, RAD 30). Respondent Twenty One added that the location of knowledge is quite ad-hoc and “it’s kind of ... knowing who’s the expert on what” (Respondent Twenty One, RAD 21).

Locating knowledge can be described as one of the most “time consuming things as well”; however, “it gets easier over time. You get smarter, maybe you've been down the road before where you need to look for the information” (Respondent Eighteen, RAD 18). People pointing others in the right direction also occurs. ‘‘Who would have the background here for this?’ And if you don’t know, he’d say, ‘that person doesn’t have that background but they probably definitely know who to put you in touch with’.
So it’s quite easy to get in contact with people, but is there a formal structure? Not that I’m aware of” (Respondent Twenty Five, RAD 25).

One of the more critical issues discovered, with regard to trying to locate the relevant knowledge, is that it is quite difficult for newer people within the Innovation Centre. It is observed that “it can be a fairly tough start” (Respondent Eighteen, RAD 18). As new employee Respondent Thirty One commented, if it were easier to locate knowledge “it would save myself time, trying to track down whoever I could ask about that or will save them time as well” (Respondent Thirty One, RAD 31).

New employees do not find it easy. They often have questions and would “ask a person who’s here and that person would then point them in the right direction. So second hand, they’d get roughly pointed in the right direction” (Respondent Twenty Two, RAD 22). Respondent Twenty Seven concurs with this as he stated that locating knowledge for newer people is “very difficult” and “colossally inefficient” (Respondent Twenty Seven, RAD 27). However, DePuy “have had hired a lot of people and everyone has done it the hard way. And it’s the same feedback from everyone trying to get in here” (Respondent Twenty Seven, RAD 27).

There is an evident dependence on DePuy’s informal network as a method of locating knowledge. This leads to other inefficiencies. As field work continued, locating knowledge was seen as “an absolute nightmare”. Respondent Twenty Three explained he “will go to as many people as it takes to get the answer” (Respondent Twenty Three, RAD 23). Time is lost as this process takes several interactions. “The likelihood is you’ll be sent [in] the wrong direction because they think you’re looking for a different thing. After you’ve spoken to about three people, you’ll have worked out how to articulate exactly what you’re looking for in a language that people who are working here will understand. And then you probably have two more hops, maybe three more hops of going to people once they understand what you’re talking about until you get to a person who, A, has the knowledge and, B, is willing to share it with you” (Respondent Twenty Three, RAD 23).

There is no clear guide as to who in the business “would know that [knowledge] before you ever got to that point” (Respondent Sixteen, RAD 16). This raises the
question whether DePuy is aware of what its employees know. This was observed as a companywide issue because DePuy may have expertise in their Raynham site in Warsaw, Poland, but “you mightn’t know this expertise exists and you could be going around in circles looking for information that you don’t know that other people have” (Respondent Sixteen, RAD 16). One of the examples given was of an employee who had to locate knowledge on a process, but spent three months doing this without significant progress. In the end, he finally found the person who had the knowledge that could help him because “he would have had more information than I would have managed to get in three months just sitting in this computer, just sitting in this desk” (Respondent Sixteen, RAD 16). There are huge inefficiencies in this area.

If a new problem comes to the fore “it would take quite a while to find the right person”, but this can be “really challenging” (Respondent Nineteen, RAD 19). “It would be a challenge. Even, for example, one of my guys asked about the QA [Quality Assurance] managers of the different sites. I’m like, ‘that’s easy, you know’. He wouldn’t know that because he’s fairly new to the business and everything” (Respondent Nineteen, RAD 19). Project Management leader Respondent Twenty explained that there are several instances of expertise that becomes available, however “there’s no gardener going round … the garden. [In terms] of infrastructure that’s here, it’s not very clear” (Respondent Twenty, RAD 20). Another issue that will be discussed in Chapter Five is that many of the employees at DePuy do not have time to engage in many of the ongoing KM initiatives. “[I do not] have that half an hour. So one of the frustrations [is] that … I don’t actually have time in the day to do work or to go and have those conversations that are scheduled” (Respondent Twenty Six, RAD 26).

When Respondent Twenty Six started at DePuy, locating knowledge was “quite difficult and it’s quite daunting, I think. I nearly had a nervous breakdown within four months of coming in here. What we have tried to do over the last two years is put a suite of documents in place” (Respondent Twenty Six, RAD 26). Again, a codification strategy (Hansen et al 1999) is the solution put forward to meet the problem of locating the right knowledge at the right time within the network (Miller et al 2011; Moffett and Hinds 2010). Western firms have used codification strategy in this way (Akamavi & Kimble 2005).
5.3.6 Re-use and Lessons Learned

“I think it’s human nature; the job is done now, have to get back again to kind of do a lessons learned. It’s a bit of a pain in the ***.” (Respondent Twenty Nine, RAD 29)

“Lessons learned might happen months down the road.” (Respondent Eighteen, RAD 18)

“I would say it’s probably fair to say there isn’t lessons learned done.” (Respondent Twenty Seven, RAD 27)

Graham and Thomas (2007) identified a number of reasons for implementing knowledge re-use and lessons learned: high staff turnover leading to loss of experience, large size of organisations make sharing knowledge difficult, and preventing departmental silos and fragmentation within the organisation. The process of re-use is a powerful factor in converting collective experience into improved average performance at any rate (Levinthal & March 1993). Knowledge re-use can be seen in the form of lessons learned and in the implementation and use of that knowledge in future projects, either through replication or general re-use. An organisation can learn to respond to new problems or experiences. Lessons learned systems provide one resource to enable this organisational learning from experience (Snider 2008). The primary potential knowledge output at DePuy is the re-use of knowledge obtained within projects themselves. When analysing the case data, one of the first things noticed was that knowledge re-use was haphazard and done only if pushed through by a project manager. Where re-use does occur, it is within the technical environment because it is driven by industry regulation. In addition, the companies could not go forward if knowledge re-use was not happening in the technical areas because they are built on new initiatives. It is not happening in the other areas either, for example, in the DePuy Innovation.

At DePuy, lessons learned would go on SharePoint, which allows the lesson to be available to everyone working on that project. However, the re-use of this knowledge is not entirely visible. “It’s not easily available at the moment” (Respondent Sixteen, RAD 16). This means people on similar projects are unable to use lessons from another group. There is a call for lessons to be generally available rather than specifically related to a particular project to increase transparency. Evidence of a clear
strategy for this could not be found. “We still make the same mistakes on all the projects that we do” (Respondent Twenty Three, RAD 23).

One of the main differences between Creganna and DePuy is that DePuy realise lessons learned are important. The literature also argues the importance of lessons learned (Snider 2008; Graham & Thomas 2007). However, evidence would show the case organisations do not do lessons learned often, and where they are done, they are not easily visible. Similar to Creganna, this shows an ambition to use KM initiatives but a failure to market these strategies and follow through with lessons learned. The issue the framework showed was that the lessons learned are not effectively translated to new projects.

Within the closed phase of a project that looks at lessons learned, the strategy is that once a group implements and closes a project, it has to do a lessons learned summary. This was not being adhered to or being followed through consistently because there “isn’t a lessons learned register, and that’s part of the problem” (Respondent Twenty Three, RAD 23). It was clear that if each group does a project, the lessons learned stay within the group. This prevents it from being shared within the greater community, and the exercise becomes fruitless. Everyone in the group already is aware of the lessons, but there is not awareness outside the group of lessons learned for projects, validations, or new product introductions.

Even management could not say “with hand on heart confidence that every lessons learned has had a defined action with a defined date and an owner of closeout. ... [We] don’t review it on a regular basis as a steering group” (Respondent Twenty Two, RAD 22). Management needs to be aware that there is no point in doing lessons learned unless it is done consistently and it is a formal process.

The case shows that when left to the individual, the lessons learned documenting procedure was poor. If the project manager does not organise a lessons learned activity it does not occur. The lessons learned are not followed up on and end up being a paperwork exercise without out any organisational benefit. It is clear within the Innovation Centre, the culture around lessons learned is quite poor. However, this
is not consistent with the wider DePuy organisation. The following example shows how lessons learned are done within the Foundry.

“We collated all of those lessons learned into a risk register ... and that was incorporated formally into the project plan document. We had to design our inspection strategy of how ... we ran into a lot of problems from an inspection perspective and measurement perspective on the project. So therefore we defined and locked down our inspection strategy and our approach straight off the mark before we ever began the project. And we’re seeing the major benefits of that right now, whereas we were drowning in a sea of ‘oh my God, what are we doing’ before.” (Respondent Twenty Five, RAD 25)

One of the reasons re-use is so poor in the Innovation Centre is that when engineers work on a project, they will sign off to reach targets, but do not consider the visibility to the rest of the organisation or its affect on future projects project. They need to consider the global scale.

If lessons learned were completed properly, DePuy would get a set of actions out of each project that need to be delivered on for the next project. At the moment, it is a “local document related to that project” (Respondent Sixteen, RAD 16). Evidence shows that lessons learned are ad-hoc and mostly hit-and-miss even if attention to investment has been especially evident in the private sector, where a firm’s learning capabilities and knowledge are viewed as strategic resources (Moffett & Hinds 2010; Snider 2008).

An attitude of “we will do better next time” does not only characterise how insufficient this area is, but highlights the need for action. Respondent Twenty, who was specifically brought in to revamp project management processes, admitted they are “not taking any active steps to learn how well that project went” (Respondent Twenty, RAD 20).

A solution to the lessons learned problem could involve implementing a better tracking system. The meeting minutes and lessons learned could be stored in folders and given a tracking system to identify where all lessons learned are with an action. Also, the Innovation Centre has actively pushed lessons learned and knowledge re-use
from top management down, something that is lacking from the evidence in the primary data.

The lack of compliance around lessons learned also could stem from a culture of unwillingness. “I would just say in terms of people’s willingness to document and impart knowledge, it’s proportional to ... other people’s willingness to actually read the material. So if I sit down and do a big lessons learned at the end of the project and I’m thinking nobody’s ever going to read this, I’m simply not going to put in the effort” (Respondent Twenty One, RAD 21). Again, at Creganna and at DePuy, many of the issues come back to time constraints. As much as these initiatives are important, time must be made for staff to actually perform and interact with these initiatives.

5.4 Summary of Issues
This section outlines the primary issues discovered in both organisations before the analysis and findings in Chapter Six. From the case studies, the research shows that there is an industry need to capture tacit knowledge in both organisations. There is also a need to document explicitly held knowledge properly. As was shown (see section 4.6.2.1 and 5.3.4) formal documenting should occur, however, it is ineffective at the firms. Employees also find it difficult to locate knowledge. As shown (see section 4.6.3 4.5.8.5 and 5.3.5) because of the over-reliance on informal methods of locating knowledge, problems exist for both organisations. Learning at both organisations depends on formal training. There is no formal mentoring at either organisation. Re-use is also quite poor as a lack of visibility, a lack of a pro-active culture and it simply becoming a paperwork exercise without benefit combine to hamper the organisations gaining anything useful. Table 5.1 below highlights the micro issues in the DePuy Case. Figure 5.1 highlights some of the macro issues in the case studies. Figure 5.2 highlights the primary issues discovered within the case studies. Expanded discussion and analysis will follow in Chapter Six.
Table 5.1 DePuy Case Micro-Issues Summary

<table>
<thead>
<tr>
<th>Knowledge Indicator</th>
<th>Knowledge Activity</th>
<th>Issue Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Acquisition</td>
<td>Capture Documenting Locating Knowledge</td>
<td>➢ What is being captured is not representative, incorrect knowledge being distributed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Outdated procedures, time lost due to inefficiencies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ New employees find it difficult to locate knowledge</td>
</tr>
<tr>
<td>Knowledge Networks/Sharing</td>
<td>Formal/Informal</td>
<td>➢ Few knowledge experts: Functional Experts/Subject matter experts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Huge dependency on informal network</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Formal network bypassed in favour of informal network</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Contractors not integrated into networks</td>
</tr>
<tr>
<td>Knowledge Learning</td>
<td>Training</td>
<td>➢ Reliance on formal training (Compliance Wire) without adequate support</td>
</tr>
<tr>
<td></td>
<td>Mentoring</td>
<td>➢ Lack of enthusiasm/awareness and understanding about formal systems</td>
</tr>
<tr>
<td>Knowledge Re-use</td>
<td>Lessons learned</td>
<td>➢ Senior managers do not have skill-sets required to provide mentoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Where done, only done if pushed by manager</td>
</tr>
</tbody>
</table>

5.5 CONCLUSION

This chapter has presented an overview of the DePuy case study. The chapter began by introducing the Innovation Centre. This was followed by a comprehensive description of the case. This provided a synopsis the organisation in its current states along with detailed organisational breakdown. This discussion took the form of a narrative, process-based description. This was done to allow the reader to immerse him or herself in the richness of the case, while having access to commentary on each issue. This included discussion of KM at DePuy, descriptions of the systems used and an exploration of the knowledge activities using the framework. In the subsequent chapter, the findings of this study will be discussed.
Figure 5.1 Case Studies: Macro Issues

**Corporate Strategy**
Creganna Corporate/Johnson & Johnson
- Dictate strategy: performance orientated, codification approach

**Parkmore West/Innovation Centre**
Knowledge Strategy
- What is knowledge/KM?
- KM is a systems answer to every problem
- One K-champion in each case

**Middle Managers**
- React to problems
- Implement KM strategy
- Do not understand nature of problems/knowledge
- Solutions \(\rightarrow\) KMS
- Systems answer always

**Frontline Employees**
- What is the system for?
- What is KM?
- Hate UPK/(Agile/Compliance Wire)
- Never heard of Link
- Little input into strategy being used that affects them

Lacking clarity and communication:
- Frontline problems not truly known
- Senior Mgt not informed
- Middle Mgt
Figure 5.2: Issues Identified in Case Studies

**Knowledge Acquisition**
- Fundamental need to acquire knowledge at both organisations
  - Dependency on informal network
  - Acquisition occurs on informal network
  - Complete bypass of formal network
  - Knowledge used but not documented
  - Functional issues with codification strategy solution
  - People prefer to use informal networks
  - New employees cannot acquire knowledge because they cannot locate it
  - Employees do not have sufficient time to use system

**Knowledge Network/Sharing**
- Lack of cross-functional sharing across groups
  - Knowledge hoarding situations present
  - Few knowledge experts hold most of the knowledge

**Knowledge Learning**
- Reliance on formal training without adequate support
  - Lack of enthusiasm/awareness and understanding about formal systems
  - “Click-job” training leads to difficulty in new scenarios
  - Employees meet with “nominated experts” who write down the development areas, but the onus to develop is placed on the employee
  - Management’s desire to save time but at the cost of quality training

**Knowledge Re-Use**

**Capture**
- Capturing only about 60% operational
  - Ability to capture before knowledge attrition occurs
  - Inaccurate documented processes — what is being recorded is not representative
  - Inaccurate knowledge used by employees

**Documenting**
- Explicit knowledge not being documented
  - Outdated procedures
  - Time lost due to inability in finding information
  - Inaccuracy within documents

**Locating knowledge**
- Problems knowing who the owner of a problem is
  - New employees experience difficulty locating knowledge
  - Time lost due to trying to locate knowledge — inefficient

**Formal/Informal**
- Huge dependency on informal network
  - Formal network bypassed in favour of informal network
  - Lack of awareness of formal knowledge systems

**Training**
- No formal mentoring programme; informal mentoring is very ad-hoc
  - Senior managers do not have skill-sets required to provide mentoring
  - Employees do not want to take the time to offer mentoring
  - Lack of functional and subject-matter experts in organisations

**Mentoring**
- Simply not done
  - Where done, only done if pushed by manager
  - Lack of visibility of lessons
  - Lack of pro-active culture
  - Paperwork exercise without benefit

**Lessons learned**
- Simply not done
  - Where done, only done if pushed by manager
  - Lack of visibility of lessons
  - Lack of pro-active culture
  - Paperwork exercise without benefit
CHAPTER 6: ANALYSIS AND FINDINGS

“The lasting source of competitive advantage is knowledge”- Nonaka
(1991:96)

6.1 INTRODUCTION

This chapter presents the primary objective of the thesis. It will discuss the operationalised KAF. It will justify the usefulness of this framework (6.2 & 7.2.4) by presenting the findings as a result of deploying the framework at organisational level. The framework highlights some interesting insights about both case studies. These areas or “knowledge gaps” give the case organisations focused areas where they can adjudicate action if they so choose.

During the early field studies and the initial data collection stages the organisations perceived that the only, and ultimate test for measuring the value of knowledge, is economic-increased efficiency. As Nonaka (2007) states; other more qualitative factors and understandings are equally important. After the presentation of the findings, derived from the framework, were presented to the case organisations, it was clear that, now, they were able to justify the value of knowledge assessment in areas that, traditionally they would not have had understanding or inclination to explore. The case organisations were then able to use these findings to prescribe actions going forward that will be discussed in section 7.2.4 –the usefulness of the framework. These findings are substantiated by further analysis of the interviews and observations from both case studies.

Due to the very nature of knowledge, the findings extrapolated from the deployment of the framework in Creganna and DePuy, are unique to Creganna and DePuy respectively. If this research is furthered and expanded upon and the framework deployed in other organisations, new findings may be discovered. Knowledge requires understanding, and thus holds different perspectives for those wielding it. Couple that with a different case setting or different context and the results are likely to be different for each new deployment. However, the way in which the framework is deployed will remain the same.
For the purpose of this dissertation, the framework has been built and utilised as an initial lens with which to go to these organisations and highlight knowledge gaps, while, at the same time, constructively building toward an operationalised framework. The limitations of this framework are also acknowledged later in Chapter Seven. It is important to acknowledge the limitations of this iteration of the framework, but also highlight and recommend the potential of knowledge assessment going forward for organisations who wish to understand, value, and further their knowledge. It is the researcher’s goal that this research helps organisations focus and recognise the importance of developing new measures of organisational performance based on knowledge, that supplement the knowledge environment (Peng et al 2012; Moffett & Hinds 2010; Minonne & Turner 2009; Nonaka 2007).

In Figure 6.1, the KAF is presented. The framework provides a lens through which to explore knowledge indicators within the organisation. These indicators each have their own knowledge activities that are presented in detail throughout Chapter Four and Chapter Five and many of the major issues concerning these are presented in Figure 5.2. Subsequently, the knowledge gaps (findings) that emerge are explored in more detail. From the activities that arise, knowledge gaps are highlighted. These are the areas of discussion raised in section 6.2. The framework, along with these findings, when presented to the respective organisations, allows decisions about what actions to take to be made.
Figure 6.1: Operationalised Assessment Framework (Post-Deployment)

Knowledge Indicators
- Knowledge Acquisition
- Knowledge Network/Share
- Knowledge Learning
- Knowledge Re-Use

Knowledge Activities
- Locating Knowledge
- Documenting
- Internal network
- External network
- Learning-By-doing
- Mentoring
- Attempt to re-use
- Lessons learned
- Capture
- Informal network
- Formal network
- Training

Organisational Level Outcomes

Company Feedback
- Knowledge Gaps
- Areas for Action

+
6.2 RESEARCH FINDINGS

Below, the organisation specific research findings, as a result of deploying the KAF, are outlined. These insights are populated by examining in greater detail the knowledge activities in the KAF. They also aim to address many of the research aims and objectives outlined in Table 1.2 in Chapter One. They will be analysed in more detail in the subsequent discussion. Following this, the usefulness and limitations of the framework will be discussed. The organisational findings are:

1) Across groups, cross-functional sharing is siloed, which leads to a lack of knowledge sharing.
2) Cultural issues, such as hoarding of knowledge, hinder KM initiatives.
   i) Employees new to the organisation find it difficult to locate knowledge because of the informal network dependence.
3) Employees are dependent upon their informal network to create/acquire/share/re-use knowledge.
   i) The external network is secondary to the internal knowledge network.
4) The implementation of several KM initiatives are hindered because staff do not have sufficient time resources.
   i) Lessons learned and knowledge re-use is not given attention when targets have to be met.
5) Due to time issues and informal network dependence, there is a lack of formal systems use.
   i) A problematic learning cycle is being fostered because of a strategy that focuses on formal systems training.
6) There is a lack of ownership of knowledge
7) There are knowledge retention problems concerning the attrition of knowledge
8) The organisation does not entirely know its employees’ skills
6.2.1. Cross-Functional Sharing

One of the first issues that became evident was problems around knowledge sharing, specifically the lack of sharing cross-functionally across groups at Creganna and DePuy. Cross-functional sharing is poor within the case organisations and could be improved. The first research finding is:

**Research Finding 1:** Across groups, cross-functional sharing is siloed, which leads to a lack of knowledge sharing.

Many KM studies\(^8\) focus on knowledge sharing. They have focused primarily at conceptual studies (Peng et al 2012; Miller et al 2011; Szulanski 1996; Bartol & Srivastava 2002; Widen-Wulff & Ginman 2004; Hendrick & Vriens 1999; Alvi & Tiwana 2001; Huysman & Wulf 2006; Sherif et al 2006: Hall 2001; Ipe 2003) or empirical approaches (Abrams et al 2003; Block et al 2005; So & Bolloju 2005; Wasko & Faraj 2005; Yang & Chen 2007). Only one study could be found that focused on the case-study approach (Pan & Scarbrough 1998). In it, the researchers examine knowledge sharing at Buckman Laboratories from a socio-technical perspective. The lack of focus on case studies in KM is not uncommon (Choi et al 2008). As highlighted in Chapter 2 (see section 2.1.7) the OECD (2002a) as well as other authors such as Nonaka (2007), have called for a deeper understanding of knowledge indicators at organisational level. This is one of the major advantages of the case study approach (Yin 2009) because the depth of data lends itself to in-depth findings and insight.

Knowledge sharing involves the transfer of knowledge from one person, group or firm to another (Choi et al 2008; Szulanski 1996). Knowledge sharing as a central pillar of KM is critical to the realisation of its full value. Knowledge sharing is recognised as one of the most significant problems facing KM (Chow & Chan 2008; Bechina & Bommen 2006). Abdullah (2009) found support for good knowledge sharing as an antecedent to progressive knowledge strategy and management values. However, it also was found that knowledge sharing is one of the largest problems for managers; this also was evident within Creganna and DePuy. Evidence from Creganna shows the existence of extensive cross-functional sharing of problems.

\(^8\) See Appendix Q
especially between business units. Within the business units it is quite active, but many employees do not know what occurs in other groups and other business units. There is evidence that cross-functional sharing between business units is poor compared with that of within-group sharing. One example of where this is evident is between Metal Shafts and New Technologies. This cross-functional sharing is necessary to Metal Shafts and New Technologies and they should be more closely joined than they are to foster the sharing environment between employees. Perhaps the nature of knowledge in itself can help to better understand these issues.

Understanding the nature of knowledge is a key factor in effective knowledge sharing. Explicit knowledge can be shared more easily through many formal methods of training and development (Nonaka 2007, Zach 2005). Tacit knowledge is more difficult, but also more important, to share (Nonaka 2007, Polanyi 1962). Since, knowledge hoarding is a common human action; it must be reversed through greater cultural preparation in engaging with staff (Miller et al 2011; Hislop et al 2000), effective management communication and better evaluation, feedback and appropriately tailored reward schemes (Hsu 2006). There is more evidence of cross-functional sharing issues throughout the case analysis. Physical proximity does not seem to matter (Skyrme 2004), as employees who are physically close do not share. This may be linked to the fact that many cases are “target-orientated”. As discussed earlier, a few experts champion the key knowledge at each organisation and employees depend on them for their day-to-day knowledge acquisition. They do not need to depend on fellow employees as they can go to the knowledge champions in their informal network. This leads to knowledge gaps because few have the knowledge and few control it.

The act of knowing what is going on within other groups is not a priority for employees especially if it does not affect the life-cycle or targets of their current project. Nonaka (2007) says that if it is the job of employees to know what is, it is the job of management to know what ought to be. Employees do not value knowledge. Perhaps management do not either. One of the possible reasons for the divide at Creganna and DePuy is that there is an element of resentment especially between the various groups within the Innovation Centre and the manufacturing floor. “There’s a perception that this is the Oval Office up here” (Respondent Eighteen, RAD 18).
Often, the Innovation Centre would need to know information or changes that were happening, but these were not communicated. However, the lack of cross-functional share is occurring on both sides equally. The framework highlights both organisations espouse KM and the commitment to KM, but are quite insular in nature when examined more closely. A system that explicitly calls for knowledge sharing and systematically reinforces this attribute is evident in high-performing firms (Hsu 2006). Hsu (2006) posits that a more integrative approach via the people, inclusive of the available systems, has a greater chance of success than piecemeal approaches. The framework highlights that this insular behaviour also is occurring at Creganna. Employees are equally guilty in that they do not see the bigger picture; however, in addition to the lack of cross-functional sharing there is a lot of “I’ll hold what I know” (Respondent Eight, RAD 8), which describes the situation of knowledge hoarding which is discussed later (see section 6.2.2.). In fast-growing, goal and target-orientated organisations like Creganna and DePuy, it becomes very easy to be cocooned; however, they must be aware of the projects and scenarios outside of this.

For quite some time, Metal Shafts was physically separated from Device Manufacturing and Design Services. The physical barrier leads to a reporting barrier which leads to an “us versus them” mentality (Respondent Twelve, RAD 12). This contradicts some of the literature that argues that physical proximity is not a critical factor in the “knowledge organisation”. Putting both groups in the same building and under one department aimed to alleviate the share problem, but it has had little effect. At DePuy, the Innovation Centre personnel are in the centre and the manufacturing personnel are on a different level- on the manufacturing floor. Again, this has lead to issues with “them and us” mentalities and cross-functional sharing problems. As posited by management at Creganna, knowledge can be separated from the individual and stored and received; however, this is far less clear-cut in practice (Alvesson & Karreman 2001).

The physical barrier between the Innovation Centre and the manufacturing floor has lead to a disconnect between the two groups, and there is a subtle divide on site between the manufacturing and Innovation Centre engineering groups. As the framework has highlighted, knowledge sharing is not a huge priority and is harder to engage in, especially as a new employee coming into the Innovation Centre. There is
evidence that sharing is quite siloed. Groups do not want to share what they are doing with others. This term came to the fore within DePuy, and moreover, the lack of sharing often can come down to a lack of time, as it is often a question of how much resources are available (see section 6.2.4). “They start at 7, they finish at 7; they’re up to their **** all day long. ... They won’t have been given any extra time” (Respondent Twenty Three, RAD 18). There also is a lack of cross-functional sharing between AMT and the manufacturing floor as they do not work with each other. This could be simply because the employees do not have a lot of interaction with each other; however, Szulanski (1996) explains that the difficulty in sharing knowledge lies in the sticky nature of knowledge, which is difficult to share. Polanyi (1997, 1969, 1966) posits that this tacit knowledge cannot be shared unless within close proximity of the knower. However, these non-routine problems also are the most difficult to share because of causal ambiguity, and the nature of this knowledge is embodied in highly tacit human skills (Szulanski 1996). The framework highlights that the lack of sharing at both organisations is due to the culture of hitting targets and achieving goals. This is the main aim of employees and they often simply lack the time to share knowledge.

Within Creganna, for example, if one is working in metal shafts many employees are left wondering what do they work on over in design services? This shows that cross-functional sharing is lacking. Some sharing occurs between managers at formal meetings, however, very little is shared at the lower levels of the organisation. There is a definite lack of cross-fertilisation of views and ideas between groups, which may be a lost opportunity; the synergies across the organisation are not captured. Within the organisations’ groups, there are several weekly and monthly update meetings for management; however, team members do not see what other groups are working on. There is a lack of formal integration, so how well these different groups share and collaborate depends on how strong the social relationship is between the project manager and the engineer and the other groups across both organisations. At DePuy, there is very poor visibility on what each group are doing, which leads to a situation where Innovation Centre employees speak with manufacturing employees who have “no clue what people upstairs [Innovation Centre] were working on” (Respondent Twenty Six, RAD 26). Better cross-functional sharing would possibly lead to greater visibility and greater knowledge sharing across the internal knowledge networks at Creganna and DePuy. The framework already has highlighted that few experts hold
the knowledge, which may be a contributing factor as to why sharing is so poor. Szulanski (1996) also argues that the inability to value, assimilate and apply new knowledge may prevent knowledge sharing; however, in this case absorptive capacity cannot be included because sharing is not occurring across groups in the first instance.

The lack of cross-functional sharing is an issue at both organisations; however, it seems more apparent at Creganna. Collaboration is not happening. Many employees commented that they had very little opportunity to work with different groups. Management also do not seem to recognise the usefulness of collaboration as they only see the target contract of the customer. Though the gaps present in the organisation concerning cross-functional sharing are a major issue, it may be as a result of the pace by which the organisation has grown (Moffett & McAdam 2006; OECD 2004). Nevertheless, with regard to the daily running of the company, personnel seem to find a way to accomplish their tasks and achieve their goals in terms of their own realm. It is not surprising that knowledge-sharing schemes in organisations “are met with mixed success” (Burton-Jones 2008: 9). The framework has highlighted that cross-functional sharing is poor. Sharing between groups generally gets ignored, which leads to the insular environment described within the case organisations.

6.2.2 Cultural Issues

This section discusses cultural issues. Specifically the framework has highlighted cultural issues that lend themselves to other situations within the organisations. The case study shows a select group of functional and subject-matter experts drive the knowledge lifecycle within Creganna. However, some people create and acquire knowledge and do not share it. The second research finding is:

Research Finding 2: Cultural issues, such as the hoarding of knowledge, hinder KM initiatives.

Sub-Finding: Employees new to the organisation find it difficult to locate knowledge because of the informal network dependence.

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It is widely acknowledged that much of the training and development expenditure is wasted because there is no knowledge transfer (Miller et al 2011; Hinds et al 2010; Abdullah 2009; Bartell 2001; Brown & Duguid 2001; Macaulay & Cree 1999). There is a strong and obvious self-interest in hoarding knowledge (Alvesson & Karreman 2001). The organisation must reverse this habit by giving suitable incentives to “sharing and helping others” (Abdullah 2009). Within Creganna, the findings have already discussed that there is a lack of cross-functional sharing. One of the cultural issues raised through the application of the framework is the scenario of knowledge hoarding among the few key knowledge experts. The research has already established that, within the case organisations there are few key knowledge experts (see section 4.3.4 and 5.3.1). Knowledge hoarding at Creganna and DePuy is widespread. Many of the key knowledge experts see knowledge as power in that they see themselves becoming dispensable without this knowledge. They become the only person who knows this key knowledge, where it is stored, and how to access it. They do not document it because they possess it tacitly and see the diffusion of this knowledge as potentially damaging to their championed position. As will be discussed later (see section 6.2.6), there is a lack of ownership at the company; however, many of the experts keep what they know to themselves. Within the literature (Hislop et al 2000; Wenger & Snyder 2000; Szulanski 1998; Tsoukas 1996) it is argued that incentives are required to avoid knowledge hoarding and propagate knowledge sharing. However, there is “no reward for sharing information” at Creganna or DePuy (Respondent Seven RAD 4). To combat knowledge hoarding, one needs to make sure there is not an over dependency on a small percentage of knowledge experts, and one must try and consciously teach people certain elements of these expert’s jobs so their knowledge improves. The knowledge within the organisation is created and expanded through social interaction (Tsoukas 1996). The evidence of knowledge hoarding was found to be widespread. This was evident in situations where few managers or experts held most of the knowledge and, because of this, were in privileged positions. Knowledge re-use (see section 4.6.5 and 5.3.6) in this situation was stunted because the knowledge was not being imparted and diffused in the first place.

Another reason that knowledge hoarding may be occurring is because of some unhealthy competition. At DePuy, there is some inter-site competition, so people do not want to share, which leads to knowledge hoarding. For the firm to operate as a
distributed knowledge system (Tsoukas 1996), there needs to be a motivational strategy (Szulanski 1996). Employees are not sharing knowledge because they are “afraid to share it” (Respondent Twenty Four, RAD 24). It is suggested that there are many employees who think; “I’m good at this, this is my role, and I’m not going to tell anybody else how to do it” (Respondent Twenty Four, RAD 24). This shows that hoarding is present and is specific to employees who believe they may have something to lose by sharing that knowledge. Furthermore, at DePuy, since the reorganisation of the company, there still is an “us and them” mentality. Case evidence suggests employees stop sharing their ideas because personnel do not react to suggestions and ideas others are giving.

The framework highlights that hoarding is occurring. This is a deep seated cultural issue at both organisations that managers stated was not happening but when examined with individual employees the outcomes were alarming. It also is an individual issue, whether that is driven by the culture of the organisation or that of the individual. The culture of each organisation is likely to be the main factor. Many within the organisations have emulated the culture. They are target-driven and strive to be that “centre of excellence”. Individuals that keep knowledge to themselves can relate to the issue of cross-functional sharing previously discussed. Employees who may be there for more than a decade do not want to share what they know. They “don’t want to share, they don’t want to move on, so they keep it to themselves. ... That’s because they’ve kept it their job” (Respondent Twenty Four, RAD 24). The framework highlights that this hoarding makes some feel important; that they believe they are the knowledge centre or a knowledge champion. Other evidence showed there was a reluctance to share knowledge because knowledge experts ask themselves “what’s in it for me? If I share knowledge, will that actually make somebody else look better?” (Respondent Eighteen, RAD 18). The cases suggest people who do not share are successful in their jobs. They are hoarding what they know and are saying “sorry, that’s not on my task list, I can’t help you on that”. Sharing knowledge is a reciprocal event where one needs to feel like the relationship goes both ways. This further explains the insular situation and siloing previously mentioned. These accounts of hoarding certainly are in line with discussions within the literature. A fear of losing the ownership of the knowledge, position of privilege or superiority within a knowledge domain (Minonne & Turner 2009; Burton-Jones 2008; Hislop et al 2000;
Szulanski 1996) may explain the lack of devotion or interest to support or openly share knowledge.

➢ **Sub-Finding:** *Employees new to the organisation find it difficult to locate knowledge because of the informal network dependence.*

As highlighted by the framework, employees experience knowledge acquisition differently. Acquisition usually takes place within teams, so often team leaders are best positioned to be the conduits for knowledge location and acquisition. Though knowledge acquisition occurs mostly informally at both organisations, the framework helps to highlight that it is not easy to locate people with the relevant knowledge. There is not a large focus on the formal aspect of knowledge acquisition. New employees often ask somebody who had been in the organisation for a longer time what to do and how to do it. It is clear that employees abandon their formal methods of knowledge acquisition in favour of informal methods. Middle managers and team leaders are best positioned to be conduits for knowledge acquisition and location and this may be an untapped resource in the KM area for these organisations. Much of the external experience brought into Creganna has a function, which has been to grow the knowledge base. It has helped the company take the step from “being the small, indigenous company to being a big player on the world stage” (Respondent Four, RAD 4). The ease of locating knowledge seems to depend on one’s ability to use their informal network.

### 6.2.3 Informal Network Dependence

This section will discuss the dependence on the informal network at both companies. The analysis of the case studies shows unequivocally that, across both organisations, a dependence on the informal network is present. Due to the lack of knowledge experts, be it functional or subject-matter, the creation and sharing of knowledge within both Creganna and DePuy is largely dependent on a small percentage of employees. The third research finding is:
Research Finding 3: Employees are dependent upon their informal network to create/acquire/share/re-use knowledge.

Sub-Finding: The external network is secondary to the internal knowledge network.

It is now realised that the creation, acquisition, sharing and re-use of knowledge is most prominent in informal networks and communities. However, the rapid adoption of technologies in recent years is challenging the understanding of what constitutes an informal network. Recent research by (Su et al. 2007) has found that throughout the working day knowledge workers constantly switch between multiple networks, all of which are a complex mixture of formal and informal, face-to-face and computer-mediated, intra-organisational and extra-organisational, and work-related and private interactions. The framework highlights that the presence and use of the informal network at Creganna and DePuy is substantial. Furthermore the management of both companies do not realise to what degree this is the case. Evidence from the cases suggests that both organisations are open, informal places of work. This, coupled with a less formalised network at each company, might suggest there is the potential for an over-dependence on the informal network. One of the main pieces of evidence to support this finding is that many of the systems that are supposed to be used to support the sharing and transfer of knowledge are often not used or not prevalent (see section 4.2.4, 4.3, 4.4, 5.3.1.1). This will also be discussed in section 6.2.5. There also is evidence that lack of time could be another contributing factor. The interesting aspect, however, is the position of management. Management look to their formal KM systems to achieve creation, acquisition, sharing and re-use of knowledge. They even depend on these formal systems to train their employees. They do not realise that these formal methods are underused and more often than not abandoned for more informal methods.

Looking at the participation in informal networks, the literature suggests individuals in these networks share the same organisational language and behaviour and are faced with similar issues related to their knowledge tasks, supporting efficiency and thus general performance (Minonne & Turner 2009; Wenger 1998; Brown & Duguid 1991). In addition, the combination and recombination of firm-specific knowledge
that is physically dispersed throughout the organisation may facilitate integrative creative performance, since these acquaintances are more common than community of practice members in having important knowledge that is non-redundant (Granovetter 1973). As there is a lack of formality, engineers can go in and out of a problem but without ever properly documenting what they did. This suggests that one can talk to the knowledge owner to acquire that knowledge. As this environment fosters an open approach and relies on knowing who knows what, it is apparent that employees who are in this environment longer have an advantage. “I’m here seven years, so … I know who’s who” (Respondent Ten, RAD 10). This poses its own problems as it is difficult and inefficient to find out who knows who or what. As it is so informal, many do not use the formal network approaches, such as Knowledge Cards (see 4.2.4) or Agile (see 5.2.4) or Link (see 5.2.5), and “it’s not exactly a very good way of doing it because ... it’s just word of mouth” (Respondent Eleven RAD 11).

However, due to less-frequent interactions and lower intensities of social pressure found in informal networks, employees may be less willing or less committed to exchange knowledge without some type of return (Hislop et al 2000). The relationship between participation in the informal network and individual performance would be mediated by internal knowledge exchange or the need to acquire that knowledge. Support for this was found at both Creganna and DePuy, where the relationship between participation in informal networks and performance was dependent on the need for internal knowledge and the need to acquire knowledge around a particular project or task. At DePuy, for example, much of the knowledge is learned from people in an informal way, and thus the internal network is very informal; if one were a scientist or an introvert, they may find it difficult to navigate. As a result, some find the organisation is not very structured or data driven, so they rely on their social links and how well they interact with others. The results suggest that individuals who participate in the exchange of knowledge and help within informal networks are more likely to become central individuals within the firm’s internal networks. These central individuals play the role of knowledge champions (Wenger 1998) and, as discussed earlier, incidents of hoarding may occur. Additionally, through their central position and collaboration with others (Peng et al 2012; Szulanski 1996), these champions are able to gather knowledge more efficiently and effectively from areas across the firm to fit their own local needs than individuals in less central positions or employees new
to the firm. This positively impacts on employees’ individual performances. While the findings regarding observations from Creganna and DePuy do offer somewhat similar results, they show the advantages of participating within the informal network as opposed to relying solely on the formal systems within the organisations.

There are some consequences of this informal network dependency however. Firstly, there are huge time inefficiencies at the companies and, secondly, there is a lack of proper use of some of the systems provided. Many employees end up spending much of their “work time” navigating the informal network only to lose sight of the knowledge they seek to acquire, delayed in the task of acquiring it. They end up doing two to three hours of work at home many nights in the week. The cases show this is because they spend their day trying to find out information through talking to others. Due to the overreliance on the informal network, there is the potential for both organisations to lose out on the power of having something more formal. The informal network only goes so far – one cannot possibly have a connection to every expert within the broader organisation.

➢ **Sub finding:** *The external network is secondary to the internal knowledge network.*

Within the knowledge networks at the case organisations the framework has highlighted interesting insights around the nature of the networks present. The nature of the framework has allowed the researcher to look at knowledge networks and to examine the networks in two distinct areas: (1) the external knowledge network and (2) the internal network. This can be separated further into each organisation’s informal and formal network.

Specifically concerning the external knowledge network, the research suggests that there is evidence of use in both organisations however; it depends on the nature and criticality of a problem. The external knowledge network is secondary to the internal knowledge network. According to Creganna (Davis 2009), around 25 per cent of what it does is outside the company. It relies on a lot of industries near Galway for information. Much of the knowledge used at Creganna is internal to the organisation; however, it is sourced from previously external people hired by Creganna. These can
include people of experience from other organisations. Most employees at DePuy use an external network to some extent; however, it is not as widely used as DePuy is a member of a wider family of Johnson & Johnson companies, which incorporates its overall knowledge network. The main point here is that before reaching out externally, the relevant people internally first are exhausted, and often there is not a need to seek information outside the company. This suggests Creganna is highly dependent on its internal knowledge network. Hutson and Skkab (2006) suggest that external networks can help acquire knowledge; however there was minimal reliance on external networks as source of knowledge in both organisations.

With regard to the internal knowledge network, the framework helps identify that, in both organisations, the informal network is the primary conduit with which employees share and acquire knowledge. Secondly, there are few knowledge experts, who attract most employees on the informal network, because they champion the knowledge. These individuals are the best positioned to share and diffuse knowledge within both organisations. Third, the over-reliance on the informal network has resulted in the underuse and general lack of awareness of formal KM solutions in place (see section 6.2.3). Finally, new employees find it difficult to locate knowledge in the informal network because they are new to the organisation. Thus the internal network at DePuy is hugely important to the operation of the company and much of the knowledge is internalised. When a problem arises, the first search or solution is internal, be it internal to DePuy or internal to Johnson & Johnson. There is disparity here; “when I think of my day-to-day, my interaction, it’s more around the J&J network ... DePuy’s too narrow, but within that J&J network” (Respondent Thirty, RAD 30). This is interesting as there is a difference in perception of what constitutes DePuy’s internal network. Some see DePuy in Cork and the confines of the plant as its internal network, and others explain DePuy’s internal network includes other companies within the J&J network. The framework highlights that, for most of the product-related material, it could be labelled the internal network, so plants in the U.S. could be considered internal to DePuy as well.
6.2.4 Time Issues
The framework has highlighted evidence in both Creganna and Depuy that fundamental time resource problems are present. The fourth finding is:

**Research Finding 4:** The implementation of several KM initiatives are hindered by evidence that staff do not have sufficient time resources to follow through with the initiatives.

**Sub-finding:** Lessons learned and knowledge reuse is not given attention when targets have to be met.

Most of the projects within Creganna and DePuy operate within a prescribed timeline. This timeline is purely customer driven. For example, Creganna is purely driven by trying to “get the thing done and not really having any scope or bandwidth to be improving the way that we’re doing things in any significant way” (Respondent Six, RAD 6). Problems around locating knowledge, acquiring knowledge, sharing knowledge and re-use were identified. A KMS often was implemented to counteract these problems, instead of looking at where the knowledge resides and how it is structured (Hahn & Subramani 2000). Examples such as UPK and Knowledge Cards in Creganna, and Agile, Compliance Wire and Link in DePuy have been presented in Chapter 4. These initiatives, however, take considerable time to use, time which many of the employees do not have to spend. The initiatives end up consuming a lot of time and energy with what is perceived as little output. The organisations are so target-driven that employees simply do not have time to use the systems or effectively partake in KM initiatives.

Successful KM implementation depends on resources (Wong 2005). Financial support inevitably is required if an investment in any KM or technological system is to be made. Human resources are needed to coordinate and manage the implementation process and to take up knowledge-related roles. Time also is a consideration; organisations have to free up time for their employees to perform KM activities, such as knowledge acquisition, sharing and re-use. Similarly, providing time and opportunities for people to learn is important (Martensson 2000). In addition, according to Davenport and Volpel (2001), attention is one of the scarcest resources in many companies. They call attention management a key component of successful
KM. Since resource availability is a primary concern in large organisations, it has to be properly considered when implementing any KM initiative (Wong 2005). Despite the potential usefulness of previous KM strategies, this research presents a situation where organisations still face difficulties in bridging strategy and practice. The difficulties arise when solutions to problems become ineffective or simply underused because of time restraints. The first initiatives that are discarded are initiatives around KM. Time is certainly an issue in Creganna and DePuy because most employees simply do not have enough.

There also is evidence that it is not only systems that suffer because of lack of time. The first initiatives that tend to be discarded are often the perceived “non-value” ones or those that are perceived to hinder meeting customer targets. At DePuy, for example, implementing lessons learned initiatives are ineffective because “it’s the time part”. It is apparent that these initiatives would benefit projects going forward, as posited by Snider (2008) and Graham & Thomas (2007). Whether there is the time to treat lessons learned properly and have a tangible benefit for the organisation is the main barrier, along with the poor culture that is not promoting these initiatives. However, there does not seem to be the managerial drive to promote the required culture. The inefficiencies caused by the informal network dependency has caused many employee’s workload to spill over into their free time, for example, “my hard work time is at home in the evening when I leave, like you’ll work ten or twelve hours in here and then you’ll do two hours at home at night, actually doing my own work” (Respondent Twenty Seven, RAD 27). There also was a lack of resources with regard to mentoring (see section 4.4.1 and 5.3.2). It is clear from the examples above that much of the “value add” initiatives go by the way side because there is not enough time available to support them. Despite what is being said in the literature, it is difficult for managers to implement KM initiatives if the cultural drive of the organisation does not foster their implementation. Much of the early KM literature looks at ways to codify knowledge (Hahn & Subramani 2000; Hansen et al 1999), and assumes knowledge can be effectively extracted and codified through document-to-person approaches, where artefacts are then stored and indexed in databases that enable easy retrieval (Hansen et al 1999). There are examples of this at both Creganna and DePuy. Though many of these initiatives, such as Link and Talent Navigator, are being used to codify, people still have very limited free time, and it is primarily about
people hours and making sure “you still get yourself your targets” (Respondent Ten, RAD 10).

Employees often will find it difficult to locate the right person with the relevant knowledge. In addition, when they figure out the right person it might be difficult for that person to give time to helping them. This could be a result of the hoarding previously discussed, the time issues discussed in this section or possibly a combination of both. Additionally, if an employee attempts to help another employee and it is perceived that time is being wasted, “their boss is going to say, ‘what the hell did you spend half today doing’” (Respondent Fourteen, RAD 14) so the culture is not exactly sympathetic to fostering that. Spender and Scherer (2007) argue that this problem of not “wanting” to give the time to a fellow employee may be down to “ownership of the means of production” (Spender & Scherer 2007: 5), or the ownership of different sources of knowledge however the framework highlights possible informal network dependency and time restraints which challenges this.

➢ **Sub-finding: Lessons learned and knowledge re-use is not given the attention when targets have to be met.**

Firstly the framework highlights that the primary knowledge output for Creganna and DePuy is what the organisations garner from knowledge re-use, more specifically lessons learned. Graham and Thomas (2007) showed re-use can help alleviate problems, such as high staff turnover leading to loss of experience, large size of organisations making sharing knowledge difficult and the existence of departmental silos and fragmentation. Knowledge re-use is lacking at both Creganna and DePuy. One of the reasons for this is the lack of time that staff has to devote to performing tasks associated with re-use (see section 6.2.4). Secondly, both organisations are driven by profit and targets. Every project is target-orientated rather than initiatives-orientated. Unfortunately, for KM to be successful, the initiatives must be given adequate time. Lessons learned and knowledge re-use are not given the attention when targets have to be met. The cases highlight that a “lack of buy in” to completing these tasks also is a problem. This largely is because management is not driving the initiative as being important to ongoing projects. General awareness of KM was poor in both organisations and there were no obvious marketing strategies to improve this.
Where lessons learned are completed, re-use is not captured or documented properly. The cases have already shown the breadth of issues regarding this (see section 4.6.1, 4.6.2.1, 5.3.3 and 5.3.4). Lessons become known within groups and projects but remain invisible to the rest of the organisation. This means there is no benefit from actually doing the lesson because the knowledge is not replicated, and it simply becomes a paper exercise that allows the group to sign off the project. The value that is actually gained or made available for future projects was highlighted as a concern. The capacity to establish ongoing links, both technological and social, for the ongoing networking of personnel within different business units must be a priority. Evidence of knowledge hoarding also was found. This was evident in situations where few managers or experts held most of the knowledge and, because of this, were in privileged positions. Re-use in this situation was stunted because the knowledge was not being imparted and diffused in the first place. For these organisations to improve their overall knowledge lifecycles, they need to better incorporate knowledge re-use. With effective re-use comes more effective knowledge creation (Snider 2008), so it stands to reason that with more knowledge creation it would be possible to innovate more, share more and improve the knowledge base of the organisation. To increase the propensity of knowledge re-use, both organisations need to increase the number of experts or up-skill other employees so they can propagate effective re-use.

6.2.5 Lack of Formal Systems Use
The previous section discussed employees’ dependency on or tendency to use their informal network and the subsequent issues with knowledge re-use. According to many KM authors, including Miller et al 2012, Hahn and Subramani (2000), Davenport (1998) and Hansen et al (1999), there is a general recognition of the importance of KMS, including those manifested in a variety of implementations, including document repositories, expert databases, discussion lists and context-specific retrieval systems incorporating collaborative filtering technologies (Davenport 1998). This is accompanied by a technology-induced drive to implement systems with “inadequate consideration of the fundamental knowledge problems that KMS are likely to solve” (Hahn & Subramani 2000: 1). The fifth finding is:
Research Finding 5: Due to time issues and informal network dependence, there is a lack of formal systems use.

Sub-finding: A problematic learning cycle is being fostered because of a strategy that focuses on formal systems training.

The primary solution offered by senior management for many knowledge issues at both Creganna and DePuy is that various formal systems have been proposed and introduced to tackle problems; for example, UPK is used for knowledge capture/training. Knowledge Cards are used for knowledge documenting, Link locates knowledge and is a knowledge network, Talent Navigator also locates knowledge, Agile deals with knowledge documenting, and Compliance Wire is used for training/learning. As previously shown, they are inefficient and ineffective in both cases (see Chapter Four and Five). Davenport and Prusak (2000) suggest that formal systems failed to live up to expectations and only a few of the formal systems developed in the 1980s were still in use in the early 1990s. Part of the reason for this was because formal systems attempted to capture knowledge as explicit decision rules. Decision rules have a limited scope and are not able to cater for rapidly changing environments (Davenport and Prusak 2000). Also, formal systems suffered from overly high expectations and excessive levels of hype. A typical pronouncement, written two decades ago might have suggested that it was too early to estimate the magnitude of the contribution formal systems will make to human capability and to the effectiveness as managers and perhaps more than a little reckless to rank it now along with steam power and electricity. But the contribution will be in that class and will be indeed profound (McDermott 1999).

There is a lack of balance or consistency within Creganna’s formal network. Some use the formal network that is in place, others do not; this is inconsistent throughout the organisation. Zach (1999) suggests there is a need to balance the two by formalising what needs to be and leaving the informal as is. This balance has eluded Creganna, and UPK was introduced to alleviate the problem with a centralised system that would act as a conduit for knowledge throughout the entire company. However, the issues remain. For example, if someone in Creganna needs to know the owner of training, it can take asking several people before becoming aware, while the
information is readily available on UPK.

As previously discussed, there is a reliance on the informal network at both companies. Agile suffers from information overload and there is a general animosity toward the system. However, from a regulatory perspective, it has to be used by employees in their training regime. Link was introduced at DePuy to function as a formal knowledge network and to pick up keywords and skill-sets and match them to profiles. Its function was to aid in sharing ideas. Though it is available to everybody at DePuy, it is underused and is not marketed or put in the limelight enough to make employees at ground level aware of its potential. Link is therefore underused. Coupled with the evidence that suggests that employees primarily use their informal network the potential of a useful system is undermined. It is argued that the programme scope (formal systems) must not be too substantial for the organisation’s available resources (Wong 2005). Investment decisions in KM should be based on a sound consideration of resources, not on the belief that it is “nice to have” (Respondent Ten, RAD 10). In addition, proper budgeting of resources is crucial for KM. Arguably, one of the key issues for any organisation in achieving effective KM is to deal with their resources, especially the availability of time. This implies it is key to be able to understand, acquire, allocate and manage these formal systems in unison with available resources to achieve organisational success (Wong 2005).

The framework also highlighted that many employees had not heard of Link or had no interaction with the system because they did not rely on it or did not have the time. Moreover, when trying to locate skill-sets or knowledge, many stated there was “no system there for that kind of stuff ... even just realising people’s qualifications or where people could help out” (Respondent Sixteen, RAD 16). This is despite the clear availability of three systems within the company. The lack of systems awareness and the lack of use of the system were interesting. When the lack of awareness of the systems was reported to management, they were surprised and admitted that the Innovation Centre would be championing these systems, when in fact the opposite was true. Collaboration across Johnson & Johnson is lauded as being important because knowledge sharing is important to the success of the organisation. This shows another disconnect between management and the Innovation Centre. This means that if there was a problem outside DePuy, even knowing Link could be used, they
probably would not use the system to pose the question. Management acknowledge that the lack of Link awareness is “definitely a problem for us” (Respondent Thirty, RAD 30). Perhaps an over-emphasis on knowledge codification (Burton-Jones 2008) without providing the necessary strategies on the ground results in the negative connotations associated with the KM tools.

Talent Navigator is the other system used for locating and archiving skill-sets and its purpose is to make the locating of specific knowledge easier for the user. However, the framework highlights that most employees are not aware of its existence. Even the head of the Innovation Centre does not use Talent Navigator regularly; “maybe twice a year, maybe three times, when deadlines are coming up”. Many said it is not user-friendly and that they prefer to use their informal network. It was interesting to see that the system has the capability, but it is not being used. It is worth noting that contractor staff cannot use the system, and DePuy personnel cannot locate any contractors on the system either. Again the framework shows that the primary problem is that “none of us have the time, to be frank. I mean, if I did, maybe, but I know we are flat out and we don’t” (Respondent Thirty Two, RAD 32).

The over-emphasis on these systems tends to focus managerial attention on the codified nature of storing knowledge, rather than on the people and their abilities to create, interpret and share knowledge (Haas & Hansen 2005). With the use of Knowledge Cards, Creganna recognised that people needed to get more knowledge about different areas. However, enthusiasm for those initiatives waned very quickly. Again there was very little use of this system at Creganna. The problems inherent in the diversion of attention from the motivational, and other problems associated with inducing individuals to volunteer their knowledge, (Burton-Jones 2008; Blyler & Coff 2003) may also have contributed to the issues discussed.

➢ **Sub-finding:** A problematic learning cycle is being fostered because of a strategy that focuses on formal systems training.

Key knowledge sustainability comes from superior learning capability (Prieto and Revilla 2005). At both case organisations, learning capability comes through a formal systems-based approach (UPK, Compliance Wire). The main issue is that as Creganna
has grown from a small business to a large organisation, it does not have the internal wealth of expertise to (1) sustain this growth long-term, (2) provide experts for the areas in which it now expands, or (3) provide training and mentoring to the wealth of new employees needed to sustain its expansion. It has not nurtured the capabilities that it needed to create effective learning while it has grown (Prieto and Revilla 2005). Within knowledge learning at Creganna and DePuy, both organisations are keen to pursue KM in a way to increase effectiveness and efficiency across a range of initiatives and procedures. However, learning within both organisations happens in a way that is counteractive to this goal. The cases show management’s expectation that learning should primarily happen through formal training. The challenge however, for both organisations rests on trying to create enough functional experts and subject-matter experts to cope with their growth. It is the functional and subject-matter experts’ responsibility to diffuse this knowledge, expand their expertise and provide the supervision and knowledge for much of the formal systems and training. There is a push to build expertise by putting the experts through “train the trainer courses” and into training positions, which attempts to deliver sharpness. In this way the experts become familiar with the detail and interacting with the formal systems.

Arrow (1994) introduced the idea that new knowledge is produced within a system or by economic process by arguing that learning-by-doing was an important by-product of production that diffused into the system (Arrow 1962). Many of the subject matter experts interviewed agree learning best occurs by “getting the hands dirty and learning the hard way through solving” (Respondent Four, RAD 4). Management take a different view. As shown in Chapter Four and Five, learning at Creganna and at DePuy takes place primarily through automated systems-based training, through UPK at Creganna and Compliance Wire at DePuy. This seems counter intuitive. This is achieved through formal training systems, such as UPK or Compliance Wire for example. A cohort of management believes this saves the organisation time (which it may do) and achieves good quality learning (which it does not). The reason that it does not achieve good quality learning is that employees do not receive a proper understanding of processes or procedures from “click-job” training. With the push to record processes and “the way employees work” in both organisations, inaccurate methods, processes and procedures are recorded and fed back into the training system;
“garbage in and garbage out”. The cycle continues and the situation worsens as the companies expand.

Von Hippel (1994) echo’s Polanyi by referring to a mentoring type relationship that can aid in offering an informal approach to training. This would be something untapped at both organisations. Currently employees will go to a training course for two hours and be told why something is “but until you go and practice it and do it and get a bit more competency in it” (Respondent Eleven, RAD 11), the process won’t be understood. The benefit of mentoring would be that “you’re actually doing a bit of training as well with them” (Respondent Seven, RAD 7) which would produce a long-term benefit. The managers and experts who are best positioned to train, mentor and impart knowledge are the ones doing the jobs day-to-day. This is where Creganna and DePuy would benefit from mentoring or informal sessions. The researcher must also take into consideration that mentoring and apprentice-type relationships may not be possible. Creganna and DePuy are growing organisations. The framework has highlighted that there are too few subject matter/functional experts to cope with the amount of new employees needed to maintain organisational growth in both organisations. Managers acknowledge that knowledge needs to be diffused throughout the organisation, and that learning is produced from experience and can only take place as part of an activity-focused attempt to problem solve. However, perhaps it is unrealistic to think that this can be achieved to 100 per cent in the current circumstances. As discussed in the literature, the best way to impart rich tacit knowledge is through the close master-apprentice relationship (Polanyi 1966), which can effectively be achieved through mentoring. The issue here, highlighted by the framework, is that there are no formal mentoring programmes available and that the expertise and skill-sets to provide this crucial mentoring are not available in enough numbers. Much of the implicit knowledge that can be used in effective training is not recorded or captured (see section 4.6.2 and 5.3.4). There is an over reliance on formal training and this is working to the detriment of effective learning at both organisations. Simply put formal training is not sufficient for complex knowledge work.

6.2.6 Ownership

An issue that came out of the Creganna case was a lack of ownership of knowledge in
certain areas or processes. Evidence then suggested an unwillingness to diffuse knowledge. Another issue was a difficulty knowing the owner of a problem. A need for knowledge owners exists at the company; for example, “fundamentally ... if it’s purchasing, you need someone who owns purchasing” (Respondent Thirteen, RAD 13). The sixth finding is:

**Research Finding 6: There is a lack of ownership of knowledge.**

Ghosh (2004) asserted that knowledge sharing is time consuming and has the potential to dilute personal power (Peng et al 2012). The analysis already has looked at cultural issues, and knowledge hoarding is viewed as compatible with the nature of many workplaces: individualistic, political and competitive (Abdullah 2009). As already discussed, this leads to time and energy inefficiencies without resulting in an output. At DePuy, management of projects in the Innovation Centre require certain expertise. Management leadership plays a key role in influencing the success of KM (Wong 2005). As DePuy has experts who show major expertise in one specific area, however on the other hand, to continue with more projects as the company expands, Creganna needs more subject-matter experts. When there is a lack of ownership due to cultural issues or a shortage of subject-matter experts, finding the knowledge owners can be difficult. If one cannot find the owner, one cannot be sure he or she is getting the right information or knowledge. The framework highlights that this has led to documented processes at Creganna being outdated because there is no expert responsible for updating a certain aspect within Knowledge Cards, for example. In addition, some of the processes are inaccurate and employees end up missing out. “We’re supposed to be doing stuff that we don’t actually do” (Respondent Seven, RAD 7). It is the knowledge owner’s responsibility to keep that information correct.

The advantage of having knowledge owners is that employees can go to somebody with questions or concerns, however, this was found to be lacking. Organisational culture is a very important factor for successful KM (Davenport et al 1998; Pan and Scarbrough 1998; Martensson 2000). It defines core beliefs, values, norms and social behaviour that govern the way individuals act and behave in an organisation. In general, a culture supportive of KM is one that highly values knowledge and encourages its creation, sharing and application. The biggest challenge for most KM
efforts lies in developing such a culture (Wong 2005). The best example of lack of ownership is data management. For example, when Respondent Eight came into the company, that particular area was devoid of a knowledge owner/expert. Data management was dispersed amongst everyone and no single person was responsible for it. Mahon believed it was not possible to run a company with an ERP system of Creganna’s size without having a core group of “absolute-skill people” who would own that knowledge. He was made the first designated knowledge-owner at Creganna. The company still does not have owners who can say “‘you need me in this and I’ll do my bit to help you’” (Respondent Thirteen, RAD 13). Across the company, there are fifteen to twenty areas in which UPK is the sole source of training. As discussed in section 5.2.5-sub-finding, this is leading to learning problems throughout the organisation.

Creganna needs knowledge owners. If Joe Bloggs is the owner of purchasing and understands how purchasing happens in Creganna, from a business point of view, he also has to be responsible for the data in the system and what goes out to the customer and the supplier. In addition, the owner also should be entirely responsible and encompass the training material and the capturing of the knowledge of people who perform within that area. Ownership would require somebody in each area with a broad overview. This would be a huge step in the right direction for Creganna and would begin to plug some of the knowledge gaps concerning this. Though there is a push to create owners, there is an attitude that “you’re not going to be able to just knight them with a sword on their shoulder and they’ll rise as an owner and a fountain of knowledge” (Respondent Thirteen, RAD 13). Indeed, it is much more difficult. Perhaps the culture at Creganna is the largest obstacle the company faces (Wong 2005).

6.2.7 Knowledge Retention
The framework has highlighted that DePuy has a difficulty in retaining knowledge due to attrition. The seventh finding is:

**Research Finding 7:** There are knowledge retention problems concerning the attrition of knowledge.
KM policies are particularly widespread in the high and medium-high tech industries, such as the pharmaceutical industry. In these industries, 40% to 45% of the firms have implemented policies to foster knowledge sharing, to retain employees or to establish partnerships to acquire knowledge, and about 25% have adopted a written knowledge management policy (OECD 2004: 4). “If you want your best executives to stay, equip them to leave” (Abdullah 2005: 119). The need to extract value and knowledge from mobile intangible assets (Teece 2000) is a vital part of KM and a vital area of concern for DePuy. Managers speak of the huge challenge to “retain the knowledge and skills” of those moving on through retirement or attrition (Spender & Scherer 2007: 6). As argued by Spender and Scherer (2007), the knowledge needed often is not sufficiently available for the firm to make necessary decisions. One of the biggest challenges for DePuy, however, is the loss of contractor knowledge. The exploitation of tacit knowledge is key to the Innovation Centre; however, contractors are simply walking out the door with this knowledge. Firms normally make strenuous efforts to retain this knowledge and impose restrictive clauses to employee contracts (Brinkley 2006), however, at DePuy the contracted workers have nothing stopping them. The ratio of contractors to permanent DePuy employees stands at about an 80 to 20 per cent contract ratio, which means the company cannot invest the same amount of time and dedication to the contractors because they are not DePuy employees. As the framework highlights, this causes DePuy to have a huge risk of knowledge attrition. An example of this attrition is the metal expert who left DePuy, before being replaced by Respondent Twenty One. He was a knowledge expert and an important subject-matter expert. He had gathered huge amounts of implicit and tacit knowledge and had not taught or imparted what he knew, thus leaving a large knowledge gap when he left. The tools-based approach (Abdullah 2009) or systems-based approach (Hansen et al 1999) to knowledge sharing essentially focuses on creating platforms and repositories for employees to transfer their knowledge that is their learning to enable easier sharing within the organisation (Swan et al 1999). As active learning by individuals enhances the capacity of individual staff (Arrow 1966), management also must establish practices to encourage the retention of this knowledge within the organisation by explicit practices of documenting, capturing and open sharing with associates; however, this is far from easy (Spender & Scherer 2007). Through these practices, knowledge has the potential of becoming organisationally shared and embedded. More importantly, the documenting also should focus on the efforts to
share the knowledge with others in the organisation (Abdullah 2009). Many of the contractors work in the Innovation Centre. The percentage of contractors in the Innovation Centre is quite high. The Innovation Centre is where DePuy creates new ideas for products, suggests innovative products and solutions to problems, which poses the question: What happens if the Innovation Centre is staffed with a transient workforce and more importantly why is this the case?

One would imagine that unless contingencies are in place, some developmental and conceptual knowledge walks out of the organisation with those contractors. When the contractors leave, their technical know-how goes with them. Capturing and documenting procedures are lacking in DePuy and the dependency on the informal network certainly does not foster a situation where this escaping knowledge can be captured. With the plethora of contractors comes a concern about trying to stem the tide – trying to contain and maintain tacit knowledge because it is leaving. However, when one collects implicit knowledge at the Innovation Centre, few read it afterward. The central issue of retaining knowledge gains its significance in KM, particularly for any knowledge intensive organisation (Wong 2005). In order to retain employees, it is important to provide opportunities for them to grow and advance their career. Policies and practices need to be designed to allow them to meet their personal aspirations (Brelade & Harman 2000). Equally important is to offer a working environment conducive to where employees feel comfortable to share and foster knowledge sharing among them (Wong 2005). The problem remains that there are sixty people in DePuy’s Innovation Centre, but only twenty of them are DePuy employees, the remainder are contractors. As the Innovation Centre only need a certain kind of chemist for a short period of time, for example, when that portion of the project is completed, the chemist (contractor) leaves and “that knowledge is gone” (Respondent Twenty Six, RAD 26). During the field work at DePuy, the Innovation Centre lost two contractors and then filled those roles twice. A third person started just as field work was finishing. This highlights the attrition and the likelihood of knowledge being lost in those situations. It is clear that the Innovation Centre has a difficulty retaining knowledge; a lot resides with people themselves. There is no way of capturing the more subtle tactic/implicit know-how that people have in terms of knowledge, so DePuy remains at high-risk of losing more key knowledge. The head of manufacturing explained “if John Lynch, who was my previous boss, had left in the
morning and I took over, there was stuff there I just wouldn’t have, I had no visibility” (Respondent Twenty Seven, RAD 27). It is clear there is huge exposure to loss of this undocumented knowledge. Most of the employees outside of the technical realm would not be able to understand the processes like the key people in DePuy, who are technically strong. However, those key people have the same training curriculum at DePuy as an average engineer. There is no differentiation, except for the knowledge that these experts hold tacitly in their heads, which is not necessarily documented anywhere. This knowledge is very much embedded (Nickols 2000). “A lot of it’s very much tacit, would be held locally within the individual” (Respondent Twenty Seven, RAD 27).

The framework highlights that if key employees were plucked from the site, most, if not all, of their tacit/implicit knowledge would be lost. Some explicit knowledge, however, would remain. Little is made of the need to provide training to employees when embarking on a KM journey, and even though “people management” plays a wider role and lies at the heart of KM, it has not been explicitly addressed as a critical factor for KM (Wong 2005). I.T. was seen as the main avenue to support all forms of KM, but has now been applied to informal types of transfer (Alavi & Leidner 2001). Within DePuy, providing training and preparation for their KM initiatives also is something that was not being done. Some initiatives to counter knowledge attrition are being spearheaded by project manager Respondent Twenty. In his group, individuals champion each area so, regardless of what happens to that particular initiative, it will be there in the long-term. If Respondent Twenty’s contract ends, “they’ll have a group of people who have built up competence and they’ll be maintaining it” (Respondent Twenty, RAD 20). This puts the responsibility on the manager to make sure the roles are back-filled and the company is not left exposed. Knowledge retention projects have yet to show convincing returns on investment. The codification-based KM changes that created bloated repositories of so-called knowledge have since been questioned.

6.2.8 Knowing Employees’ Skills
The second issue that became evident after the analysis of the DePuy case was the Innovation Centre was not aware of employee skills or of what they know. This was
unique to DePuy. This also is a concern between sites, such as between Cork and Warsaw. It was found that when Warsaw needed a resource on a project with particular expertise and that resource was in DePuy, that link was not made. The eighth and final finding is:

**Research Finding 8:** The organisation does not entirely know its employees' skills.

Within the centre itself, for example, one employee’s background was in chemistry; however, management was not aware of that. Management at DePuy do not actually know the full capabilities of their people. Similar to the lack of awareness around formal systems, there is very little awareness of who knows what and who has what skill sets. Kogut and Zander (1996, 1992) saw the firm as a social community whereas Miller et al (2011) sees it as a transient scenario. For example, a group of repair technicians possess a body of knowledge about repair that is held in common by the various technicians. However, each individual technician does not possess the entire body of knowledge (Cook & Brown 1999), or the knowledge of which repair technician knows what (Svieby 1997). Cook and Brown see knowing as being distinct from knowledge, and thus distinct from the tacit form of knowledge, whereas Sveiby (1997) contends that information about “who knows what” and “who knows how to do what” is vitally important. The head of the Innovation Centre was unaware of who possessed what skills. His knowledge about competencies within the centre was quite haphazard. “I thought you [Respondent Sixteen] were a chemistry person, but god, I didn’t realise you’d done that as well. Oh, you did that for your Ph.D.? We have like maybe ten or twelve Ph.D. folks. I would not be able to tell you exactly what each of the twelve done for their Ph.D.” (Respondent Twenty Two, RAD 22). This shows evidence of the consequences of the capture issues discussed in Chapter Four. Employees need to know who to go to, to acquire knowledge so that knowledge can be diffused; however, the problem is trying to find out where the expertise is.

The use of the framework highlights evidence that there is a lot of knowledge in DePuy that the organisation necessarily “wouldn’t have clear view at. ... Who’s the best person to talk to there?” (Respondent Thirty Two, RAD 32). Several employees admitted that the Innovation Centre could do things much better from a sharing
perspective, especially with regard to “realising what skills are in the organisation” (Respondent Sixteen, RAD 16). Neither management nor employees are aware of employee capabilities. Thus, they are unaware of their competency gaps. This seems to be due to a lack of visibility. Knowledge is not captured by the formal systems at DePuy. Knowledge is shared and acquired on the informal network, which has led to a lack of formal transparency that could help employees locate and acquire knowledge more effectively. Again, to combat these issues, DePuy needs to look at ways to encourage employees to look at the core competencies and key skill-sets of different teams. Within the Innovation Centre, it is not entirely known what is known, nor are the key skill-sets within the groups; it would be beneficial if this could be captured. It then becomes an issue of asking what the characterisation of competencies a project would need to deliver are, and then locating the team that would best deliver that based on the defined competencies. Davenport et al (1998) suggest building teams to support knowledge-related tasks that could help members become aware of what skills are present; however, clarification as to what is being managed within an organisational context is needed (Burton-Jones 2008).

6.3 CONCLUSION

This chapter presented the post-deployment KAF in Figure 6.1 and discussed the micro findings within the thesis. These include: Across groups, cross-functional sharing is siloed, which leads to a lack of knowledge sharing. Cultural issues, such as hoarding of knowledge, hinder KM initiatives. Employees new to the organisation find it difficult to locate knowledge because of the informal network dependence. Employees are dependent upon their informal network to create/acquire/share/re-use knowledge. The external network is secondary to the internal knowledge network. The implementation of several KM initiatives is hindered because employees do not have sufficient time resources. Lessons learned and knowledge re-use is not given attention when targets have to be met. Due to time issues and informal network dependence, there is a lack of formal systems use. A problematic learning cycle is being fostered because of a strategy that focuses on formal systems training. There is a lack of ownership of knowledge. There are knowledge retention problems concerning the attrition of knowledge. The organisation does not entirely know its employees’ skills. Chapter Seven will conclude the dissertation.
CHAPTER 7: CONCLUSION

This chapter concludes the dissertation. It will present some macro discussion, the thesis contributions; including theoretical, practical and research implications while also discussing the implementation of the KAF. Future studies will also be discussed. It will also discuss some of the actions taken by the case organisations, resulting from the insights gained from this dissertation. Furthermore, the process of the application of the framework will also be discussed. It is important to note, and will be alluded to again, that the KAF is not generic but unique to each situation it is applied.

7.1 MACRO DISCUSSION

By and large, the results provide a strong case for the use of the framework as an exploratory assessment tool at organisational level. As firms grow in size, their management becomes more complex and the need for efficient KM also increases (Minonne & Turner 2009; Moffett & McAdam 2006; OECD 2004). Without that capacity to manage, the ability to bring new products to the market and develop new processes for producing and delivering them is reduced, and any such reduction in opportunities to innovate has far-reaching economic and social implications, particularly since it is big firms that are responsible for mass production in the industrialised economies (OECD 2004).

Firstly, there are still huge challenges remaining with regard to the understanding of KM and managing knowledge at organisation level. There is an overwhelming sense that there is a divide in the managerial and worker perspectives. What managers expect with regard to knowledge creation, sharing, learning and re-use is quite different to that of workers’ experiences and expectations. There are divergent ideas between management’s visions for the organisation and workers’ visions. If the job of the coal-face engineers is to know “what is”, it is the job of senior management to know “what ought to be” (Nonaka 1991:103). Management see KM as an immediate fix to their problems. They see KM as their saviour without truly understanding their problems or the nature of knowledge. Employees in both organisations, on the other hand, were not aware to any great degree of what KM is or what it can be used to achieve. This also may be linked to the stages of rapid growth that have occurred in
each organisation over the last decade. Many of the issues discussed within the literature, such as the relabelling of terms (skills and embodied knowledge) (Alvesson & Karreman 2001), confusion as to the nature of knowledge (implicit and tacit) (Spender & Scherer 2007), an overbearing focus on knowledge codification strategies (UPK and Agile), and relationships between individual and collective knowledge (Burton-Jones 2008), all are present within the case studies and were discussed earlier. Burton-Jones (2008) calls for (1) A managerially relevant theory of the firm that explains the firm’s role in the knowledge-based economy, (2) clarification as to what KM means in the organisational context, and (3) a conceptual framework that brings together divergent approaches to manage knowledge.

The mistakes that can be avoided still are being made within Creganna and DePuy, which leads to the conclusion that there is a substantial disconnect with what is being read by practitioners and the leading academic research, if in fact practitioners pay attention to the academic literature. The researcher somewhat agrees with Wilson (2002) in that, his study suggests KM research is driven by consultancy companies and not academic research. The relationship between what is being touted in the current literature is not what was observed on the ground. Organisational challenges created by the dissemination of information technologies and the need for new methods for evaluating intangible assets make it essential for companies to introduce explicit knowledge management methods (Moffett & Humphreys 2012; OECD 2004). The division between those interested in the technology aspects and those emphasising the people side of KM, which now is an accepted pillar of KM (Spender & Scherer 2007; Choi & Lee 2000; Hansen et al 1999), was not observed at the case organisations. A systems approach, or a KMS solution to a management problem, was the common solution offered to most problems by senior management. Practitioners have been advised (Alvesson & Karreman 2001) that IM and KMS be used as instruments of facilitation; however, the opposite was encountered during research. IM and KMS were being used as the only clear-cut solution and were expected to solve any problems that arose with creating, acquiring, sharing and re-using knowledge.

The knowledge activities explored in the case studies and presented in the KAF in Figure 6.1 raised several issues within each activity (see section 6.2). These also are
apparently interrelated, due in no small part to the inter-related nature of the knowledge lifecycle (Peng et al 2012; Choi et al 2008; Nonaka 2007; Choi & Lee 2003; Brown & Duguid 2001; Szulanski 1996; Nonaka & Takeuchi 1995; Brown & Duguid 1991). As well as lending some weight to the importance of future studies (which will be discussed in section 7.4), many of the problems that are discussed in this chapter are linked; however, it was not the focus of the research question to explain those links. That could be further achieved through an explanatory study. Nevertheless, it was found that an industry requirement forced both Creganna and DePuy to document and capture knowledge. This was done using the various systems described and was done quite poorly as already evidenced. Lack of documenting and inaccuracies with content was widespread throughout both case studies. The Extended Library approach (Lloria 2008; Alvesson & Karreman 2001) extensively uses available technology to make knowledge accessible via a technological platform. One of the main findings of the research is that, many of the respondents rely on their informal network to acquire, share and maintain their knowledge. As the discussion made clear, the overuse of the informal network was explicitly observed.

By using the framework an assessment tool, further observation also highlights that, in both cases, the primary knowledge network was the internal informal network. Within the literature, to maximise one’s knowledge network one must be aware of the opportunities to share knowledge; the parties involved must think the sharing of knowledge to be worthwhile and must be motivated to pursue the sharing of knowledge (Von Krogh 2001). There is a need to formalise the informal network to a point where the knowledge is more accessible to the organisation. It is vital that personal knowledge and tacit insights are made available to others in the organisation (Nonaka 1991). An example is that of Respondent Twenty One, the metallurgist at DePuy. It is vital that DePuy do not make the same mistakes they made concerning the predecessor, in which knowledge was lost after he left the company because he siloed his knowledge (see section 6.2.7). There was a whole host of implicit and potential tacit insight lost because there was no means available to empower this man to convert his implicit knowledge into a shareable form. It is also possible the culture of the organisation (see section 6.2.2) fostered his siloing behaviour. The key in converting knowledge that is created in the informal knowledge network is to create a means that will internalise it to the organisation (Nonaka 2007). It is suggested by the
literature that one of the more effective ways to internalise knowledge of this nature is to first socialise the knowledge (Nonaka 2007). This already occurs in the informal network. Once the knowledge has been socialised, it must be articulated into an explicit form and be combined and standardised into the work of the employees. The case organisations have already tried formal systems approaches to internalise their knowledge. This, as the research shows, has failed to a large degree. They now need a more holistic view about KM initiatives.

Locating local knowledge also was shown to be problematic for new employees. Pujol and Sangüesa (2002) recognise the importance of locating knowledge. Knowledge originates and is used within a community of people with a common set of goals inside the organisation. However, there was very little available regarding a helpful social knowledge domain as Von Krogh et al (2001) describes. The work groups within both organisations exist in such a way that knowledge is quite siloed within those groups. It is local to those groups. However, one might expect that if you are within these groups, this local knowledge is being shared. Interestingly, this is not the case. This may be because there are limited means with which to share knowledge or employees do not have the time. Nonaka (2007) offers that socialisation is one such way this sharing can occur; however, this was not observed within the work groups. Though there is an abundance of explicit knowledge created from various KMS, this combination of explicit to explicit knowledge does not, in any real way, extend the company’s existing knowledge base (Nonaka 2007). There are definite opportunities here. Another reason which might explain why local knowledge is not being shared is that certain personality types thrive in different situations. There is a whole body of literature on Adapter/Innovator that suggests that the successfulness of processes, such as sharing knowledge, depends on the type of personality characteristics an individual has. Enabling project information to be available on a single integrated database, rather than the fractured situation at DePuy, may prevent discrimination in access to knowledge.

In both cases, but more so at DePuy, formal opportunities to share knowledge were not known (for example, Link). The knowledge experts, as previously discussed, are in positions where they hold much of the subject knowledge and functional knowledge. They often were not willing to share knowledge or did not see sharing as
being worthwhile, and while both cases appeared to be open organisations, there are no active incentives that motivate people to share, structurally or informally. Hoarding occurred in the organisations, which is natural in this situation (Miller et al 2011; Alvesson & Karreman 2001). The external network was found to be secondary, and though in some cases could be deferred to; the internal knowledge network primarily was used to acquire knowledge. The results from the study also provide evidence that much of the learning within both cases was achieved through formal training. Arrow (1962) posits that learning is produced from experience and a focused attempt to problem solve. Senior management from both organisations state that implicit and tacit knowledge is vitally important. This is the knowledge that they most desire to acquire; however, their approach to harvesting this knowledge has lead to (1) inefficiencies in training, (2) common distrust of formal systems, (3) loss of knowledge due to attrition, and (4) lack of mentoring programmes. These issues were outlined in Chapter Four.

The confusion and misunderstandings around KM that have led to problems in training may be rooted in Creganna’s and DePuy’s assumption that certain knowledge can be disembodied and managed separately to the knower (Burton-Jones 2008). This runs contrary to the Polanyian (1966) view that knowledge is embodied in humans and dependent on unconscious processes (Burton-Jones 2008). Evidence from the cases also leads to the conclusion that knowledge re-use and lessons learned within both cases are ad-hoc and poorly performed. In very few instances was the knowledge gained on projects re-used and incorporated back into the knowledge lifecycle. Graham and Thomas (2007) identified a number of reasons for implementing the re-use of lessons learned: (1) high staff turnover leading to loss of experience, (2) large size of organisations make sharing knowledge difficult, and (3) preventing departmental silos and fragmentation within the organisation. It was shown in the research findings that cross-functional sharing was quite poor. This is exacerbated by the fact that knowledge re-use often depends on whether the project manager organises a lessons learned activity. If he or she does not, it will not happen. Unless the manager was heavily engaged and took it upon him or herself, this was absent.

In addition, the contribution made by highlighting distinctive cultural aspects, especially time limitations in large organisations, also is significant. As previous
discussions on KM, Growth Theory or OECD reports had not attributed this as linked with the implementation of KM initiatives (Wong 2005). Some of the examples include Knowledge Cards, UPK, Talent Navigator and Link. “It’s just that you need to have someone who has the time to do it properly (Respondent Seventeen, RAD 17).

Within each organisation, it also was observed that there is a limited pool of experts. These organisations have grown exponentially since their inception. To sustain this growth, especially for Creganna, the companies hired outside expertise to try and keep up with the growing need in training. However, there still is a huge shortage of subject matter and functional experts. This has led to knowledge gaps across the organisation. More worryingly, these knowledge experts act as key people in these situations. Other workers depend on them for a whole host of knowledge enquiries. The experts become knowledge champions. Unfortunately, the nature of this situation has lead to these experts realising their increased prestige and the value of the tacitly held knowledge. Translating these secrets is very important to the organisations (Nonaka 2007). Nonaka argues against one expert or group of experts having exclusive responsibility for knowledge. However, the fear of losing one’s indispensability because of sharing knowledge may stunt the dispersion of the embodied knowledge (Nickols 2000). This also has lead to the situation where, to accommodate the increasing need for knowledge experts, the UPK and Agile endeavours, each organisation tries to record expert knowledge and make these recordings the formal training for workers. Due to knowledge ownership issues, there unfortunately is a problem with assumption. The assumption here is that often the expert is an expert. In reality the “expert” being used to capture knowledge processes is neither a functional or subject matter expert and has been “dubbed” an expert by means of seniority. In Creganna, this has led to inaccurate content being recorded as the future training material for its employees.

Another interesting finding concerns the act of knowing. It was observed that the act of knowing happened more often when important, urgent problems occurred. This know-how was more prominent when workers were dealing with problems in which they were engaged — the involvement of the self (Nonaka 2007, 1991). Where workers were not engaged in problem-solving, knowledge creation/sharing/learning and re-use almost were stagnant. This may be of interest to organisations that seek to
capture and document their knowledge, but more importantly, where active knowledge and know-how would be most effectively observed.

With regard to Growth Theory, Brinkman and Brinkman (2001) suggest that a failure to allow for cultural and social variables within Growth Theory has lead to a lack of a holistic view with regard to knowledge in the field. The researcher has tried to incorporate cultural issues from within the KM domain to offer a more complete perspective. Aghion and Howitt (1998: 435) note that “we do not have any generally accepted empirical measures of such key theoretical concepts as the stock of technological knowledge, human capital, the rate of obsolescence of old knowledge”, and so forth. They make it perfectly clear that the problem is not a purely empirical or data problem: “It would be more accurate to say that formal theory is ahead of conceptual clarity”. The real question is one of meaning, not measurement. Only when theory produces clear conceptual categories will it be possible to measure them accurately (Steedman 2001; Aghion and Howitt 1998). As previously stated, using KM and EGT is a new endeavour for the two literatures and few have looked directly at the basic implications of models that distinguish firm-level knowledge (Laincz & Peretto 2004). The combination of both in attempt to explore the indicators of knowledge at firm-level is worthwhile, especially in future studies.

One of the interesting findings that may be of interest to organisations considering or in the process of implementing KM is the organisation’s stage of growth. Many organisations see this as a “machine for information processing” (Nonaka 2007, 1991: 96). The problem with this view is that the only useful knowledge is formal, hard, codified data, such as lower costs, added-value and return on investment. It is clear that Creganna is further along the KM journey than DePuy. The level of KM at Creganna is where DePuy desires to be. However, without truly understanding the pitfalls they will encounter, they will continue to make the same mistakes that Creganna have made. Some of the mistakes both organisations have made also are dubbed the “deadly sins of KM” by Fahey and Prusak (1998). Both cases have exhibited catastrophic failures in some of the basic tenets of KM. Neither organisation has a developed working definition for knowledge. They do not have awareness about what knowledge is or what KM is. They both espouse the view that knowledge exists predominantly outside the heads of individuals and as such have garnered initiatives.
that nurture this view. Both organisations focus too much on emphasising knowledge databases and compiling information to the detriment of knowledge flow. This also may be due to the industry need to capture and document. As a siloed environment exists, they have not understood that the fundamental, intermediate purpose of managing knowledge is to create shared context. Though they are aware of tacit knowledge, there is confusion between implicit and tacit knowledge and the accessibility of each. From the training debacles with UPK and Compliance Wire and the general lean toward formal systems training, thinking and reasoning are downplayed. This in no way lends to the continued progress of being knowledge-creating companies, which they hope to be. Prusak and Fahey (1998) also posit organisations must focus on the future. Creganna and DePuy are so caught up in current customer expectations they often fail to see the long-term benefits of KM. Unfortunately, KM cannot perform miracles overnight. The deadliest of the “KM sins” observed at the case organisations is that they seek to substitute human contact for technological interface. It is clear that people want a direct connection with a person to brainstorm or solve problems. After the field work, the researcher presented the finding to DePuy and Creganna.

The research shows, in seeking to develop direct measures of knowledge, that an internal measure for organisations might be interesting. But the most important measurement is the impact of KM on the organisation. Why does an organisation need knowledge management? What will be better with KM? What problems go away? What capabilities arise? In 2010, Moffett and Hinds (2010) called for more definitive and comprehensive studies that recognise the importance of strategy and vision in this field while in 2008, Burton-Jones (2008: 9) called for “a conceptual framework for integrating currently divergent approaches to managing knowledge and its representations”. Based upon the literature studied, the analysis and findings discussed previously and an illustration of the Knowledge Assessment Framework is presented in Figure 6.1, while the application of the framework is presented in Figure 7.1. Following the discussion of the results, the author is confident that key findings of this dissertation have been highlighted. Through the exploratory nature of the case studies and the qualitative methods employed, a better understanding of the research phenomenon, about which little is known, is achieved (Strauss & Corbin 1990).
7.2 CONTRIBUTION
This thesis investigated how a Knowledge Assessment Framework can be used and operationalised to explore knowledge indicators at organisational level and offers the research outcomes from this. This resulted in a working framework for consideration. This research was carried out within two case studies, Creganna of Galway and DePuy of Cork, both of which are medical device companies in Ireland. The findings provide evidence that the application of the framework has offered useful insights and assessment into both organisations, and offered several areas that are worthy of attention. Based on the data collected and the analysis presented, a Knowledge Assessment Framework has been operationalised and presented in Figure 6.1. This framework focuses on the knowledge indicators derived from the literature: acquisition, networks/sharing, learning and outputs. Findings also suggest external knowledge acts within the firms; however, is not as important as the firm’s internal knowledge. The research contributes positively to theory, methods and practice. These will be discussed in greater detail in subsequent sections. The central contribution of this research is that it offers a novel way to explore knowledge indicators at organisational level. Engaging in knowledge assessment can be seen as beneficial because it offers firms greater opportunities to understand their knowledge indicators, but also provides a way to highlight some of the knowledge gaps within the firm. The research contributions are summarised in Table 7.1 below.

Table 7.1: Thesis Contributions

<table>
<thead>
<tr>
<th>Contribution</th>
<th>Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. Conceptualising a KAF</td>
<td>Theoretical</td>
<td>The organisation of the existing literature into a framework with the view to operationalise the framework with various knowledge activities</td>
</tr>
<tr>
<td>2. Updating KM literature</td>
<td>Theoretical</td>
<td>Based upon observations and evidence generated from two exploratory case studies, a set of findings are developed, which explore the activities of knowledge</td>
</tr>
<tr>
<td>3. Combined KM and EGT, a new departure for both literatures</td>
<td>Theoretical</td>
<td>Within EGT, cultural aspects are not included within models for knowledge. In this research, cultural issues are included within the framework</td>
</tr>
<tr>
<td>4. Case-study approach</td>
<td>Methodological</td>
<td>As identified, a call for exploratory case studies to answer the need to understand the indicators of knowledge at firm-level</td>
</tr>
<tr>
<td>5. Research probes used</td>
<td>Methodological</td>
<td>Provides a set of probes used in conjunction with the framework; useful for future studies that aim to build upon this research</td>
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</table>
6. Identifying key knowledge activities  

<table>
<thead>
<tr>
<th>Theoretical/practical</th>
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<tr>
<td>From the case studies, knowledge activities are identified. This research then points to some of the issues that were highlighted during the study that aid in the organisation gap analysis</td>
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7. Operationalised Framework  

<table>
<thead>
<tr>
<th>Practical</th>
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<tbody>
<tr>
<td>A framework that has been tested and operationalised at firm-level and can be carried forward for future research and knowledge gap analysis in other knowledge firms/industries</td>
</tr>
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</table>

8. Framework gap analysis  

<table>
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<tr>
<th>Practical</th>
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</thead>
<tbody>
<tr>
<td>A gap-analysis was provided to each case organisation using the findings derived from the exploratory nature of the framework</td>
</tr>
</tbody>
</table>

7.2.1 Theoretical Implications

There is an increased interest by organisations in the role of “institutional frameworks...promoting...and improving organisational innovation and management quality” (Brinkley 2006: 4). To date, little empirical information has been made available on the indicators of knowledge within knowledge-intensive organisations (OECD 2009), and a call has been made for more understanding of these interplays and linkages (OECD 2005). The qualitative nature of these, as highlighted by the exploratory nature of the framework, is the subject of the two case studies presented in this thesis. An increased use of both interpretive and critical field studies is required to make KM research more relevant and more sensitive to values. Only field studies provide unlimited access to accounts of personal experience (Zinning & Sheffield 2006). As outlined, quantitative methods are not always applicable to all research questions (Karami et al 2006). Qualitative research provides valuable insights and understanding of the problem setting (Zinning & Sheffield 2006; Karami et al 2006), and this research has presented “consistent definitions, discourses and concepts” that is needed in KM research (Zinning & Sheffield 2006: 1). To date, KM predominantly has focused on a pragmatic interest in managing organisational knowledge and the importance of knowledge internal to the organisation, as evident from some of the definitions existent in the literature. KM has been defined as the process of identifying/creating, capturing and applying organisational knowledge to exploit new opportunities and enhance organisational performance (Bassi 1997); however, no frameworks are identified within the KM literature that deal exclusively with internal knowledge assessment at organisational level. This research lends itself to providing a practice-based framework that operationalises several conceptual knowledge activities and highlights key internal knowledge gaps for discussion in the organisations that took part in the study.
The literature first informs the theoretical framework and, secondly, the theoretical contributions are informed by the analysis and from employing the framework within the case studies. The dissertation has theoretical implications for the KM perspective. First, this study contributes to the understanding of knowledge indicators by defining the indicators within the context of the case organisations. Within the OECD reports and KM literature itself, it is contended that organisations do not have ways of determining their knowledge base (OECD 2006; Laincz & Peretto 2004; Lev & Daum 2003). The consensus on the existence of knowledge is unfounded (Alavi & Leidner 2001). Growth theory provides for the existence of internal organisational knowledge. Some insights are criticised in the literature (Pack 1994) for being too macro in nature, and calls have been made for a framework that explores knowledge assessment at organisational level. The lack of consensus in KM (Hakanson 2003) has contributed to a lack of exploratory research in the area of knowledge assessment. Wilson (2002) also argues that the field of KM is driven by consultancy companies and calls for academic approaches to be offered. The framework developed in this thesis offers a novel way of looking at knowledge at organisational level. First it looks at how knowledge is acquired (through people), where it is acquired (the internal knowledge network). It looks at how knowledge is shared in the organisation (through the informal dealings with people at the expense of formalised approaches). It highlights that the organisations take a very formal approach to learning and that this learning is stunted for the reasons discussed. It looks at the knowledge outputs of the organisation and shows that knowledge re-use is lacking in both organisation. Combined it offers the organisation a way of highlighting these issues.

Wittgenstein (1953) argues that the creation of knowledge is innately a social process among individuals. For the most part this is true, however for the case organisations knowledge creation is achieved through the acquisition of people and a select group of experts. Furthermore knowledge was not documented. Where it was documented, it was documented poorly which lead to the use of inaccurate knowledge. Winter and Szulanski (2000) stress that new ways of developing knowledge re-use such as capturing and documenting procedures are important; however this was a real problem at organisational level. There is a vagueness in the field of KM about the nature of tacit, implicit and tacit knowledge (Alvesson and Karreman 2001). Indeed, at organisational level there is a severe lack of understanding between these forms of
knowledge. This coupled with knowledge ownership issues leads to employees being unable to find who knows what and a heavy dependence on the informal knowledge network.

The sharing of knowledge is one of the main pillars discussed in KM. The propensity and ability to maximise knowledge sharing also is very important to managers on the ground, which was clear in both case studies. Cook and Brown (1999) discuss knowledge and knowing between the individual and the group. At organisational level it seems because of certain barriers, some due to cross-functional sharing issues across groups, sharing knowledge on the individual level and in a group level scenario is not successful. These sharing issues can be caused by several factors. Within the literature, what is not linked as a critical success factor for KM initiatives to succeed is the importance of the resource of time. Wong (2005) suggests this is a critical factor that needs to be realised. The lack of time as a resource to many of the respondents in this study was clear. The use of I.T. tools (codification) versus social means to capture knowledge has been discussed in the literature (Swan 2001), however, the study highlights that knowledge capture in these organisations is happening through codification means only. The research has established that employees are not using the formal systems available and are not sharing that formalised knowledge. Swan (1999) talks about a clear focus on people rather than technology; because if the structure of the network is in place, knowledge sharing will happen. The research found that at Creganna and DePuy there was a clear focus on technology, the structures were in place, however, sharing was not as successful it might be. Successful knowledge sharing may be achieved by; 1) an increased awareness of opportunities to share, 2) making sure that it is worthwhile to parties involved and 3) making sure that parties are motivated to share (Von Krogh 2001). The study highlights that at organisational level there is; 1) a lack of awareness of opportunities; 2) sharing is only worthwhile if successful 3) hoarding is widespread and 4) Parties cannot share because of insufficient time constraints.

Research in the area of KM tends to focus on knowledge workers (Drucker 1959), knowledge organisations (Sveiby & Risling 1986), and knowledge creation and sharing (Nonaka 2007, 1998, 1995, 1991). Within organisations, an attempt to manage knowledge, through personalisation and codification strategies has been the norm.
throughout the literature (Alvi & Leidner 2001; Hansen et al 1999). In addition, the literature tends to focus discussions on two dimensions of knowledge: the tacit-explicit dimension and the individual collective or group dimension (Cook & Brown 1999; Spender 1996a). Though Simon’s (1991: 125) statement that “all learning takes place inside individual human heads” focuses on individually held knowledge, a more recent volume of research has focused on a more sociological approach to knowledge and has grown considerably.

Concerning the OECD, this study provides knowledge activities that have been explored at organisational level. The OECD (2009) calls for more open perspectives on KM. The study found that the organisations are open to embracing KM, however, there is a very rudimentary understanding of knowledge and KM practices at firm-level. In order for strategy development, organisations must understand the indicators of knowledge better. Interactions and linkages of knowledge flows between actors must be explored (OECD 2005). The framework has highlighted that informal knowledge flow between actors within Creganna and DePuy is hugely dependent on informal networks for diffusion of knowledge and personal attainment of knowledge. This approach sees knowledge as socially constructed and embedded in the social relationships between individuals (Kogut & Zander 1992) and as distributed across groups or collectives of individuals who develop and possess social relationships. The framework highlights with regard to the dependence on the informal network within both cases, and it confirms there is a considerable amount of organisationally held knowledge embedded within the informal network. The research also has offered that there is a need to try and tap into this opportunity.

Hakanson (2003) and Mattsson (2003) question the use of the concept tacit knowledge and see its general acceptance as a testament to the term “vagueness”. Researchers have a “lack of a clear understanding of its meaning” (Hakanson 2003: 8). The research shows this also is very true of practitioners. This research also offers instances of knowledge capture in both cases. From the descriptions of tacit knowledge as the kind that is “all in people’s brains, really” (Respondent Twelve, RAD 12), and other descriptions that suggest tacit knowledge often is confused on the ground, some clear distinctions between the tacit knowledge that is embedded and the implicit knowledge that can be captured and diffused are needed at organisational
level. Tacit knowledge is pursued in the same way as explicit knowledge, when indeed different approaches are needed when dealing with the dimensions of knowledge as the Polyanian view suggests.

Growth Theory has presented several models of growth (Arrow 1962; Romer 1986, 1990; Lucas 1988; Stokey 1988; Aghion & Howitt 1992; Young 1993; Jones 1995. However, within these models, there is a lack of social and cultural aspects included (Brinkman & Brinkman 2001), where at the organisational level cultural factors seem to offer more of an impact than suggested within the growth theory literature. Factoring in this criticism, within EGT literature, the framework encompasses and encountered cultural issues within the research. Cultural issues, such as hoarding knowledge and time resource issues, were presented as some of the knowledge gaps at both cases. “A depressingly significant proportion of the EGT literature just ploughs ahead into the ‘analysis’ of un-thought-out assumptions, offering for example...variables one of which – the stock of knowledge – has not been shown to be, and may well not be, cardinally measurable. Such a cavalier approach does the profession little credit, for conceptual confusions cannot yield convincing conclusions” (Steedman 2001: 10). Young (1993) argues that there must be incentives to engage in knowledge creation and a level of invention present for learning to exist.

The EGT literature posits that successful learning is produced from experience (focused attempt to problem solve) (Arrow 1962). The lack of learning success from formal training at the case organisation shows that this may be even more important for organisations to realise. Learning is achieved to a degree, however, only to the point that fills the immediate need. The ineffective nature of re-use of procedures within the formal systems (UPK etc) seems to be leading to a progressive decline. At the case organisations there were no incentives offered to increase individual knowledge gaps. Formal training courses are being attended when gaps in knowledge arise or when the situation dictates rather that by pro-active pursuit. These issues also were included in the final iteration of the framework. The framework has used criticisms and lessons from the available literature to add to its own development and provide a more rigorous, robust analytical tool.
7.2.2 Research Implications

The research has many implications. Empirically, however, the aim of this research has always been to explore and create more questions than answers by establishing a gap in relation to knowledge assessment, exploring it, and developing a working framework that may form the building blocks of future research in the area. Seeing the field of KM as one driven by consultancy companies and not academic research (Wilson 2002), this research answers calls for academic solutions to practitioner problems. New frameworks are called for that include divergent literatures to answer the KM problems on the ground (Burton-Jones 2008). Strauss and Corbin (1990) argue that qualitative methods are best suited in situations where the understanding the phenomenon is relatively unknown. In addition, the adoption of interpretivist methods in the research is a novel approach within organisational knowledge assessment, which is an under-evaluated area. However, case studies in this area tend to be positivist in nature (Yin 2009; Creswell 2007; Eisenhardt 1989). The use of an interpretivist approach in this dissertation extends knowledge on knowledge assessment in several ways. First, the use of interpretivist methodological tools is seen as the most appropriate method of exploring an area within which prior research is limited (Kotler et al 2006). Knowledge assessment at organisational level is one such area. Thus, the research responds to calls for a more case-based study to explore and extend the understanding of knowledge assessment at organisational level (Lev & Daum 2003) and to broaden the field of KM and Growth Theory by providing novel insights regarding the nature of the knowledge assessment itself.

For this purpose, the advantages of qualitative tools for a study aimed at the initial exploration of a topic are somewhat paramount; for example, qualitative tools and data analysis allow for novel data to emerge from the research setting and do not confine the research outcomes to theoretically pre-defined categories (Patton 1990). Secondly, the study of the case studies as a method for carrying out knowledge assessment research provides probes that can be carried forward or improved upon in future research. Jakob Edler (2003) used a structured set of questions for his study on the Measurement of KM Practices in the German Business Sector. This research also calls for the building of good indicators, which should be central to any investigation. However, these require “fine and detailed case studies”, which this study aims to provide. This research provides probes and questions used in the application of the
framework within the cases. In this study, qualitative methods also facilitate the investigation of knowledge assessment within the medical device sector in Ireland. Again, exploring with the use of the framework within this arena opens up knowledge assessment to other industries.

The findings presented in the analysis of the cases also serve to extend knowledge assessment empirics. Essentially, the findings identified in this research can be further defined and understood through explanatory research into possible testable hypothesis on knowledge assessment. Guba and Lincoln (1994) state that a good hypothesis contains both explanatory potential and predicative adequacy. The findings in this research allow knowledge assessment empirics to move toward hypotheses of this nature. Finally, the empirical setting of the research also is important from an Irish perspective, especially in the current economic climate where the only certainty is uncertainty (Nonaka 1991). No studies could be found that investigate knowledge assessment in an Irish context, although the inability of organisations in general to understand this area is cited as an area of national concern (OECD 2007a; Laincz & Peretto 2004; Lev & Daum 2003) and an area in which progress is needed in order to improve competitiveness (Kanda 2008).

7.2.3 Practical Implications
One of the primary implications of the results from the research is for the field of KM. This research shows that implementing generic KM strategies with systems across an organisation, especially in the realm of capturing knowledge, may not prove successful. The findings indicate that organisations concerned with KM may need to rethink their knowledge management strategies. One of the main strengths associated with theory building from case study research is that the resultant theory likely is to be empirically valid (Eisenhardt 1989). This aids its applicability in real-world situations. This section will highlight the implications for management practice arising from this research. A working Knowledge Assessment Framework and a greater understanding of the associated knowledge indicators at organisational level have several managerial implications. Managers who are involved with KM and who assign resources to initiatives regarding KM within organisations can benefit from understanding the importance of being able to assess knowledge gaps within their
organisations. Being able to identify that time resources are contributing to the lack of use of a system or that knowledge hoarding is happening within certain groups are important issues to highlight and counteract. Results from the study indicate that some of the issues generated by the application of the framework occur in both of the case studies. From a managerial standpoint, these issues need to be recognised as major barriers to any KM initiatives that are pursued. Many employees do not have the time resources to be fully involved in initiatives. This is shown at both case studies. In addition, when introducing KMSs, managers must be wholly aware that employees rely heavily on their informal network, which can lead to a lack of use of formalised systems, as well as a lack of awareness of those systems and initiatives.

The managerial implications outlined above assume that the firm seeks to increase awareness around KM and looks at knowledge assessment as a path to highlighting knowledge gaps. In addition, there have been other practical outputs from the thesis. For Creganna, a preliminary knowledge gap analysis was provided and coordinated with Respondent Fifteen at Creganna after the initial phase of analysis as part of Creganna’s KM Policy Document. The purpose of this document was to give an overview of the issues and areas worth highlighting under the criteria set out by the framework. This culminated in an eight- to ten-page document that was accepted by Creganna’s Human Resources department and was added to the KM Policy document. Material from the gap analysis itself was incorporated into the discussion earlier in the chapter. A similar knowledge gap analysis document was produced and presented to DePuy’s KM champion, Respondent Twenty Six. Similar recommendations and issues were raised that were summarised earlier in the chapter and the document itself is incorporated into the analysis. The advantage of carrying out the research in Creganna led to a more comprehensive gap analysis for DePuy. This also was implemented in DePuy’s KM awareness initiative. In addition, the findings and recommendations from the research at DePuy were of special interest to the company. The researcher was invited back to DePuy to give a lecture (in the DePuy lecture series) for the purpose of increasing awareness of KM and present the findings of the research. This was successful and the lecture was implemented in DePuy’s training curriculum.

In addition, from the point of view of adding practical value to the research, the researcher was allowed to go back to the case organisations to conduct a post-case
survey to objectively look at KM awareness. From working closely with Respondent Fifteen and Respondent Twenty Six, the organisation now uses ten questions regarding KM awareness. These provide some rudimentary statistics for Creganna and DePuy, but also some valuable comments from the respondents. It shows to some degree where the organisations’ workers are with regard to their understanding of KM and general awareness about the phenomenon after the research was conducted. This was done in response to a request by the companies to add further value for them.

7.2.4 Usefulness of the Framework
This section is broken down into four parts. The first part will highlight the usefulness of the framework as an assessment tool. This is already heavily substantiated by the findings generated as a result of the framework deployment in section 6.2. The second part will present the research probes generated following the deployment of the KAF and how these may be useful in future research. The third part will discuss how organisations can deploy the framework. Finally, the fourth part will discuss the implemented actions as a result of the findings generated from the deployment of the framework in this dissertation.

The usefulness of the framework can be summarised into several key points. The framework offers the organisation an initial lens through which it may examine its knowledge activities by focusing on some key indicators. From these key indicators (knowledge acquisition, sharing, learning and re-use) critical knowledge activities have been identified and presented in Figure 6.1. It is important to note, as stated already, the activities and findings generated in this dissertation are unique. The findings are unlikely to be generic for other organisations because of the nature of knowledge itself.

The organisation then can locate areas where gaps are present and can counter these gaps accordingly. The key insights for the organisations are presented in section 6.2.

The framework offers key knowledge indicators, such as acquisition, networks, learning and outputs, and then explores certain knowledge activities for each indicator. Some key knowledge activities offered by the framework are locating
knowledge, documenting, internal informal network, training, mentoring, and lessons learned. Ordering workers on certain paths does not foster the high degree of personal commitment on which effective KM initiatives are built. This framework enables management to provide workers with a conceptual tool that will help them make sense of their own experience. Once communicated properly from top management to the coal-face engineers, the results of this study will provide workers the freedom and autonomy to complete goals and will aid in the implementation of KM initiatives. This is important because, though the visions of top management are important, they will not be enough on their own. The best way forward for management is to clear obstacles and prepare the groundwork for KM initiatives to take hold. The framework will be a useful diagnostic tool in this regard. Finally, the framework has been presented to and accepted by the case organisations as a useful tool. It offers a set of probes that accompany the framework (see Table 7.2). These provide, in the form of guiding questions, a method with which to guide future qualitative studies or organisations that wish to employ the framework.

7.2.4.1 Research Probes Generated Post-Framework Deployment

This section presents the research probes that accompany the framework. To find the original probes used in the pilot study and the initial case research; refer to Appendix B, D and E. In Table 7.2 the post-framework deployment probes are presented. These were generated after the analysis of the case data. In conjunction with return visits to both case organisations, follow up discussions, and presentations, these were collaborated on by the researcher and the organisations while being informed by the original literature. In conjunction with the framework itself, these probes provide a useful set of questions for inquiry at organisational level. These probes adhere to growth theory’s definition of a true knowledge organisation (Skyrme 2004) which is one that has the capacity to take advantage of knowledge. This depends on of course, how quickly it can become a learning organisation. These probes are characterised by the very knowledge they seek to explore: they are less about passing on information and focus more on how people create/share/acquire and reuse knowledge. They focus on the continuous dynamic ever-changing nature of knowledge. They focus on the potential knowledge capacity within the organisation and the personal experiences of the employees. The success of using these probes in conjunction with the framework
depends on the discovery, dissemination and understanding of the knowledge explored.

Table 7.2: Framework Probes Post-Deployment

<table>
<thead>
<tr>
<th>Framework Probes</th>
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<tbody>
<tr>
<td>1. Describe what you do prior to a project, to create/acquire/share/re-use knowledge.</td>
</tr>
<tr>
<td>2. How are these actions carried out with regard to: a. system b. person c. process</td>
</tr>
<tr>
<td>3. What do you do to keep your knowledge up to date?</td>
</tr>
<tr>
<td>4. How is knowledge creation encouraged/fostered? a. Issues/problems?</td>
</tr>
<tr>
<td>5. Describe what you do during a project to create/acquire/share/re-use knowledge.</td>
</tr>
<tr>
<td>6. How is knowledge sharing encouraged/fostered? a. Issues/Problems?</td>
</tr>
<tr>
<td>7. Describe what it is like when trying to locate the person with the relevant knowledge surrounding a problem.</td>
</tr>
<tr>
<td>8. Describe what it is like when somebody comes to you with a knowledge problem.</td>
</tr>
<tr>
<td>9. Describe the use of your formal network within the organisation. a. Importance/frequency/issues?</td>
</tr>
<tr>
<td>10. Describe the use of your informal network within the organisation. a. Importance/frequency/issues?</td>
</tr>
<tr>
<td>11. Do you need to go outside the organisation (external network) to solve problems?</td>
</tr>
<tr>
<td>12. After the completion of a project, how is knowledge creation/acquisition/sharing/re-use fostered? a. Lessons Learned/knowledge outputs/affect existing processes?</td>
</tr>
<tr>
<td>14. What is the critical knowledge base of your organisation?</td>
</tr>
</tbody>
</table>

7.2.4.2 The Application of the Framework

This section will explain the application of the framework. The framework is broken down into key knowledge indicators: acquisition, sharing, learning, re-use. The framework is based upon these core indicators. The OECD alluded to the need for greater understanding of the indicators of knowledge at firm-level. This framework offers an initial understanding of these indicators and their associated knowledge activities at organisational level. When the organisation decides to deploy the
framework it can do so by using the probes as presented in Table 7.2. For example, with regard to knowledge acquisition, the first four probes would be explored. It is recommended within the literature (Nonaka 2007) that middle management undertake the deployment of any conceptual framework. This is done in conjunction with, and using the probes. Since middle management is the primary conduit between senior management and the frontline employees, it is their responsibility to help frontline employees make sense of their experiences (Nonaka 2007). Figure 7.1 shows the synthesis of this application.

Figure 7.1 Framework Application at Organisational Level

1. C.E.O./Senior Mgt
   - Sets overall strategy
   - now informed by frontline employees

2. Srn. Mgt/Middle Mgt
   - Sets KM strategy
   - Sets out ways in which org problems will be tackled by KM

3. Middle Mgt/Knowledge Champion
   - Conduct interviews using KAF probes \( \rightarrow \) Table 7.2
   - now informed by frontline employees

4. K-Gaps/Insights (see Chp 6)
   - Context Specific
   - Various knowledge activities/issues

5. Middle Mgt + Frontline employees
   - Consolidate findings
   - Prioritise areas with issues of critical nature

6a. All Management Levels
   - Informs front line employees of findings
   - seeks input, makes decisions

6b. All Management Levels
   - Sets out strategy/decisions to deal with problems highlighted

7. All Management Levels
   - Decisions feed back into overall Strategy and KM Strategy
Once the knowledge activities are populated (see chapter 6 and Figure 6.1), further analysis reveals the primary knowledge gaps within the area of deployment (see section 6.2) whether that is team, department or organisation wide. Once the organisation or the persons conducting framework deployment highlights the knowledge gaps, actions and recommendations can be made. (For the methodological foundations and research strategy concerning the deployment of the framework in these cases see Chapter Three for more detail).

7.2.4.3 Actions Implemented by Organisations Post-Framework Deployment

Before the limitations of the framework are presented, this section will discuss some of the more critical actions taken by the case organisations post-deployment of the framework and after the initial findings from the analysis had been presented to the case organisations.

Creganna

The purposeful knowledge organisation, according to Nonaka (2007), provides employees with a conceptual framework that helps them make sense of their experiences. Though Creganna had one man (Respondent Fifteen) very clear on what he wanted to achieve with regard their knowledge management progression, the framework highlighted a clear lack of organisational direction with regard to knowledge.

The first considerable action that Creganna made after the presentation of the framework findings is that they incorporated those findings into their organisation-wide “Knowledge Policy Document” through the Human Resource Department. This has led to an organisational vision (as Nonaka 2007 argued) of what knowledge management is valued as and what its goal within the organisation is. This is available for all employees.

Secondly, Creganna has increased its activity in the area of designating knowledge owners. These owners are now working closely with Respondent Fifteen, so that the
understanding of their responsibilities is clearer than in the past. Nonaka (1991) talks about middle managers synthesising the implicit knowledge of the frontline workers with the hope of making it explicit for the organisation. Creganna now views these “owners” as the knowledge engineers of the firm.

**Thirdly**, Creganna is looking into adopting a more intensive mentoring programme. The organisation are open to the recommendation that close mentoring relationships are required to aide in the transfer of personal knowledge into organisational knowledge (Nonaka 2007). Respondent Nine, the HR manager, is now looking at ways that this can be achieved using the current resources but given the organisations aggressive pursuit of progressing their KM, this may become a reality.

**Fourth**, Creganna’s HR department (initiated by the findings from the framework and a conversation between Lean expert Respondent Eleven and the researcher), are working with Lean expert Respondent Eleven to pursue a Knowledge Management Incentive Programme called the KMIP. Its aim is to see if incorporating new KPI’s into the employee appraisals as a means of incentive, is possible for the progression of KM within the organisation. Creganna has stated it is interested in any future research concerning the framework and remains in contact with the researcher.

**Fifth**, Creganna is also examining and re-evaluating its heavy reliance on formal systems as the primary mode of learning within the organisation. The organisation has acknowledged that its “70-20-10” approach to learning is not what is happening in practice. Other forms of informal learning such as discussions, brainstorming sessions (successful form the IMP) and personal mentors, are being introduced into the project methodologies across the board at Creganna.

**Depuy**
Like Creganna, DePuy showed that it wanted to progress its knowledge management programme, however, unlike Creganna, DePuy had a very poor understanding of what knowledge management potentially could actually achieve for them. DePuy’s view was that if they could quantifiably state what their knowledge gaps were, understanding the underlying knowledge indicators was not a primary focus. Indeed, after the presentation of the case findings to DePuy, Respondent Twenty Six stated
that; “wow, we had no idea, we totally underestimated the scope of what knowledge management is” [Observation Notes].

DePuy's first action after the initial findings was to re-evaluate their position on KM. Unlike Creganna, they did not possess a clear understanding of what KM could deliver for them.

Secondly, DePuy Senior Management was unaware of the “them and us” atmosphere between the Innovation Centre and the Manufacturing floor. Members of the manufacturing floor are now being invited to, and collaboratively interact in the Innovation Centre weekly lectures. This is aimed at alleviating some of the cultural issues highlighted in the analysis.

Thirdly, the Innovation Centre is analysing ways in which it might prevent such loss of tacit and implicitly held knowledge highlighted by the loss of knowledge from contractors leaving. There does not seem to be any quick-fix solution to this problem. Linked with this, the problem DePuy has in identifying its employee’s skills- a renewed effort to promote talent navigator as the primary database for employee skill sets and interests and areas of speciality has been started.

Fourthly, new employees will now receive an extra informational item in their welcome package explaining; who are the key experts in certain areas of the Innovation Centre. This is a small step, but an active step in the process of alleviating the issue of locating knowledge for new employees. Senior Management still seems overwhelmingly in favour of pursuing formal systems at the firm, even with the substantial evidence pointing to the dependence on the informal network.

Fifth, DePuy is examining the finding that employees have insufficient time. The company, because of their great success meeting their customer targets as well as their other economic successes, are reluctant to change practices that would drastically change their employee’s interactions with set tasks, projects and initiatives. However, the organisation is planning for a more collaborative approach to their KM initiatives through seminars and making more information readily available to their employees. Depuy admitted they had neglected to market the Link project and because of the
findings from the framework, they will be running a marketing campaign aimed at improving awareness about the initiative.

**Sixth**, DePuy have been open to continued co-operation and communication with the researcher as they go forward with their KM adoption and progression. Their knowledge champion, Respondent Twenty Six is interested in collaboration between a number of organisations and the Universities in Ireland and continuing progress is being made fostering that collaboration.

In addition, after the analysis from the framework was presented to both organisations, the researcher and the companies collaborated to develop a small KM survey that would aid the companies in furthering their own KM exploration. The framework proved useful for both organisations and their willingness to accept the majority of the findings, coupled with the willingness to change some of their practices and even begin new best practice initiatives as a direct result of the KAF, lends to the validity of the framework going forward with future research.

### 7.3 LIMITATIONS OF THE FRAMEWORK

This section will discuss the observed limitations of the framework and suggest possible improvements. These limitations are presented separately from the methodological limitations of the research.

The limitations of the framework are as follows:

1. The indicators for knowledge used in the framework are derived from the KM and EGT literature. However, structurally, they are similar to the indicators used by the OECD. Criticisms may arise here about the quality of the indicators to begin with. The researcher acknowledges this, however argues that because the indicators used in this study are derived from theory, bearing in mind the criticisms of the OECD indicators highlighted in Chapter Two; these knowledge indicators are useful within the context of the study.

2. The second limitation of the framework concerns the scope of the results. The framework can highlight that there are problems regarding locating knowledge
and knowledge capture at DePuy. However, it does not give general evidence
that explains why these problems occur. It uses context-based accounts from
the people who live within the organisations studied. This framework is not
exhaustive and further research is needed to improve the framework presented
in this study. This framework is an initial lens.

3. The third limitation concerns the comparison of the results from Creganna and
DePuy. Again, the framework can show that there are knowledge-retention
issues at DePuy and that there are ownership issues at Creganna. However, the
framework will not explain if there is any relationship between different
issues. In addition, it is unlikely that conclusions could be drawn about why
there are ownership issues. However, with that in mind, the framework does
highlight ownership issues. Methodologically, the framework is exploratory in
nature and does not attempt to answer explanatory issues that may be the focus
of a separate study.

4. The fourth limitation deals with the scope of the framework itself. The
framework deals primarily with the issues arising internally to the
organisation. Primarily, this is to do with the endogenous nature of knowledge
within the organisation. Future research may wish to explore more of the
external knowledge factors aside from external networks alone.

5. The fifth limitation of the framework is that, primarily, the analysis produced
in this dissertation comes from observations and personal accounts. It is
entirely qualitative in nature. For example, the framework will highlight some
of the issues with regard to employee personal experiences. It will make the
reader aware that these issues exist. However, the analysis and the narrative
offered is often from the point of view of the person who is experiencing the
issue. This leads to a difficulty of placing oneself within the context of the
issue raised. It becomes difficult them, for the organisation to understand these
experiences, however the organisation is a living organism and managers are
not comfortable with this (Nonaka 2007).

6. One area the research recognises but does not use in any detail is the area of
Intellectual Capital (IC). IC discusses human, structural and relational capital.
This highlights the individual stock of knowledge accumulated by a firm’s
employees (Chartrand 2005; Roos et al 1997), the procedures, systems,
routines and rules that comprise the core of the firm and the external
relationships that a firm develops with its stakeholders, competitors, customers and suppliers, among others (Bontis 1999). It is worth noting, for future research, that theoretical areas of IC could be explored for any future iterations of the framework.

The known limitations of the framework have been outlined. Though there may be further limitations, it is the researcher’s belief that these are the key limitations that must be highlighted and thus can be improved upon and eliminated in future studies.

7.4 FUTURE RESEARCH
This dissertation also leads to several ideas that could be pursued for good quality and interesting future research, some of which the researcher is very interested in pursuing in a post-doctorate study. In future work, researchers can choose to focus on improvements of the work carried out or extensions of the research. The author firmly acknowledges that the present research could be improved in several ways:

1. The development of weighting indicators using a scale would be very useful in attributing values or metrics to a variety of indicators. This was one area the author had looked at; however, due to what the thesis could realistically achieve, this was a factor in not following this research path. The scale development work of Churchill (1979), Diamantopoulos (2001), Finn (1997), Hand (1996), Hinkin (1995), Rossiter (2002) and Parameswaran (1986) would be particularly useful here in future studies.

2. Furthermore if weighting of indicators already was achieved the interaction of knowledge indicators could be further quantitatively explored through Structural Equation Modelling. The research could be improved by using quantitative methods in future studies. This could be achieved by delivering the study to a far greater sample of companies (250 respondents) through questionnaires or surveys to allow this approach to be statistically robust.

3. Other facets of the organisation’s knowledge activities could be further explored, such as other external knowledge activities and focused multi-level facets of the organisation and other areas not explored by this thesis. For instance, the findings arising from the study could be further analysed by testing hypotheses in an in-
depth explanatory study.

4. As this thesis takes a snapshot of two medical device companies in 2009 and 2010, a more in-depth, longitudinal study over a number of years also would benefit the research and deepen the understanding of several indicators that are dependent on time factors. Dawson (1997) argues that when the aim of a study is a process over time, this would be suitable. In addition, choosing to increase the number of case organisations also should increase the breadth of the study while lending to increased validity and generalisability (Guba & Lincoln 1994). Processual research, used to understand patterns of contextualised phenomena in a more holistic way, also may be an avenue worth exploring.

5. Generalisability of the studies’ findings also is an issue. It is difficult to assess how representative the findings are for other organisations other than the ones examined here. Although the focus is on building a framework for knowledge assessment at firm level, exploration of indicators within lesser knowledge-intensive firms or those consisting of non-business organisations may have different membership and knowledge dynamics. Thus, studies comparing various settings and their dynamics across a variety of organisations are suggested.

7.4.1 Policy and Social Impact: Energy

“For future success in the energy sector, Ireland needs to start looking seriously at improving our scientific knowledge”, (Motherway and Kennedy, 2010: 20)

Knowledge is recognised as a key input in the innovation process (Miller et al 2012: 663). The KAF is an innovative way of looking and gauging knowledge in many ways. This dissertation offers many avenues for future research with regard to policy and social impact. Currently there is an excitement around energy within the smart economy. Around the world, clean technology is on the agenda for policy makers, entrepreneurs and investors. In Ireland, the smart economy plays to our strengths and is a huge opportunity (Motherway & Kennedy 2010, OECD 2009, Minonne and Turner 2009). Ireland needs to focus on building businesses that bring new products and services to Irish and global markets demanding clean, low carbon solutions. According to the Report on the Smart Economy by the Sustainable Energy Authority (SEAI) in 2010, momentum is building in energy. Ireland has a range of strong
support measures in place, and several recent clean tech enterprise announcements show that they are delivering. The Government has signaled its intent, and action is following (Motherway & Kennedy 2010). From a strategic perspective, several companies interviewed agree that certainty around policy is critical. “There must be a line of transparency that everybody trusts”, (Motherway & Kennedy 2010:2). Lack of clarity, can be a significant barrier to planning and investing in research (OECD 2009). While many stakeholders acknowledge ongoing support from Irish state agencies, particularly Enterprise Ireland, all favour greater integration, communication and co-operation between them. This is where the KAF can be implemented in assessing the areas for action that may be required to improve these criteria, (see Figure 7.1). For example, “If you are looking to accelerate things you need to use the existing people, buildings and offices that are in place and just join the dots”, (Motherway & Kennedy 2010:2) Several of the major organisations emphasise the need for quality assurance and verifiable standards in an ever-expanding clean tech market. Active Thermal, for example, favours greater assessment of all companies providing services in the sector. Greater focus on research and development, especially through industry and academic collaboration, also features highly as a means to becoming a leader in this sector. The report stresses the need for a deeper scientific knowledge in clean tech if Ireland is to compete globally; “There are not a lot of people, relative to other countries, who really understand the nuts and bolts of energy...Energy is a very tough area scientifically and, right now, I feel as a country we are just skimming the surface.” (Motherway & Kennedy 2010). Greater involvement of the third-level sector, coupled with effective knowledge transfer aided by implementation of the KAF may bring positive results.

7.4.1.1 Challenges faced

Despite this, and the fact that the business is growing at around 30% to 50% each year, price is a significant concern for companies; “I think many of us are being undercut by new companies and new individuals with no track record whatsoever other than being able to complete some paperwork.”. (Motherway & Kennedy 2010:16). The SEAI would favour greater evaluation of all companies that provide services in this area. “There’s an exam now for individuals carrying out BER [Building Energy Rating] assessments...It was a good idea to actually examine
people on things like their knowledge on interiors and insulation, but it could include examining their communication skills, health and safety, quality and their customer service” (Motherway & Kennedy 2010:16). As members of SEAI’s panel of advisors point out that they are continuously evaluated and scored, and are subject to suspension if they fall below a certain level. “Now that’s a very innovative way of doing business.” There is a belief that a greater interaction between different agencies operating in this space would also beneficial for assessment purposes.

7.5 CONCLUSION

It was important that this chapter effectively provided an overview of the findings of the dissertation. Assessing one’s knowledge clearly is a central goal for organisations to consider in the face of changing market and economic conditions. Being aware of knowledge gaps in any organisation is important and is a driver for organisations to both adapt and reinvent themselves in the face of these various challenges. In this dissertation, the author attempted to operationalise a Knowledge Assessment Framework and to use it to explore knowledge indicators at the organisational level in two case studies, namely Creganna and DePuy. The insights that are highlighted by the framework also are important for the organisations going forward. As discussed, the study contributes to knowledge assessment in several aspects: theoretically, empirically and practically. The limitations of the research also have been identified and presented. From the analysis of the framework, several knowledge activities were presented. The importance of cross-functional knowledge sharing and its ability to improve knowledge revitalisation within the firm also was discussed. The nature of informal network dependency and the lack of time as an organisational resource were presented. The two exploratory case studies provided the ideal setting to operationalise a knowledge assessment framework. This was achieved at firm level and examined the combined and independent effects of the various indicators of knowledge and the issues that it unearthed. Knowledge indicators need not be considered random or intangible. This study shows they can be studied comprehensively and can be characterised. The framework is useful as a way for organisations to evaluate where they are lacking. The organisation then can adjudicate action to increase knowledge in that area. As Sigmund Freud once said, “the more the fruits of knowledge become accessible to men, the more widespread their benefits”.

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APPENDICES
APPENDIX A: Publications concerned with this Thesis

Research Publications in Refereed Journals
“An Operationalised Knowledge Assessment Framework: Two Case Studies in the Irish Knowledge Intensive Sector”, Knowledge Management; Research and Practice WORK IN PROGRESS - 2012

Solicited Research Publications
“The Need for a Robust Knowledge Assessment Framework in the Medical Device Sector”, National Institute of Health Sciences-Research Bulletin, 6 (3)


Manuscripts

Book Chapters
“Building a Competitive Public Sector with Knowledge Management Strategy”, for Dr. Yousif Al-Bastaki and Amani Shajera, University of Bahrain, Bahrain, WIP, October 30th 2012

Conference Presentations
“The Need for a Robust Knowledge Assessment Framework”, The European Conference in Knowledge Management, Universidad Politécnica de Cartagena, Spain
“The Conceptualisation of a Knowledge Assessment Framework at Organisational Level”, European Conference in Knowledge Management, Passau, Germany, 2011

“Knowledge Constructs & Factors: The Irish Medical Device Sector”, Irish Academy of Management Conference, NUI Galway, 2009

“Ireland’s Knowledge Problem: A Study within the Irish Medical Device Sector”, KBS Research Conference, University of Limerick, 2009

“Using EGT for the Development of a Knowledge Assessment Framework”, Irish Academy of Management, Dublin City University, 2008

“A Framework for Ireland’s Knowledge-Based Economy”, KBS Research Conference, University of Limerick, 2008

Other Scholarly Presentations

“nVivo: A Qualitative Research Tool”, Guest Speaker, Advanced Methods Seminar, Department of Management, University of Limerick, May 2010

“The Exploratory Case-Study Approach: They Keys To Successful Access”, Faculty Development Presentation, University of Limerick, February 2010

“Knowledge Management and Strategy: Can Knowledge be Strategic?” Strategic Management Discussion, For Dr. John McCarthy, University of Limerick, May 2009

“Triangulation of Methods in Knowledge Management Research”, Department of Management, University of Limerick, Guest Speaker for Dr. Jill Pearson, April 2009

“Knowledge and the Irish Economy: Meeting the Current Challenges and Offering Solutions”, Information Management and Decision Making Discussion, Guest Speaker for Dr. John Walsh, University of Limerick, March 2009

Presentations In Progress

“Connected thinking in Knowledge Management Strategy”, MBAA International Conference, Chicago, 2013

“A Role for KM in Catholic Liberal Arts Institutions?” “9th International Conference on Catholic Social Thought, 2013

“Knowledge Sharing within a Case-based Scenario”, 33rd International Conference in Knowledge Management, 2013

APPENDIX B: Research Interview Probes & Questions DePuy

Commissioned and carried out by the AIB Centre for Information and Knowledge Management and supported by the Department of Management and Marketing, University of Limerick.

Contact/Return Address
Jamie O’Brien,
Centre for Information and KM,
S120 Schuman Building,
Department of Management & Marketing,
Kemmy Business School,
University of Limerick
Name of your organisation:

Your job/function

Criticisms?
Please note down any questions or remarks you may have on single questions or the questionnaire as a whole directly on the questionnaire.

Explanations

What are the objectives of this study?
The starting point for this study is the reflection that the increasing significance of knowledge for production and innovation presents a challenge to the management of organisations, publicly funded research and policy-makers in Ireland. The aim of this study is to explore the assessment of knowledge within high technological organisations in Ireland using a derived framework. This interview is being carried out in parallel with other organisations in Ireland in order to derive a knowledge assessment framework.

What will happen with your data?
Your data will be treated with strictest confidentiality, will only be used for the purposes of this study and presented in anonymous fashion. A disregard of these principles would not only violate the requirements of scientific rectitude/honesty, but also the ethics of our research institute.

What advantages do you have from participating?
- This provides you with an exclusive overview of the status of knowledge in Irish high-technological industry.
- When answering, you will automatically review the problems involved intensively, perhaps even receive new stimuli.
- You will be of great help to KM research in Ireland
Questions and Probes

DePuy: “Knowledge Indicators”

Section 1: Opening Questions

1. What is your job title at DePuy?

2. How many years have you been employed with DePuy?

3. How many years technical experience do you have in that specific field?

4. Any previous industry employment?

5. What is your educational background?

6. What kind of projects do you work on in DePuy?

Section 2: Creation/Acquisition/Sharing/Reuse

7. What kind of things do you do prior to a project to:
   - acquire knowledge about the project,
   - how do you do this (system/person)? Explicit K that is captured?

8. What do you do to keep this knowledge up to date?

9. Are expert technical staff important for the duration of the project?

10. Is creating new knowledge encouraged at DePuy?
    Is it happening, how? Incentives?
    Is there any technology/system that aided in the acquisition of knowledge for
    the duration of the project? Documenting, problem solving

Sharing/Networks

11. Issues on the project around the sharing of knowledge?
    - Is sharing important at DePuy?
    - Encouraged? How? Incentives?

12. Do you find it easy to locate the relevant person with the relevant knowledge
13. Somebody came to you with an issue?
14. Formal and Informal networks?
    - Important, Encouraged?

15. Were there any active communities of practice that you were aware of or apart of?
-Were there regular meetings to discuss problems that arose?

16. Did you ever have to reach outside of DePuy gain knowledge around a problem?
   -External network

**Re-use/Outputs**

17. Is knowledge re-use happening at DePuy?
   -How?

18. What knowledge outcomes do you expect from the project?
   -Onus on new knowledge? Incentives?

19. Any outcomes after the completion of the project that affected existing processes or practices within DePuy?

**Section 3: Learning & Training**

20. New Learning through solving problems versus training and preparation?
   -training: Formal/Informal
   -training with explicit knowledge
   -training with tacit knowledge.......mentoring?
   -industry experience and its role?
   -previous education?

21. What would you say is DePuy’s knowledge base?
   -why is DePuy so successful?
APPENDIX C: LIST OF OECD INDICATORS (Adapted from OECD report on Main Science and Technology Indicators 2007, OECD 2007b)

Indicators by subject:
Gross domestic expenditure on R&D (GERD):
1. Gross Domestic Expenditure on R&D -- GERD (million current PPP $)
   1.a. GERD (million national currency - for euro area, pre-EMU euro or EUR)
2. GERD as a percentage of GDP
3. GERD -- (million 2000 dollars -- constant prices and PPP)
   3.a. GERD -- Compound annual growth rate (constant prices)
4. GERD per capita population (current PPP $)
5. Estimated Civil GERD as a percentage of GDP
6. Basic research expenditure as a percentage of GDP
R&D Personnel (FTE):
7. Total researchers (FTE)
   7.a. Total researchers -- Compound annual growth rate
8. Total researchers per thousand total employment
   8.a. Total researchers per thousand labour force
9. Total R&D personnel (FTE)
   9.a. Total R&D personnel -- Compound annual growth rate
10. Total R&D personnel per thousand total employment
10.a. Total R&D personnel per thousand labour force
GERD by source of funds:
11. Industry-financed GERD as a percentage of GDP
12. Government-financed GERD as a percentage of GDP
13. Percentage of GERD financed by industry
14. Percentage of GERD financed by government
15. Percentage of GERD financed by other national sources
16. Percentage of GERD financed by abroad
GERD by performance sectors:
17. Percentage of GERD performed by the Business Enterprise sector
18. Percentage of GERD performed by the Higher Education sector
19. Percentage of GERD performed by the Government sector
20. Percentage of GERD performed by the Private Non-Profit sector
Researchers (headcount):
21. Total researchers (headcount)
21.a. Women researchers (headcount)
22. Women researchers as a percentage of total researchers (based on headcount)
   22.a. Business Enterprise Sector: Total researchers (headcount)
   22.b. Business Enterprise Sector: Women researchers (headcount)
   22.c. Business Enterprise Sector: Women researchers as a percentage of total researchers (based on headcount)
   22.d. Government Sector: Total researchers (headcount)
   22.e. Government Sector: Women researchers (headcount)
   22.f. Government Sector: Women researchers as a percentage of total researchers
22.g. Higher Education sector: Total researchers (headcount)
22.h. Higher Education sector: Women researchers (headcount)
22.i. Higher Education sector: Women researchers as a percentage of total researchers (based on headcount)

Business Enterprise Expenditure on R&D (BERD):
23. Business Enterprise Expenditure on R&D -- BERD (million current PPP $)
23.a. BERD (million national currency - for euro area, pre-EMU euro or EUR)
24. BERD as a percentage of GDP
25. BERD -- (million 2000 dollars -- constant prices and PPP)
25.a. BERD -- Compound annual growth rate (constant prices)
26. BERD as a percentage of value added in industry

Business Enterprise R&D Personnel (FTE):
27. Business Enterprise researchers (FTE)
27.a. Business Enterprise researchers -- Compound annual growth rate
28. Business Enterprise researchers as a percentage of national total
29. Business Enterprise researchers per thousand employment in industry
30. Total Business Enterprise R&D personnel (FTE)
30.a. Total Business Enterprise R&D personnel -- Compound annual growth rate
31. Total Business Enterprise R&D personnel as a percentage of national total
32. Total Business Enterprise R&D personnel per thousand employment in industry

BERD by source of funds:
33. Industry-financed BERD -- (million 2000 dollars -- constant prices and PPP)
33a. Industry-financed BERD -- Compound annual growth rate (constant prices)
34. Industry-financed BERD as a percentage of value added in industry
35. Percentage of BERD financed by industry
36. Percentage of BERD financed by government
37. Percentage of BERD financed by other national sources
38. Percentage of BERD financed by abroad
BERD performed in selected industries:
39. BERD performed in the aerospace industry (million current PPP $)
39.a. Percentage of BERD performed in the aerospace industry
40. BERD performed in the electronic industry (million current PPP $)
40.a. Percentage of BERD performed in the electronic industry
41. BERD performed in the office machinery and computer industry (million current PPP $)
41.a. Percentage of BERD performed in the office machinery and computer industry
42. BERD performed in the pharmaceutical industry (million current PPP $)
42.a. Percentage of BERD performed in the pharmaceutical industry
43. BERD performed in the instruments industry (million current PPP $)
43.a. Percentage of BERD performed in the instruments industry
44. BERD performed in service industries (million current PPP $)
44.a. Percentage of BERD performed in service industries

Higher Education Expenditure on R&D (HERD):
45. Higher Education Expenditure on R&D -- HERD (million current PPP $)
45.a. HERD (million national currency - for euro area, pre-EMU euro or EUR)
46. HERD as a percentage of GDP
47. HERD (million 2000 dollars -- constant prices and PPP)
47.a. HERD -- Compound annual growth rate (constant prices)
48. Percentage of HERD financed by industry
Higher Education R&D Personnel (FTE):
49. Higher Education researchers (FTE)
49.a. Higher Education researchers -- Compound annual growth rate
50. Higher Education researchers as a percentage of national total
51. Higher Education Total R&D personnel (FTE)
51.a. Higher Education Total R&D personnel -- Compound annual growth rate
Government Expenditure on R&D:
52. Government Intramural Expenditure on R&D -- GOVERD (million current PPP $)
52.a. GOVERD (million national currency - for euro area, pre-EMU euro or EUR)
53. GOVERD as a percentage of GDP
54. GOVERD (million 2000 dollars -- constant prices and PPP)
54.a. GOVERD -- Compound annual growth rate (constant prices)
55. Percentage of GOVERD financed by industry
Government R&D Personnel (FTE):
56. Government researchers (FTE)
56.a. Government researchers -- Compound annual growth rate
57. Government researchers as a percentage of national total
58. Government Total R&D personnel (FTE)
58.a. Government Total R&D personnel -- Compound annual growth rate
Government Budget Appropriations or Outlays for R&D by socio-economic objectives (GBAORD):
59. Total Government Budget Appropriations or Outlays for R&D -- GBAORD (million current PPP $)
59.a. Total GBAORD (million national currency - for euro area: pre-EMU euro or EUR)
60. Defence Budget R&D as a percentage of Total GBAORD
61. Civil Budget R&D as a percentage of Total GBAORD
62.a.1. Civil GBAORD for Economic Development programmes (million current PPP $)
62.a.2. Economic Development programmes as a percentage of Civil GBAORD
62.b.1. Civil GBAORD for Health and Environment programmes (million current PPP $)
62.b.2. Health and Environment programmes as a percentage of Civil GBAORD
62.c.1. Civil GBAORD for Space programmes (million current PPP $)
62.c.2. Space programmes as a percentage of Civil GBAORD
62.d.1. Civil GBAORD for Non-oriented Research programmes (million current PPP $)
62.d.2. Non-oriented Research programmes as a percentage of Civil GBAORD
62.e.1. Civil GBAORD for General University Funds (GUF) (million current PPP $)
62.e.2. General University Funds (GUF) as a percentage of Civil GBAORD
R&D Expenditure of Foreign Affiliates:
63. R&D expenditure of foreign affiliates (million current PPP $)
63.a. R&D expenditure of foreign affiliates (million national currency - for euro area, pre-EMU euro or EUR)
64. R&D expenditure of foreign affiliates as a percentage of R&D expenditure of enterprises
Patents
65. Number of triadic patent families (priority year)
65.a. Number of patent applications to the EPO (priority year)
65.b. Number of patents granted by the USPTO (priority year)
66. Share of countries in triadic patent families (priority year)
67. Number of patent applications to the EPO in the ICT sector - (priority year)
67.a. Number of patents granted at the USPTO in the ICT sector - (priority year)
68. Number of patent applications to the EPO in the biotechnology sector - (priority year)
68.a. Number of patents granted at the USPTO in the biotechnology sector - (priority year)

Technology Balance of Payments (TBP):
69. Technology balance of payments: Receipts (million current dollars)
69.a. Technology balance of payments: Receipts (million national currency - for euro area, pre-EMU euro or EUR)
70. Technology balance of payments: Payments (million current dollars)
70.a. Technology balance of payments: Payments (million national currency - for euro area, pre-EMU euro or EUR)
71. Technology balance of payments: Payments as a percentage of GERD

International trade in highly R&D-intensive industries:
72. Export market share: Aerospace industry
72.a. Total imports: Aerospace industry (million current dollars)
72.b. Total exports: Aerospace industry (million current dollars)
73. Export market share: Electronic industry
73.a. Total imports: Electronic industry (million current dollars)
73.b. Total exports: Electronic industry (million current dollars)
74. Export market share: Office machinery and computer industry
74.a. Total imports: Office machinery and computer industry (million current dollars)
74.b. Total exports: Office machinery and computer industry (million current dollars)
75. Export market share: Pharmaceutical industry
75.a. Total imports: Pharmaceutical industry (million current dollars)
75.b. Total exports: Pharmaceutical industry (million current dollars)
76. Export market share: Instruments industry
76.a. Total imports: Instruments industry (million current dollars)
76.b. Total exports: Instruments industry (million current dollars)
APPENDIX D: Pilot Interview

Commissioned and carried out by the AIB Centre for Information and KM and supported by the Department of Management and Marketing, University of Limerick.

Contact/Return Address
Jamie O’Brien,
Centre for Information and KM,
S120 Schuman Building,
Department of Management & Marketing,
Kemmy Business School,
University of Limerick
Name of your organisation:

Your job/function

Criticisms?
Please note down any questions or remarks you may have on single questions or the questionnaire as a whole directly on the questionnaire.

Explanations
What are the objectives of this study?
The starting point for this study is the reflection that the increasing significance of knowledge for production and innovation presents a challenge to the management of organisations, publicly funded research and policy-makers in Ireland. The aim of this study is to explore the assessment of knowledge within high technological organisations in Ireland using a derived framework. This interview is being carried out in parallel with other organisations in Ireland in order to derive a knowledge assessment framework.

What will happen with your data?
Your data will be treated with strictest confidentiality, will only be used for the purposes of this study and presented in anonymous fashion. A disregard of these principles would not only violate the requirements of scientific rectitude/honesty, but also the ethics of our research institute.

What advantages do you have from participating?
- This provides you with an exclusive overview of the status of knowledge in Irish high-technological industry.
- When answering, you will automatically review the problems involved intensively, perhaps even receive new stimuli.
- You will be of great help to KM research in Ireland
Questions and Probes

KPMG/ACCENTURE/DELL: “To-Be Project”

Section 1: Opening Questions

1. What is your job title at KPMG/ACCENTURE/DELL?

2. How many years have you been employed with KPMG/ACCENTURE/DELL?

3. How many years technical experience do you have in that specific field?

4. Any previous industry employment?

5. What is your educational background?

6. What kind of projects do you work on in KPMG/ACCENTURE/DELL?

Section 2: Knowledge around To-Be Project (Creation, Flow, Use)

7. What kind of things did you do prior to the project to:
   (a) Familiarise yourself with the project,

   (b) Help yourself create new knowledge you would need for use in the project?

8. What were the key things that you had to do when the project started, to keep this knowledge relevant?

9. (a) Were expert technical staff important for the duration of the project?

   (b) What kind of collaboration was taking place?

10. (a) What kind of problems arose on the project around the sharing of knowledge?

    (b) When you had a problem or an issue surrounding the project what did you do?

11. Was there any technology/system that aided in the acquisition of knowledge for the duration of the project?

12. How did you locate the correct person with that knowledge?

13. If somebody came to you with a problem what kind of things did you do to help them solve the problem?

14. Is knowledge sharing actively encouraged?
15. Over the duration of the project, did different types of problems warrant different ways of helping people?

16. Concerning your own informal and formal networks, how were these important throughout the duration of the project?

17. Were there any active communities of practice that you were aware of or apart of?

18. For the duration of the project, were there regular meetings to discuss problems that arose?

19. Did you ever have to reach outside of KPMG/ACCENTURE/DELL gain knowledge around a problem?

Concerning projects in organisations, there are outcomes that can be measured and some that can’t.

20. What were the direct outcomes that you had expected from the project?

21. Was new knowledge created after the project? Was there then an element of knowledge re-use?

22. Were there any outcomes after the completion of the project that affected existing processes or practices within KPMG/ACCENTURE/DELL?

Section 3: Learning & Training around the project

23. During the project did you learn new knowledge through actively solving problems or was knowledge acquired through preparation and training for the project or a combination?

24. How are people trained in preparation for a project?

25. If you are dealing with explicit knowledge on a project how are people trained?

26. If you are dealing with tacit knowledge how are people trained? Is their mentoring?

27. How much does industry experience play a role in this preparation?

28. How important is previous education with regard to this preparation?

29. What would you say is KPMG/ACCENTURE/DELL’s knowledge base? Why is KPMG/ACCENTURE/DELL so successful?
APPENDIX E: Research Interview Probes & Questions Creganna-Tactx

Commissioned and carried out by the AIB Centre for Information and Knowledge Management and supported by the Department of Management and Marketing, University of Limerick.

Contact/Return Address
Jamie O’Brien,
Centre for Information and KM,
S120 Schuman Building,
Department of Management & Marketing,
Kemmy Business School,
University of Limerick
Explanations

What are the objectives of this study?
The starting point for this study is the reflection that the increasing significance of knowledge for production and innovation presents a challenge to the management of organisations, publicly funded research and policy-makers in Ireland. The aim of this study is to explore the assessment of knowledge within high technological organisations in Ireland using a derived framework. This interview is being carried out in parallel with other organisations in Ireland in order to derive a knowledge assessment framework.

What will happen with your data?
Your data will be treated with strictest confidentiality, will only be used for the purposes of this study and presented in anonymous fashion. A disregard of these principles would not only violate the requirements of scientific rectitude/honesty, but also the ethics of our research institute.

What advantages do you have from participating?
- This provides you with an exclusive overview of the status of knowledge in Irish high-technological industry.
- When answering, you will automatically review the problems involved intensively, perhaps even receive new stimuli.
- You will be of great help to KM research in Ireland.
Questions and Probes

Creganna:

Section 1: Opening Questions

1. What is your job title at Creganna?

2. How many years have you been employed with Creganna?

3. How many years technical experience do you have in that specific field?

4. Any previous industry employment?

5. What is your educational background?

6. What kind of projects do you work on in Creganna?

Section 2: Creation, Acquisition

7. What kind of things did you do prior to the project to?
   - Familiarise yourself with the project,
   - Help yourself create new knowledge you would need for use in the project?

8. What do you do when the project starts, to keep this knowledge up to date?

9. Are expert technical staff important for the duration of the project?
   - Collaboration, outsourcing?

10. Is creating new knowledge encouraged at Creganna?
    Is it happening, how? Incentives?
    Is there any technology/system that aided in the acquisition of knowledge for the duration of the project?

Sharing/Networks

11. Issues on the project around the sharing of knowledge?
    - Is sharing important at Creganna?
    - Encouraged? How? Incentives?

12. Do you find it easy to locate the relevant person with the relevant knowledge?

13. Somebody came to you with an issue?
14. Formal and Informal networks?
   -Important, Encouraged?

15. Were there any active communities of practice that you were aware of or apart of?
   -Were there regular meetings to discuss problems that arose?

16. Did you ever have to reach outside of Creganna gain knowledge around a problem?

---

Re-use/Outputs

17. Is knowledge re-use happening at Creganna?
   -How?

18. What outcomes do you expect from the project?
   -Onus on new knowledge? Incentives?

19. Any outcomes after the completion of the project that affected existing processes or practices within Creganna?

---

Section 3: Learning & Training around the project

20. New Learning through solving problems versus training and preparation?
   -training
   -training with explicit knowledge
   -training with tacit knowledge......mentoring?
   -industry experience and its role?
   -previous education?

21. What would you say is Creganna’s knowledge base?
   -why is Creganna so successful?
APPENDIX F: Initial Correspondence With Companies

My name is Jamie O’Brien, from the University of Limerick. I would be interested in using ____________ as a research site. I have outlined my research topic and research site requirements below. If you think that ___________ might be interested in participating in an interview based study on knowledge assessment using, please contact me at jamie.a.obrien@ul.ie

Kind regards,
Jamie O’Brien

Knowledge Assessment

My name is Jamie O’Brien from the Centre for Information and KM in the University of Limerick. My Ph.D. research focuses on knowledge assessment indicators in the medical device sector. The area of knowledge assessment has received little theoretical attention though given the economic climate it is becoming increasingly important to attain competitive advantage through increasing the knowledge base in organisations. Being aware of the intensity of knowledge within an organisation is an important step. Added to this the recognised sources of growth have evolved over time, until we have now reached a juncture where these knowledge sources are moving beyond the boundaries of obvious tangible assets. Increasingly innovative organisations are becoming aware of organisational knowledge such as knowledge networks and flows of knowledge and the importance of intangible assets. An initial investigation into OECD reports on science and technology indicators pointed to a more complex and dynamic knowledge hierarchy. This research aims to explore that hierarchy. I am now at the stage of conducting in-depth investigation in order to map and eventually model knowledge assessment and knowledge indication. Each individual who agrees to take part in the study will be interviewed regarding their experiences with the various indicators of knowledge and knowledge lifecycle within their organisation, to allow for the comprehensive exploratory study of knowledge indicators present within the organisation. The overall findings of this thesis aim to develop best practice in the area of knowledge assessment. This will aid your organisation as it aims to become a knowledge leader

Research requirements

Time Requirements: The overall time period would extend to approx. 5 to 10 intensive days to carry out the interviews and make non-obtrusive observations.
Research Method: Research would take the form of interviews, document analysis and non-obtrusive observation, focusing on:
Respondents: Individuals at senior management, middle management and design team levels.
Documentation: Access to annual reports, any other knowledge related documentation and documentation relating knowledge assessment, indicators or factors etc. may be required where appropriate.
Dear Jamie,

Your application has been reviewed by the KBS Research Ethics Committee and I am pleased to inform you, that your application has been given research ethics approval, subject to the condition that MBA class time is not used to complete the questionnaire.

Kind regards

Michelle Cunningham
Administrator
Research Ethics Committee
Kemmy Business School
University of Limerick
APPENDIX H: Interview & Project Scope

Individual Respondent Interview Requirements and Interview Consent Form
Each respondent receives a project outline tailored to their organisation and the interview requirements prior to the interview taking place.

AIB Centre for Information and KM
Knowledge Assessment for _____________

My name is Jamie O’Brien, from the Centre for Information and KM at the University of Limerick. As part of my Ph.D. thesis on knowledge assessment, I will be compiling a case study on _____________ specifically focusing knowledge indicators within the organisation. Below I have outlined the project brief, scope and methodology including the respondent requirement. If you have any questions please contact me at Jamie.a.obrien@ul.ie

Project Brief:
My name is Jamie O’Brien from the Centre for Information and Knowledge Management in the University of Limerick. My Ph.D. research focuses on knowledge assessment, indicators of knowledge in knowledge intensive organisations. The area of knowledge assessment has received little theoretical attention though given the economic climate it is becoming increasingly important to attain any competitive advantage through increasing the knowledge base in organisations. Being aware of the intensity of knowledge within an organisation is an important step. Added to this the recognised sources of growth have evolved over time, until we have now reached a juncture where these knowledge sources are moving beyond the boundaries of obvious tangible assets. Increasingly innovative organisations are becoming aware of organisational knowledge such as knowledge networks and flows of knowledge and the importance of intangible assets. An initial investigation into OECD reports on science and technology indicators pointed to a more complex and dynamic knowledge hierarchy. This research aims to explore that hierarchy.
**Project Scope:**
I am now at the stage of conducting in-depth investigation in order to map and eventually present a framework of knowledge assessment and knowledge indication. Each individual who agrees to take part in the study will be interviewed regarding their experiences with the various indicators of knowledge in the organisation, to allow for the comprehensive exploratory study of knowledge indicators within your organisation. The overall findings of this thesis aim to develop best practice in the area of knowledge assessment. This will aid your organisation as it aims to become a knowledge based leader.

**Project Methodology:**
Interviewer: Jamie O’Brien
Research Topic: Knowledge Assessment: Knowledge Indicators.
Research Method: In-depth Interview with each respondent and attendance at relevant meetings and other site visits.
The research will take the form of interviews and non-participant observation.

- Interviews: These are conducted in person; each interview should take approx. 45 mins. Additional contact with respondents may be required for clarification on certain points.
- Non-participant observation: The researcher may be asked to attend meetings etc. that are deemed important to knowledge assessment in relevant projects.

**General Interview Themes:**
1. KM policy and strategy
2. Tacit/Explicit/Implicit knowledge as well as the knowledge lifecycle (creation/acquisition/sharing/reuse)

**Assessment of Knowledge:**
- Knowledge Inputs $\rightarrow$ various activities
- Knowledge Stocks/flows $\rightarrow$ various activities
- Knowledge Networks $\rightarrow$ various activities
- Knowledge Learning $\rightarrow$ various activities
- Knowledge Outputs $\rightarrow$ various activities

3. Invention/Learning
4. Intellectual Capital
### APPENDIX I: Research Project Scope

<table>
<thead>
<tr>
<th>Revision No</th>
<th>Date &amp; Rev signed off by Sponsor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Project name**

“The use of KM, EGT and intellectual capital theory to derive and evaluate a knowledge assessment framework for use in the Irish high-technological sector”

**Researcher**

Jamie O’Brien, Centre for Information & KM, University of Limerick

**Supervisor**

Dr. Fergal McGrath, Centre for Information & KM, University of Limerick

**Strategic priority**

VISION: The vision of the research project would be to contribute to the growth of Depuy’s KM practice. This would also help Depuy become a leading medical technology company by enabling staff members to develop in pace with business goals in a more cost-effective way, while promoting responsive flexibility core value for our customers, and enhancing staff members experience within Depuy; improving communication and KM practices. Strategic deliverable addressed: **Service = Knowledge Assessment Framework/KM Practice**

**Driver**

<table>
<thead>
<tr>
<th>Strategic</th>
<th>Revenue increase</th>
<th>Expense reduction</th>
<th>Regulatory / Legal</th>
</tr>
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<td></td>
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</tbody>
</table>

**Goal (Use SMART goal format)**

**MISSION:** The knowledge assessment framework would add to Depuy’s current KM practice using real data. This knowledge assessment framework is intended to achieve increased understanding for indicators of knowledge and intangibles within Depuy and add to the learning activity. The goal is to ensure an increase in innovation and output through increasing the knowledge around knowledge assessment and the indicators of knowledge. This research is intended to focus on the development of indicators for knowledge within Depuy aligned with business goals. • Increase the understanding of knowledge assessment by the end of 2010; • Better KM best practice using recommendations and conclusions from the research. In establishing a knowledge assessment framework, we will achieve a greater ability to map the company’s knowledge and address any gaps.

**Boundaries**

In scope: • Managers/Staff engaged in technical activities where co-operation, teamwork or a community is used. • Managers/Staff engaged in research & development. • Managers/staff engaged in publishing or patenting for Depuy. • Managers/staff engaged in training/education or marketing new products for Depuy

Out of scope:

Any persons with a particular interest in KM and/or knowledge assessment:

**Key Stakeholders**

Any persons key to or familiar with KM procedures in Depuy: To approve and support the research approach and process. Any persons key to or familiar with knowledge assessment procedures in Depuy: To provide insight to the processes, procedures or indicators within Depuy. Any persons with a particular interest in KM and/or knowledge assessment: For people who feel they can contribute to the research in some way.

**Milestones**

- When we have permission from Depuy we would like to visit Depuy, take a tour and meet some of the people interested in the research and also set out a plan for the field work. May 10
- When we have a research survey piloted we would like to begin fieldwork with Depuy. June 10
- Field work continues. June 10
- Fieldwork would continue until the saturation point of the interviews has been reached, in that we are no longer receiving any new information or knowledge from the interviews and observations. July 10
- When we have completed the field work, transcription of the semi-structured interviews and observations will take place. July 10
- When we have compiled the data from the various research fields, including Depuy, analysis of the data will take place. August 10
- When we have reviewed the results, we will begin writing the final report and communicate the analysis back to Depuy. All findings will be made available to Depuy, and updates may be requested at any time. September 10

**Assumptions**

- That Depuy is interested in the research being carried out and its results. • Depuy will in some way benefit from the research outcomes. • The building of a trust relationship between the researcher and Depuy is very important. • That Depuy will try and help the researcher carry out the research effectively and efficiently. • All research and findings made concerning Depuy are completely confidential and anonymity will be given in the final thesis or any published works if Depuy so desires.

**Key deliverables**

1. Development and understanding of key indicators for knowledge as per knowledge assessment framework 2. Case Study results and any other findings made available to Depuy, including full access to data 3. KM Assessment Framework and KM best practice procedures

**Risks**

1. Need engagement and involvement from key stakeholders to ensure research’s validity. 2. Consent to audio recording of research interviews and observation(s). 3. The possibility to observe Depuy’s KM practices in everyday work processes.

**Doc location**

Access to KM documents regarding KM best practice, implementation of KM procedures, measuring knowledge within Depuy, documents regarding knowledge inputs, knowledge stocks & flows, knowledge networks, knowledge learning, and knowledge outputs akin to the knowledge assessment framework would be very beneficial to the research. Documents regarding how Depuy may measure or quantify its intangible assets.
## APPENDIX J: Chronology of Access and Data Collection

### Initial Identification of Potential Case Firms

<table>
<thead>
<tr>
<th>November ’07</th>
<th><strong>Initial Criteria for selection:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Knowledge Intensive/ High technology</td>
</tr>
<tr>
<td></td>
<td>- Irish Plant</td>
</tr>
</tbody>
</table>

*Practicalities:* Industrial Development Authority (IDA) provides the only available list, Classified along OECD high technology definitions.

**Additional Criteria for Selection:**

- Indigenous/Foreign Manufacturing Firms residing in Ireland

**Outcomes:** 147 high technology firms identified, contact information for R&D and technical managers retrieved through cold-calling and the IDA contacts database.

### Initial Contact with Potential Case Firms

<table>
<thead>
<tr>
<th>January ’08</th>
<th><strong>Cold-calling of contacts in potential case firms</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Further Criteria for Selection:</strong></td>
</tr>
<tr>
<td></td>
<td>- Willingness to participate</td>
</tr>
<tr>
<td></td>
<td>- Further confirmation of initial criteria</td>
</tr>
</tbody>
</table>

*Outcomes:* 42 organisations identified with some salience for the topic.

<table>
<thead>
<tr>
<th>May ’08</th>
<th><strong>Further contact with remaining potential case firms</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose:</td>
<td><strong>Informally discuss knowledge assessment with each contact</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Outcomes:</strong> knowledge assessment is a definite area for further investigation,</td>
</tr>
</tbody>
</table>
- it is obvious that a small scale exploratory study is required.

### Final Identification of Case Firms

<table>
<thead>
<tr>
<th>November ‘08</th>
<th>Further contact with case firms based on well defined research criteria. Further criteria for selection:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Willingness to participate given time requirements</td>
</tr>
<tr>
<td></td>
<td>- Possibility to interview the members of one group/or members across the organisation</td>
</tr>
<tr>
<td></td>
<td>- Firms to represent medical device industries if possible,</td>
</tr>
<tr>
<td></td>
<td>- to ensure best practice of case research was observed and to offer different contexts of study</td>
</tr>
</tbody>
</table>

**Outcomes:** 6 firms identified in 4 different industries: Medical device, pharmaceutical manufacturing, biotechnology manufacturing, computer equipment manufacturing

1. Boston Scientific
2. Genzyme
3. Dell
4. Creganna
5. Cordis
6. DePuy

<table>
<thead>
<tr>
<th>December ‘08</th>
<th>Identification and confirmation of most appropriate contact in each firm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Purpose:</td>
</tr>
<tr>
<td></td>
<td>- To establish the most appropriate contact in each firm,</td>
</tr>
<tr>
<td></td>
<td>- if not the original contact</td>
</tr>
<tr>
<td></td>
<td>- An initial communication was made via telephone to</td>
</tr>
</tbody>
</table>
- introduce the study

**Outcomes:**
The new contact in Dell felt that his group could not guarantee sufficient free time to participate in the study, leaving 5 organisations.

<table>
<thead>
<tr>
<th>Negotiation of Access and Conducting Interviews and Observation with Case Firm</th>
<th></th>
</tr>
</thead>
</table>
| **January ’09 - February ‘09** | Formal E-mail Contact with each potential case firm, outlining in detail the requirements of the research
Purpose:
- To maintain contact with case firms and negotiate access
Continued Contact with each case firm
Purpose:
- To build the relationships and develop strong links with each respondent |

**Outcomes:** All 5 firms interested in participation

| **February ‘09** | Initial Meeting at Creganna to present on research and negotiate access
**Outcomes:** Creganna agree to participate in the study
Boston Scientific and Cordis experience a downturn in their market and pull out of the study
**Outcomes:** 3 case firms remaining |

| March ’09 onwards | Conduct Interviews and Observation at Creganna
**Outcomes:** Interview members of the Inventory Management group, and observe them at work, as well as the plant in general.
Return Interview transcripts to each respondent for review
Genzyme decide due to time constraints not to partake in research
**Outcomes:** DePuy left as alternative case |
<table>
<thead>
<tr>
<th>Month(s)</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>January ‘10</td>
<td>Initial Meeting at DePuy to present on research and negotiate access</td>
</tr>
<tr>
<td></td>
<td><em>Outcomes:</em> DePuy agree to participate in the study</td>
</tr>
<tr>
<td></td>
<td><em>Outcomes:</em> 2 firms remaining in the study</td>
</tr>
<tr>
<td>July/August ‘10</td>
<td>Presentation of Findings at Creganna</td>
</tr>
<tr>
<td></td>
<td>Conduct Interviews and Observation at DePuy</td>
</tr>
<tr>
<td></td>
<td><em>Outcomes:</em> Interview members of the Innovation centre group, and observe them at work, as well as the organisation in general. Return Interview transcripts to each respondent for review</td>
</tr>
<tr>
<td>October ‘10</td>
<td>Conduct informal update sessions at Creganna and DePuy</td>
</tr>
<tr>
<td></td>
<td><em>Outcomes:</em> Informally talk to members of the both sites about their experiences on the project to date and about further updates Return all completed case studies to each respondent for review and verification</td>
</tr>
<tr>
<td>December ‘10</td>
<td>Conduct Presentation of Findings at DePuy</td>
</tr>
<tr>
<td>Jan-March ‘11</td>
<td>Conduct Post-findings Survey to gauge KM awareness at request of Case organisations</td>
</tr>
</tbody>
</table>
## APPENDIX K: Initial Nvivo Free Nodes

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
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<td>70-20-10</td>
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<td>2009-12-5</td>
<td>5:05 PM</td>
</tr>
<tr>
<td>Respondent Twelve Background</td>
<td>3</td>
<td>2009-12-6</td>
<td>6:29 PM</td>
</tr>
<tr>
<td>Respondent Twelve Educational Background</td>
<td>2</td>
<td>2009-12-6</td>
<td>9:25 PM</td>
</tr>
<tr>
<td>Automation</td>
<td>3</td>
<td>2009-12-3</td>
<td>11:43 AM</td>
</tr>
<tr>
<td>Awareness</td>
<td>3</td>
<td>2009-12-4</td>
<td>10:01 AM</td>
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<tr>
<td>Background Education Respondent Five</td>
<td>1</td>
<td>2009-12-3</td>
<td>11:38 AM</td>
</tr>
<tr>
<td>Background Respondent Five</td>
<td>1</td>
<td>2009-12-3</td>
<td>11:37 AM</td>
</tr>
<tr>
<td>Respondent Fifteen Background</td>
<td>1</td>
<td>2009-12-8</td>
<td>1:49 AM</td>
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<tr>
<td>Becoming Knowledge Organisation</td>
<td>1</td>
<td>2009-12-7</td>
<td>5:57 PM</td>
</tr>
<tr>
<td>Benefit to Sharing Synergies Cross functionally</td>
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APPENDIX L: Final Nvivo Tree Nodes

1.0 Creganna General
  1.1 Automation
  1.2 Becoming Knowledge Organisation
  1.3 Challenges-Issues
  1.4 Consolidation of Business Units
  1.5 Creganna still learning how to do business
  1.6 Creganna’s Customers
  1.7 Creganna’s Strengths
  1.8 Creganna’s Weaknesses
  1.9 Customer focus negative
  1.10 Customer Focused
  1.11 Design Service needs
  1.12 Design Services Background
  1.13 Design Services Project Options
  1.14 General Needs
  1.15 Growth of Creganna
  1.16 How Creganna behaves
  1.17 Information about Creganna
  1.18 Ireland-Massechusetts relationship
  1.19 Managerial Openness
  1.20 Metrics DS
  1.21 Metrics for hiring at Creganna
  1.22 Open Company
  1.23 Opinion about Creganna
  1.24 Org Structure
  1.25 Past Performance
  1.26 Projects at Creganna
  1.27 Reason for bringing in new employees
  1.28 Restructure of units
  1.29 Restructuring of Business
  1.30 Small Family Feel
1.31 Supply Chain
1.32 Why People Leave

2.0 Creganna's Culture

2.1 Culture Before
2.2 Incentives
   2.2.1 Incentive for mentoring
   2.2.2 Incentives on creating knowledge
2.3 Knowledge Sharing Culture

3.0 Employee Backgrounds

3.1 Respondent Twelve Background
3.2 Respondent Twelve Educational Background
3.3 Background Education Respondent Five
3.4 Background Respondent Five
3.5 Respondent Fifteen Background
3.6 Educational Background
3.7 Respondent Seven Education
3.8 Respondent Seven Industry Experience
3.9 Industry Experience previous to Creganna
3.10 Respondent Eight Background
3.11 Respondent Eight Industry Experience
3.12 Respondent Thirteen Background
3.13 Respondent Thirteen Educational Background
3.14 Respondent Six Educational Background
3.15 Respondent Six Industry Experience
3.16 Respondent Six employed at Creganna
3.17 Respondent Six Job at Creganna
3.18 Previous Industry Experience
3.19 Respondent Ten Background
3.20 Respondent Ten Creganna Experience
3.21 Respondent Ten Educational Background
3.22 Respondent Nine Educational Background
3.23 Respondent Nine Previous Industry Experience
3.24 Respondent Fourteen Background

333
3.25 Respondent Eleven Background
3.26 Time Employed with Creganna

4.0 IMP

4.1 Communication within Inventory Management
4.2 Importance of Inventory Management
4.3 Inventory Management Drivers
4.4 IMP
4.5 Inventory Management Sharing
4.6 Knowledge Outputs Inventory Management
4.7 Tacit Knowledge within Inventory Management

5.0 KM Initiatives

5.1 Corporate Yellow Pages (Need)
   5.1.1 No Corporate Yellow Pages
5.2 Issues Log Problem
5.3 Knowledge Cards

6.0 Knowledge

6.1 Awareness
   6.1.1 Increasing Awareness
   6.1.2 Understanding the Issues
6.2 Innovation
6.3 Knowledge Context Problem
6.4 Knowledge Gaps
6.5 Knowledge Hoarding
6.6 Knowledge Mapping
6.7 Lack of Awareness
6.8 Lack of understanding
6.9 Lost Knowledge
6.10 Managing Knowledge
6.11 Ownership
   6.11.1 How capture with lack of knowledge owners
   6.11.2 Knowledge Stores Owner
   6.11.3 Lack of Knowledge Owner
   6.11.4 Owner requirements
6.11.5 Ownership need

6.12 Stock of Knowledge

6.12.1 Positives to having Knowledge Stock

6.13 Tacit Knowledge

6.13.1 Mining Tacit Knowledge
6.13.2 Need to capture Tacit Knowledge
6.13.3 Relearning Tacit Knowledge
6.13.4 Tacit Knowledge

6.14 Unused Knowledge

7.0 Knowledge Inputs

7.1 Knowledge Acquisition

7.1.1 Capture

7.1.1.1 Expectation to capture new knowledge

7.1.2 Capture current Process
7.1.3 Capture Improvement
7.1.4 Capture Incentives
7.1.5 Capture-Documenting

7.1.6 Capture-Documenting Problems
7.1.7 Documenting

7.1.7.1 Lack of Documenting
7.1.7.2 Standard of Documents
7.1.7.3 Standardised Documents
7.1.7.4 Structuring of Documents
7.1.8 Documenting processes
7.1.9 How capture with lack of knowledge owners

7.1.10 Knowledge Acquisition without learning

7.1.11 Locating Knowledge

7.1.11.1 Cannot Locate Knowledge
7.1.11.2 Internal Knowledge
7.1.11.3 Locating Knowledge better
7.1.11.4 Locating Knowledge expert no system
7.1.11.5 No formal database for Knowledge Acquisition
7.1.11.6 No formal system
7.1.12 Problem Solving

7.2 Knowledge Creation

8.0 Knowledge Learning

8.1 70-20-10

8.2 Education

8.3 Experience

8.3.1 Experience progressing knowledge creation

8.3.2 Lack of experience

8.3.3 Purchased Experience

8.4 Expertise

8.4.1 Develop skills for knowledge experts

8.4.2 Functional Experts

8.4.3 Identifying knowledge experts

8.4.4 Importing Experts

8.4.5 Knowledge Expert

8.4.6 Knowledge Expert Overdependence

8.4.7 Lack of Knowledge experts

8.4.8 Subject matter experts

8.5 Lack of Knowledge

8.6 Learning dictated by industry need

8.7 Learning-by-doing

8.7.1 Technical know-how

8.7.2 Technical knowledge

8.7.3 Technological Change

8.8 Lessons learned from issues

8.9 Lessons learned from projects

8.10 Mentoring

8.10.1 Incentive for mentoring

8.10.2 Informal mentoring

8.10.3 Lack of Mentoring

8.10.4 Lack of skills to mentor

8.10.5 Mentor Training

8.10.6 Mentoring Issue
8.10.7 Need for Mentoring
8.10.8 No Formal Mentoring

8.11 Training
8.11.1 Formal Training
8.11.2 Informal Training
8.11.3 Lack of Training
8.11.4 No Training System
8.11.5 Training & Development
8.11.6 Training Effectiveness Measure
8.11.7 TWI Training
8.11.8 UPK Requirement for training

9.0 Knowledge Networks
9.1 Communities of Practice
9.2 External Network
9.2.1 External Knowledge
9.3 Internal Network
9.3.1 Cross-Functional
9.3.1.1 Benefit to Sharing
9.3.1.2 Cross-Functional Awareness
9.3.1.3 Cross-Functional Experts
9.3.1.4 Cross-Functional Relationships
9.3.1.5 Cross-Functional Sharing Incentives
9.3.1.6 Lack of Cross-Functional Awareness
9.3.1.7 Lack of Cross-Functional Collaboration reason
9.3.2 Formal Network
9.3.2.1 Formal Structures
9.3.2.2 Lack of Formal Network
9.3.3 Informal Network
9.3.3.1 Informal knowledge
9.3.3.2 Informal network damaging formal systems
9.4 Meetings
9.4.1 Communication
9.4.2 Teams
10.0 Knowledge Outputs

10.1 Knowledge Re-Use

10.1.1 Knowledge re-use

10.1.2 Knowledge re-use design services

11.0 Knowledge Sharing

11.1 Collaboration

11.1.1 Collaboration

11.1.2 Collaboration better reason

11.1.3 Collaboration Inventory Management

11.1.4 Collaboration problems

11.2 Formal Sharing

11.3 Informal Sharing

11.4 Knowledge Sharing Culture

11.5 Knowledge Sharing through experience

11.6 Knowledge Sharing within Units

11.7 Knowledge Transfer

11.8 Not Sharing

11.8.1 Not Sharing Possible absorbative capacity

12.0 KPI System

12.1 Critical Success Factors

12.2 Key Competencies

12.3 KPI

12.4 KPI (lagging)

12.5 KPI across business units

12.6 KPI problem

12.7 KPI to measure formal collaboration

12.8 Managerial Behaviour Measure

13.0 LEAN in Creaganna

13.1 Lean

13.2 Lean & KM

13.3 Lean Training

13.4 Lean used in Manufacturing

14.0 Oracle
14.1ERP
14.2ERP issues
   14.2.1 Problem Definition
15.0Other (Still Sorting)
   15.1Bridge Business Needs-IT needs
      15.1.1 Facilitate
   15.2Drive Change
   15.3Other Quotes
16.0Process
   16.1Building Process Knowledge
   16.2Compliance
      16.2.1 Formality Compliance not required by Creganna
      16.2.2 Lack of Compliance
      16.2.3 Share Compliance
   16.3Incorrect Processes (people)
   16.4No Process development
      16.4.1 Lack of Planning
   16.5Poorly written documents-procedures
   16.6Procedures
   16.7Process Context
   16.8Process Detail
   16.9Process Discipline
   16.10 Process Improvement
   16.11 Process Needs
   16.12 Process of Capture-Documenting
   16.13 Process Perfection by revision
   16.14 Process Problems
   16.15 Project Methodology
   16.16 Writing quality processes
17.0Time Issues
18.0UPK
   18.1LMS
   18.2Prior to UPK/UPK Problem/UPK requirement for training
APPENDIX O: Comparisons of KM Studies

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Source: Adapted from (Choi & Lee 2003)
### APPENDIX P: Summary of the Studies on Knowledge Sharing

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**Source:** Adapted from (Choi et al 2008)
Board of Directors
Ian Quinn, Chairperson  Bernard Collins
Enda Quinn           Bernie Lyons
Helen Ryan           Dan Tully
Padraic Clarke       George Aitken-
Davies

Helen Ryan
CEO

Caroline Egan
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APPENDIX S: Preliminary Gap Analysis for Creganna

A Knowledge Gap Analysis for

Creganna

Prepared by
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September 2010
The Framework

The knowledge assessment framework analyses Creganna’s knowledge gaps under the following criteria:

- Knowledge Inputs
- Knowledge Networks
- Knowledge Learning
- Knowledge Outputs

Knowledge Format

Organisational knowledge comes in different formats; therefore the manner in which it is captured and shared will differ accordingly. For purposes of simplification and clarity of this analysis “knowledge” can be categorised into three formats: explicit, implicit and tacit (see figure 1). However, it must be remembered that all knowledge is intertwined and is dependent on the other forms for its existence.

Terms that are important to understand prior to the analysis:

Figure 1: Knowledge Categorisation Process

![Diagram showing knowledge categorisation process]

Explicit knowledge is described as knowledge that can be articulated and is sometimes referred to as “know-what”. It is defined as: writings (documents and work manuals), drawings (knowledge process maps), computer programmes (embedded work routines...
Implicit knowledge is knowledge such as procedures, which has not yet been articulated but can be articulated and, therefore, capable of being converted to explicit knowledge given the time, commitment to share and organisational effort.

Tacit knowledge is sometimes referred to as “know-how”. It is knowledge that is not capable of being articulated, intuitive and embedded in the individual (Polyani 1966), more associated with experience and the embodiment of such. A variant subset within tacit knowledge is a form of social or collective knowledge. Collective knowledge results from connections and synergies of knowing between individual members of a group or departments which is integral to the existing social arrangements. Thus knowledge for sharing what is used within organisations can be found in files, documents, procedures, databases, knowledge bases, experience databases, rules, manuals, people and more.

Knowledge Processes
Different knowledge processes are recommended to deal with each knowledge format to ensure effective knowledge retention and sharing. Depending on the nature of the knowledge work various combinations of the following will be employed in both one off and recurring sharing activities.

Documenting is linked with explicit knowledge (i.e. the knowledge that has been articulated). It refers to the process of documenting procedures, rules and modes of practice in manuals, guidelines, drawings, etc.

Training is a suitable way to ensure the transfer and sharing of explicit/implicit knowledge. Implicit knowledge is the knowledge that has not yet been articulated but can be articulated through various tutoring techniques.

Mentoring: Tacit knowledge is very difficult to articulate, therefore one of the ways to foster sharing and transfer is to put in place a mentoring or master/apprentice relationship this allows the overlapping of knowledge workers to observe, discuss and challenge their understanding by way of a socialised context this can often result in the establishment of knowledge networks that are accessible over extended time and distance.

Collaborating is a way of fostering the sharing and transfer of social knowledge through the establishment of both technical and social networks, common examples being the use of web2 wiki type technologies and “communities of practice” as means of facilitating knowledge sharing among distributed groups.

Limitations:
• This is the first iteration of analysis from the framework
• The framework does not encompass all aspects of the organisation, for example; culture or time requirements.

Knowledge Gap Analysis:
From the preliminary analysis knowledge-gaps have been identified using the framework under the following headings:
• Knowledge Experts
• Knowledge Sharing
• Locating Knowledge
• Training
• The Capture & Documenting of Knowledge

Though there were other issues these were the most notable.

Other Minor Issues:
• Incentivising the sharing and transfer of knowledge by individuals and groups.
• Challenges in relation to the types of knowledge which is being transferred.
• Capacity to establish ongoing linkages both technological and social for the ongoing networking of personnel within the different business units.

Knowledge Experts
• There seems to be an issue surrounding the amount of knowledge experts/owners. Though there is progress in creating functional experts and subject matter experts, the consensus is that there is a lack of expertise in parts of the organisation. This leads to the issue of a general lack of knowledge in certain areas. Further analysis is needed here

Knowledge Sharing
• Cross-functional sharing, collaboration and relationships between the business units at Creganna seems to be one of the major issues. There are knowledge gaps here in that, sharing is poor. There is a serious lack of collaboration and the relationships have been described as a “them and us” type of situation.

Locating Knowledge
• Especially for new employees in Creganna, there seems to be an issue around the location of knowledge from the perspective:
  1. The relevant person.
2. The relevant procedural knowledge (e.g. documents etc).

This may be a marketing problem.

**Training**

- ERP (Oracle) training seems to be an issue. There seems to be a general dislike for Oracle. This may be a cultural thing or maybe linked to a lack of training within Oracle when it first went live, but there are further issues to be explored here.

- UPK as a training tool seems to be an issue. This links back to the knowledge expert issue. As there seems to be a lack of knowledge experts/ownership, the issue around the level of accuracy in the processes recorded on UPK may be delivering inaccurate training or incomplete training.

- UPK intention not understood, only 10%  

- In addition, other issues around UPK as a training tool include, people completing the UPK training but not having a sense they understand the process steps they have completed. This coupled with a lack of a mentoring programme could lead to gaps in what Creganna expects its employees to know, and what they actually know.

**Capture & Documenting of Knowledge**

The network in Creganna is extremely informal. Though in ways this is a good thing. In other ways it works to the detriment of capturing and documenting of knowledge. It has been identified that there is a lack of capturing and documenting in areas.

**Some Preliminary Recommendations:**

To ensure that a KM initiative is implemented successfully, it is important that it not be seen as something apart from the real practice of the organisation, but that it becomes woven into the fabric of the individual’s every-day practice. In other words, a successful KM initiative involves a fundamental change in the attitudes or culture of any organisation.

**Catalysts**

- Education in the understanding of concepts of knowledge and KM techniques particularly in relation to sharing and transfer is a prerequisite in order to understand the intricacies and nature of the challenges that will arise.

- Individuals are more likely to engage with the process of making their knowledge available to others if they perceive that the effort they make is appreciated, valued and respected and they are confident that the knowledge they share will not be abused.

- In order to participate in knowledge sharing, individuals need to be motivated. Motivation can be either extrinsic in the form of pay increases, bonuses, job security or promotion, or in the perception that their efforts will be reciprocated by others; or intrinsic, such as altruism or conscientiousness.
• There may be opportunities in promoting KM initiatives in Creganan by looking at linking progression in this area to critical success factors or perhaps some KPI's. This was raised as a possible opportunity if tapped correctly.

• The support for an experimental approach to the management of some of these initiatives is a significant opportunity to recognize the complexity and unpredictable nature of the outcomes that may develop. An experimental attitude in a period of transition allows for trial and error and periods of reflection on how to make progress going forward.

• A culture that is focused on supporting the retention and transfer of knowledge, top management support, and trust are all essential factors. A culture that fosters knowledge sharing, transfer and capture is the most effective catalyst to the implementation of any KM initiative and by using a best-practice framework to achieve this will help create this culture.

Barriers
• The motivation of staff to actively engage with programs for the sharing of their knowledge.

• Capacity of individual staff to articulate what they know or their ability to know what they know (causal ambiguity) is a key assessment risk.

• Incoming staff may not match the grades/experience of exiting staff leaving a knowledge gap that will be difficult to replace in the short term.

• Incoming staff may not have the skill level to absorb and apply the knowledge being transferred to them in order to do their jobs (absorptive capacity).

• Individuals tend to be visual learners, and therefore need to see something before they understand it. Trying to describe the end result is difficult if the individual really needs to see work in practice.

• Large organizations tend to be risk-averse, and accordingly, if the KM initiative would involve leading the pack, there will be some unwillingness to go out on a limb for something new and untried, recognition and rewards for progressive departments/agencies may help overcome this.

• While technical and logistical barriers must be addressed as part of the overall KM initiative, the cultural barriers are the most critical and must be successfully addressed if the KM initiative is to succeed. How they are addressed should, of course, reflect the different cultures of each organization.

Conclusion
This is the first preliminary analysis of the issues raised by the analysis of Creganna. Much deeper analysis will occur over the next 2 months. These issues will be explored further and a better understanding of these issues will be the outcome.