A Human-Centred Framework For Eliciting Users' Embedded Knowledge Requirements During Information Systems Development.

By
FIONA M. MURPHY

Waterford Institute of Technology
Department of Computing, Maths and Physics

Research Supervisor: Dr. Larry Stapleton

Thesis Submitted to WIT for the Award of
Doctorate of Philosphy
May 2008

Declaration:

The author hereby declares that, except where duly acknowledged, this thesis is entirely her own work and has not been submitted for any degree in Waterford Institute of Technology, or in any other University in Ireland.

Signed: ____________________________________

Fiona M. Murphy

This thesis is dedicated to my grandfather,
'Christy' Butler.
For the picture he will never have.

"We have become far too smart scientifically to survive much longer without wisdom."

Mike Cooley

Table of Contents

Chapter 4: A Working Theory of Eliciting User Embedded Knowledge Requirements for ISD

Chapter 5: Research Methodology

Chapter 6: Findings

Chapter 7: Discussion

Chapter 8: Conclusion

Appendices

Table of Figures

Table of Tables

Acknowledgements

Before I close this chapter on my research journey there are a few people that I would like to thank for all their hard work, support and co-operation throughout the years.

Firstly I would like to thank my supervisor, Dr. Larry Stapleton for giving me the opportunity of doing a PhD and for sticking by me for all those years. I also wish to thank my mentor, Professor Karamjit S. Gill for all his hard work, time and dedication.

To my case companies, I wish to extend my sincerest thanks for all the time, effort and support you have given me, without which this thesis could not have been completed. And I also wish to apologise for all the times I harassed you looking for meetings.

To Mr Paul Barry and Mrs. Mary Barry for their advice, support and gentle push in the right direction. It was greatly appreciated.

To my friends within the ISOL Group, thank you for your support and assistance throughout these past few years and the best of luck to you all in whatever you choose to do with your careers.

To my friends, Michelle, Siobhan, Mary and Damien thank you for your constant encouragement, long chats and all of the much needed distractions.

To Jamie Power, Mary Holden and Felicity Kelleher my sincerest thanks for all the endless help and advice you have given me and for the long chats over coffee when they were needed the most. Thank you all so much.

To my dad, mam, brother and Ruaidhrí words cannot express how much I appreciate everything you have done for me over the past number of years. For all the love, support, encouragement, help and advice you have given me. Thank you from the bottom of my heart.

To my partner, Pat, thank you so much for all the times you were there giving me help, advice and most of all your love. Even when things seemed so complex and I got lost, you were there by my side and helped me find my way again. Thank you.

Finally, thank you to everyone whose names I haven't mentioned and who have helped me throughout this journey.

Abstract

Despite considerable research widely acknowledging that embedded knowledge is a necessity for successful development and implementation of information systems, there has been insufficient empirical research carried out in this area. Existing literature has been significant in directing attention towards the importance of embedded knowledge and the determinants that affect its transfer. However, it offered little insight into the actual knowledge transfer process itself. Thus, the research set out to investigate and understand how user embedded knowledge requirements could be transferred from the user to developer and then elicited by the developer during the systems development process.

An interpretive multi-case study approach based upon interviews, reflective practices, observation and document analysis was chosen. The findings presented in this thesis illustrate the knowledge transfer processes that were used by systems developers to ensure the successful elicitation of the users' embedded knowledge requirements. The analysis of both case studies supported the initial conceptualisations that participation in the users' context, observations, investigation of the informal networks, personal interactions, user collaboration and storytelling result in the transfer of these requirements between the system users and developers. Since this research was interested in understanding the transfer of knowledge for systems development, it relied upon the human centred systems theory for its theoretical explanations.

From this study, a number of important practical and theoretical contributions arose. For example, the detailed case description provided substantial insights into the knowledge transfer processes and techniques that should be employed during every stage of the development lifecycle. By utilising these processes and techniques, developers can ensure that the developed system will meet and support the users' working practices and knowledge needs. Indeed, for these requirements to be successfully elicited, the developer must collaborate and involve the users throughout the development lifecycle at every stage. The research has also contributed to theory by expanding the literature on information systems development. For instance, the development of a model that would allow systems developers to identify and elicit embedded knowledge requirements is a significant contribution to theory as it has not been researched before. Furthermore, this research has expanded the literature on knowledge transfer by illustrating that knowledge transfer processes do not transpire as a sequential orderly progression but are complex and occur simultaneously.

Chapter 1: Introduction

1.1 Introduction to the Research Problem

The Irish Government have recognised that knowledge produced needs to be managed and developed in society as well as in industry, particularly if Ireland is to become a world leading 'knowledge economy' (Forfás, 2005A). Indeed, it was felt that investment in research would generate a great deal of knowledge which would be made available to industry and utilised by companies in order for Ireland to become more competitive on a global level. Despite this strong commitment and investment, much work remains to be carried out before Ireland can realize its ambition of becoming a world-leading 'knowledge economy' (Forfás, 2006)[1]. Links between industry and higher education have remained poorly underdeveloped in terms of research and development (R&D), while private sector R&D had not grown in line with public expenditure in the area[2]. However, in 2007 the state of knowledge transfer between organisations had changed considerably, with Ireland now in line with the OECD average (Forfás, 2007). Closely linked to globalization and increased competition is rapid technological change, which can be brought about through revolutionizing business processes and shortening product life cycles. The capability of Irish organisations to quickly develop and absorb new technologies into their products and processes will be a significant driver for Ireland's future competitive advantage (Forfás, .2005B, 23).

---

[1] The National Development Plan 2000 - 2006 has allocated €2.48 billion to research and development (Forfás, 2005A).

[2] Despite a large increase in R&D expenditure, Ireland is making limited progress towards the Irish (2.5% of GNP by 2013) and the Lisbon (3% of GDP by 2010) targets. Total R&D spending in Ireland increased from 1.32% of GNP in 2000 to 1.59% of GNP in 2006. This compares with an OECD average of 2.26% (2006) (Forfás, 2007, 90).

Although all projects are not destined to fail, the development process finds it difficult to ensure the success of its projects (Goulielmos, 2003). On average, 80 to 90% of information systems (IS) projects fail to meet all of their system requirements (Shore, 2005; Clegg et al, 1997). These failures could in turn, have a significant impact upon Ireland obtaining its status as a world 'knowledge economy'. Current research suggested that many system failures could be attributed to a lack of clear and specific information concerning users' requirements (Alvarez, 2002).

In order for Ireland to reach its ambition of becoming a world leading 'knowledge economy', the systems development industry must produce systems that meet the requirements of the users and supports all their working practices. By meeting these criteria, the systems development industry may ensure that systems development projects could be a success as they would meet the objectives of its users. However, the reason why systems have failed to meet their objectives was due to the lack of attention systems developers paid to the organisational and human aspects of technology (Alvarez, 2002; Clegg et al, 1997). Within the system development literature, requirements elicitation have been regarded as the most critical activity of the information systems development (ISD) process, and poor execution of this stage have guaranteed that projects have failed to meet performance objectives (Hickey & Davis, 2004; Alvarez, 2002; Browne & Ramesh, 2002; Yu, 1997). So the question that needed to be considered was: *what is being done within ISD practices to rectify these problems?*

IS literature have provided systems developers with various different approaches towards eliciting users' requirements. However, in practice, structured methods and tools were more often used for requirements analysis and design. Clegg et al's study determined that these methods "do not work, omit too much, and … are too technical orientated" (1997, 858). By adopting a methodology the development team could focus on the procedures rather than addressing the real business need, thus affecting the emergence of the users' requirements (Avison & Fitzgerald, 2003). Most systems development methodologies have concentrated on the technical process. In addition, they failed to equip the analyst with the tools and the knowledge for dealing with the social processes inherent in IS development (Murphy & Stapleton, 2005; Alvarez, 2002; Hirschheim & Newman, 1991). In particular, the reason IS projects have failed to successfully meet the performance objectives set out by the users was that they focused more on the technical requirements rather than the subjective needs of the users (Huysman & Wulf, 2006; Avison et al, 1999; Clegg et al, 1997). To meet the performance objectives set by the users, the world of the human and the knowledge required for them to carry out their work must be understood during IS requirements gathering.

1.2 Emergence of the Research Problem: A Personal Perspective

The purpose of this section was to set out the motivation for this study and to communicate a general description of the researcher's values, experiences and the world view that has guided this project. For this reason, I am dropping the usual 3rd person language for this section.

There have been a number of significant factors that have provided guidance and direction in carrying out this research. The process began in 2002 with an advertisement in the local newspaper for a postgraduate researcher to study the human impact of systems development. I had just completed my degree in Commercial Software Development, so I decided to apply for the position. After carrying out a detailed interview and presentation with the potential research supervisor, the postgraduate position was offered to me.

During one of my first meetings with my supervisor, I was given a list of about twenty names of different researchers along with a general idea of their research area. As I had covered some of the research topics in my undergraduate course I decided to take a look at the subject area of Reflective Practices and the work of the author, Donald A. Schön. While reading Schön's work, I came across the term 'tacit knowledge' (1987; 1983). I then started thinking about this knowledge in relation to what I had learned while an undergraduate student. I became particularly interested to understand why, if this knowledge was so important and valuable, I was not told about it when I was studying systems development for my degree? Then I started thinking, if this knowledge was important to users of a system, how do systems' developers take this knowledge into account and incorporate it into the development of the system? Essentially, *what are developers doing with this knowledge when developing systems?* Thus, my initial focus for reviewing the literature was on tacit or embedded knowledge[3] (Baumard, 1999; Polanyi, 1967; 1966A; 1966B; 1962; 1961).

However, it was clear to me that while many authors acknowledged that embedded knowledge was a necessity for successful development and implementation of information systems, it had been a largely neglected issue in ISD theory. I realised that most researchers focused on the inputs (e.g. Engström, 2003; Hansen, 1999), or on characteristics of the transfer of embedded knowledge (e.g., Malone, 2002), or on the management of the process (e.g., Kalling, 2003; Haldin-Herrgard, 2000; von Hippel, 1986) or on the consequences of transferring embedded knowledge (e.g., Mascitelli, 2000; Szulanski, 1996). However, there was little attention to the actual knowledge transfer processes that were involved in IS development.

[3] The term embedded knowledge will be used throughout this thesis.

For me this was a critical issue. I felt that this theoretical deficit had serious implications for both practitioners and academics. Without an understanding of the processes involved in obtaining these embedded knowledge needs, academics would be unable to provide practitioners with the processes needed to ensure that the systems development process would successfully meet the users' specifications.

This is where my PhD research began. I realised that the user was the source of the system's requirements and if their knowledge needs were not supported and incorporated into the development process, the likelihood of failure increased significantly. However, due to the embedded nature of this knowledge, users would not be able to articulate their requirements clearly (Haldin-Herrgard, 2000; Schön, 1987; 1983). Thus, the users had to be involved in the development process if the system was to support their embedded knowledge needs (Clegg et al, 1997; Blackler & Browne, 1985; Ives & Olson, 1984).

Therefore, the research problem that emerged and became the focus of this study was: *how can user embedded knowledge requirements be transferred and elicited as part of the systems development process*. I felt that by conducting this research, I could make a significant contribution to theory by providing academics with a greater understanding of the knowledge transfer process. In addition, I felt that this research could provide a significant contribution to practice by providing practitioners with a framework for eliciting users' embedded knowledge requirements.

To address the problem, the research approach that seemed most suitable was the case study approach. By adopting this methodology, I could explore and understand what happened to these knowledge requirements during the systems development process. It would also give the users and developers the opportunity to reflect on their development process and to discuss in-depth how these knowledge requirements were transferred and elicited in the development of the system.

1.3 The Objective, Research Questions and Method

The general objective of this study was to understand how user embedded knowledge requirements could be transferred between the user and analyst and elicited by the analyst for the system development process. The motivation to study the knowledge transfer processes used in the elicitation of the users' embedded knowledge requirements from a systems development perspective was that existing research was incomplete. More specifically, the research questions were:

Question 1: What were the knowledge transfer processes used by systems developers to elicit the embedded knowledge requirements of the systems users during the development process?

Question 2: How do these knowledge transfer processes interact with each other to enable the transfer of the users' embedded knowledge requirements to the systems developer during the development process?

The first question focused on identifying the processes used by the systems developer or analyst to elicit the embedded knowledge needs of the users. The latter question identified how these knowledge transfer processes interacted and overlapped with each other to ensure the successful transfer of the users' embedded knowledge requirements to the developer during the systems development lifecycle in order to support these complex systems.

1.3.1 Method

This study sought to understand the processes that were occurring within the development of an information system that enabled user embedded knowledge to be identified, elicited and successfully supported in the design of that information system. In order to fulfil these objectives, two interpretive case studies were carried out.

1.4 Definitions and Clarifications of Key Concepts

The following sections provided the definitions and usage of the key concepts that were used throughout this thesis.

1.4.1 Information System(s) & Information Systems Development

For this study, the definition of information system(s) was *a computer supported system that provides the users with information concerning certain topics within an organisational context* (Iivari & Hirschheim, 1996). Information systems development referred to the social interplay of multiple actors who attempt to interpret or 'make sense' of their and others' actions, largely through the medium of language (Hirschheim & Newman, 1991, 30).

1.4.2 Requirements & Requirements Elicitation

Requirements were *the embodiment of everything a user values* (Coughlan et al, 2003). For Goguen (1996), requirements were situated in the users' environment and incorporated not only how they were produced but also how they were represented within the users' world. In essence, requirements were embedded in the social worlds of the users and could only be interpreted through an understanding of their context (ibid).

Consequently, requirements elicitation could be thought of as the process of determining the needs of the stakeholders (Hickey & Davis, 2004). For Coughlan et al (2003), successful elicitation involved an understanding of both the problem and the context in which the requirements were located.

1.4.3 Lead User

Lead or key users were defined as, *system users that present strong needs, which in months or years into the future will become general market needs* (von Hippel, 1986). Also, they were the systems users that were positioned to profit radically by obtaining a solution to those needs. Lead users could serve as a 'needs-forecasting laboratory' for research into the market place, as they were familiar with circumstances which were in the future for other system users. "Almost every organisation has individuals who are known to be 'experts' or 'lead users' in a particular system [who] …serve as 'informal consultants' and can be approached for general information, and more importantly, when the trainee is in trouble" (Gallivan, 2000, 55).

1.4.4 Embedded Knowledge & Embedded Knowledge Transfer

Embedded knowledge was *work-related practical knowledge, which is neither expressed nor declared openly, but rather implied or simply understood and is often associated with intuition* (Brockmann & Anthony, 1998). It was non-codifiable knowledge that was acquired through the informal take-up of learned behaviours and procedures (Howells, 1996). It was not easily catalogued and was completely embedded in the individual. It was ingrained into their practice and expertise, and could only be expressed and conveyed through proficient execution and through forms of learning that involved demonstrating and imitating (Fleck, 1997).

For this project, knowledge transfer was defined as *the process by which one unit (person, group etc.) is affected by the experience of another* (Grant & Gregory, 1997; Howells, 1996). It was well argued in the literature, that embedded knowledge did not travel easily from one person to another (Roberts, 2000; Fleck, 1997). Fleck argued that embedded knowledge was part of the individuals' natural behaviour and thinking, therefore expressing and sharing this knowledge form was complex as individuals were not always aware of the range of their own knowledge (Baumard, 1999). In essence, the articulation of something that was obvious and natural was difficult and the more experience one has, the greater the level of embeddedness of the knowledge, which in turn can lead to greater difficulty in the articulation of that knowledge (Haldin-Herrgard, 2000). The successful transfer of this knowledge resulted in changes in the knowledge or performance of the recipient unit and required the individual to make changes to their existing behaviour (Argote & Ingram, 2000; Howells, 1996).

1.4.4 Practice & Practices

A subtle difference existed between practice and practices. In essence practice was *an activity*[4] *that seeks a goal*, while practices are *"ingrained habits of embedded knowledge", which make up the activity system* (Turner, 1994, 8). Burstein & Linger (2003) referred to practices as 'knowledge work', which was the collection of actions that made up a task. This form of knowledge consisted of explicit and embedded knowledge held by the community carrying out the practice (Burstein & Linger, 2003). Thus, one cannot exist without the other, as practices shape and are shaped by the goal-seeking behaviour of the practice or activity (Jarzabkowski & Wilson, 2002). In other words, the practice was the process that allowed individuals to experience

[4] Schön argues "practice refers to the performance in a range of professional situations", however it also is the preparation prior to performance (1983, 60). Furthermore, practice consists of an element of repetition, which in turn creates specialists in that practice.

the world through meaningful engagement, since it evolved as shared histories of learning (Wenger, 2004). The development of a practice required the formation of a community, where members could connect with one another and recognize each other as participants (Wenger, 1998).

1.6 Structure of Thesis

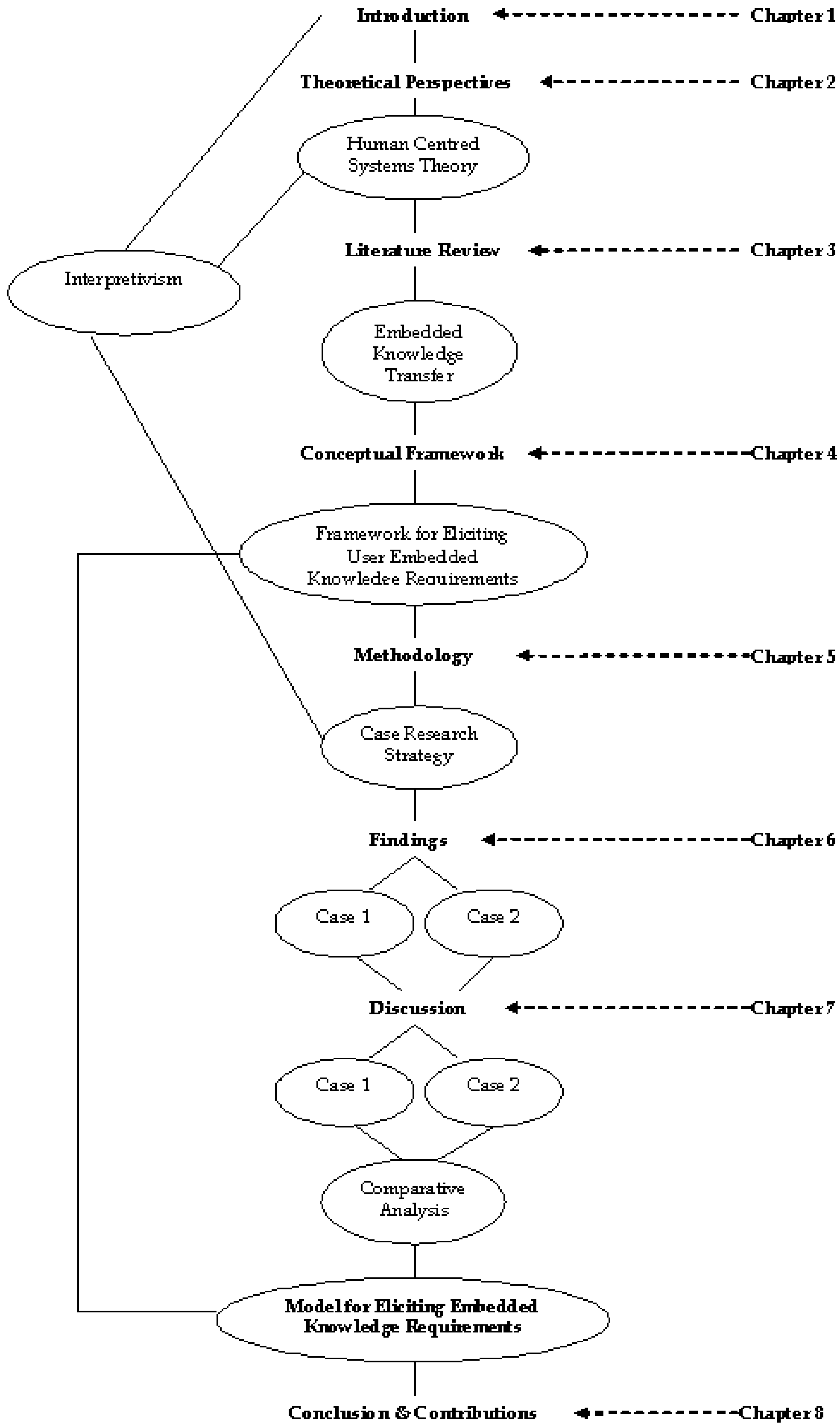
Figure 1.1 presented an overview of the thesis structure. Chapter one introduced the context of the research problem. Also, the objective of the research was set out, the research questions, the motivation behind the research, the methodology chosen and the clarification of key concepts.

In Chapter two, theoretical perspectives pertaining to IS development were evaluated as to their applicability to the research problem. The main body of this chapter set out the human centred systems theory as a reputable theoretical basis for understanding how users' embedded knowledge requirements could be successfully elicited, in light of the philosophical foundations of this study.

Chapter three dealt with the key concepts of this study in relation to embedded knowledge: the processes used to successfully transfer and elicit embedded knowledge. The context that these transfer processes would be used in, namely the community of practice of the users, was also explored.

Chapter four introduced a conceptual theoretical framework as to how the systems developer would identify the embedded knowledge needs of the users by taking into account the community of practice needs of the users who will be supported by the system. This included some working propositions that would be addressed in the findings from the case studies.

Figure 1.1: A Pictorial Representation of the Structure of the Thesis



Chapter five set out the methodological overview of the current study. The foundation and justification for the research approaches chosen to investigate the research objective was clarified. This chapter also set out some problems encountered while conducting the research and how they were overcome. The chapter concluded with a discussion on the credibility, dependability, transferability and confirmability of how the data was gathered, analysed and interpreted.

The findings from each of the case studies were set out in Chapter six. This chapter focused on the transfer of knowledge requirements between the development company and both user companies during the development of their respective system. It also illustrated a comparative analysis of the main findings identified from each case.

Discussions of the findings from each case study in relation to the literature on the research area were reported in Chapter seven. This was followed by a comparative discussion on the overall findings and the literature. The discussion resulted in a revised theory for embedded knowledge transfer that could be used by developers to understand the working practices of users and when eliciting users' embedded knowledge requirements for systems development.

Finally, Chapter eight concluded with a discussion of the findings of this research in relation to the research objective identified in Chapter one. The chapter also presented a realistic discussion of the limitations of this research study, the theoretical, practical and methodological contributions of the study and the future directions this research may take.

Chapter 2: Systems Theories

2.1 Introduction

The traditional orthodoxy of the ISD process has been overly dominated by a functionalist perspective. Rational explanations were sought concerning how individuals and society interacted (Hirschheim & Klein, 1989; Burrell & Morgan, 1979). The focus of systems developers have been directed towards the development of a technical artefact. The role of human choice and the systems users have disappeared into the background (Dahlbom & Mathiassen, 1993; Klein & Lyytinen, 1985). Knowledge and requirements were seen as stable, ordered and structured (Klein & Lyytinen, 1985; Argyris, 1971) whereby attention centred on prediction and explanation. In essence, systems development has concentrated on what was to be modelled and how to model it (Wood & Wood-Harper, 1994). What can be understood from this was that "technologists adopt a rather mechanistic view … [and] users are still not involved enough" (Clegg et al, 1997, 860).

Systems developers have to address fundamental human aspects that make up organisations (Avison et al, 1999). "Failure to include [these] human factors may explain some of the dissatisfaction with conventional information systems methodologies [as] they do not address real [organisational issues]" (ibid, 94). Huysman & Wulf (2006) essentially made the same point. They argued that, disappointing acceptance rates with system development were caused by developers only perceiving the system as a technical artefact and ignoring the human element of it. Hence, the analyst must understand how the systems users operate their interactive systems and the way that they manage and process their knowledge requirements. If these needs were not taken into account then the system would not support all the knowledge needs of the users. Thus, the question that needed to be addressed was *what systems theory was more applicable to addressing the human aspects of systems development in order to overcome these difficulties with IS development?*

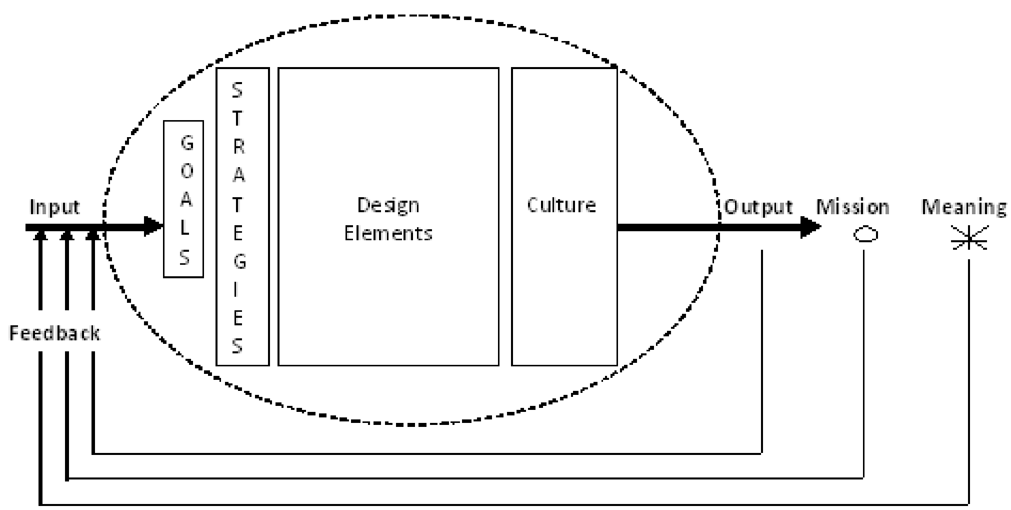
Within ISD several theoretical positions have emerged over the years. These were summarised as, a general, a closed or an open systems approach. The remainder of this chapter provided a discussion of which theoretical position was more applicable for this research and the philosophical foundations underlining this position.

2.2 General Systems Theory

For Boulding (1956), the main objective of general systems theory was to enable a specialist from one discipline to catch relevant communications from other disciplines in a language that could transcend all disciplines. General systems theorists believed that across various different sciences a single set of concepts or theoretical constructions could be applied (Katz & Kahn, 1966; Miller, 1965A; 1965B; 1955) where gaps in empirical knowledge could be revealed (Checkland, 2000). A further concept of this theory was feedback. Feedback loops are either negative (weakening) or positive (enforcing) (Tschiersch & Schael, 2003). They are used for the stabilisation of a system or for the direction of actions towards a goal where the results of that goal are fed back, as information, until the goal has been reached (von Bertalanffy, 1968). Figure 2.1 highlights an example of a feedback loop for an open, socio-technical-economic system. This figure showed the importance of feedback mechanisms in stabilising complex social systems, especially where system design activities are an integral part of the overall system itself, as is typically the case in large-scale information systems development

(Stapleton, 2000). It also demonstrated the complex nature of the feedback mechanisms themselves, in this case affecting system activity at various levels, including the systems which shape meanings within the socio-technical context. The possible contribution of general systems theory to this study may have been in explaining how embedded knowledge could be identified, used and transferred between the analyst and user, as the user would receive almost instantaneous feedback that would determine whether the knowledge transfer was a success. However, several fundamental problems existed with this theory. First, its focus was on biochemical and biological levels of phenomena and explanation, resulting in a "high-level meta-theory of systems, [that were] mathematically expressed" (Checkland, 2000, 93). Embedded knowledge cannot be mathematically stated as it was held within the individuals' practices and their working context.

Figure 2.1: The Open, Socio-Technical-Economic System
(Source: Henning & Marks, 1989, cited in Tschiersch & Schael, 2003).



Second, it was easier to focus on the static, stable relations of elements, rather than the dynamic interactions that comprised an open system (Katz & Kahn, 1966). Thus, organisational roles and the relations between those roles have been viewed as being independent of the personal attributes of the individuals who occupied that position within the organisational structure. In essence, this theory sought to identify the underlying regularities and structural uniformities which exemplified the world in general (Burrell & Morgan, 1979; Buckley, 1967). Embedded knowledge was interactively produced and transferred through social interaction and collaboration, not through a process that was stable and closed. Accordingly, many approaches labelled systemic and adopting this approach were in actuality closed and static (Burrell & Morgan, 1979; Katz & Kahn, 1966). Third, as argued by Naughton (1979), "there is nothing approaching a coherent body of tested knowledge… rather [it was] a mélange of insights, theorems, tautologies and hunches" (cited in Checkland, 2000, 93). For these reasons, the general systems theory was removed from consideration as a perspective underlying this research.

2.3 Closed Systems Theory

The next theoretical paradigm that could have been considered for this research was the closed systems theory. This view failed to take into account organisational environments and was based upon the assumption that organisational behaviour was highly constrained, rigid and could be reduced to a useful purposeful description (Stapleton, 2000; March, 1987; Scott, 1987; Katz & Kahn, 1966). Organisations were perceived as *machines*, and it was the analyst's task to make these machines more efficient at fulfilling their purpose (Stapleton, 2001). The closed systems approach applied rational frameworks to understand how embedded knowledge requirements could be elicited and transferred from the user to the developer.

However, embedded knowledge was not ordered and unchanging, and it cannot be easily catalogued. It was shared through the informal take-up of learned behaviours and procedures (Howells, 1996). For Burrell and Morgan, as "a theoretical perspective in social science, the notion of a closed system tends to be avoided like a dreaded disease" (1979, 60) given that the user would be required to produce *information* and make explicit what was known. Knowledge was something that we each possess. It was interwoven within our practice, and was normally dependent on a definite situation (Fleck, 1997). Since this approach was based on the assumption that the world we were trying to understand and manage was itself an ordered and fundamentally unchanging system it did not consider or capture the complexity of knowledge transfer, or knowledge that was embedded within the system user, their environment or their practices and so, it was also removed from theoretical consideration (Dahlbom & Mathiassen, 1993).

2.4 Open Systems Theory

The third theory underlying ISD was open systems theory. Open systems do not exist in isolation (Vickers, 1983). In essence, there was a close relationship between a structure and its environment, which required continuous inputs or the system would deteriorate, in other words, the principle of entropy (Daft, 1998; Katz & Kahn, 1966). Open systems theory perceived each individual as having different and/or similar interests, with each attempting to obtain something from the collectivity by interacting with others (Pfeffer & Salancik, 1978). Essentially, one of the main contributions of this perspective was the recognition that many social systems contained elements (e.g. individuals) that were only slightly related to other elements and, were capable of autonomous actions (Scott, 1987; Weick, 1992).

Several problems existed in relation to choosing the open systems theory as argued here. First, while this theory was applicable to dynamic *recurring* processes (Katz & Kahn, 1966), when put into practice, it often resulted in a vague form of empiricism that ignored the processual nature of the systems concept (Burrell and Morgan, 1979). Embedded knowledge was part of the individuals' natural behaviour and thinking, and was ingrained in their working practices. This knowledge also changed according to new phenomena being encountered, which this approach did not take into account (Howells, 1996; Searle, 1995). Second, the openness concept that this approach espoused was "constrained by the assumption that the system was stable" (Burrell & Morgan, 1979, 159). When this approach was used in practice, open systems theorists often found that they ended up turning to more traditional, structured approaches, which in turn, viewed knowledge as static and unchanging (ibid). Embedded knowledge was not stable and was difficult to codify. For theses reasons, the open systems theory as argued here was disregarded for consideration as an applicable theory on which to base this research.

However, while not taking an extremist position in relation to open systems theory as discussed above, there were several different perspectives based upon this theory that could have been applicable to this research. These were the socio-technical systems approach (Katz & Kahn, 1966) and the human-centred systems approach. Each of these would now be discussed in turn.

2.4.1 Socio-Technical Systems Theory

The British socio-technical theory based upon the works of Trist (1958) and Emery (1959) emerged under the influence of The Tavistock Institute in the aftermath of World War II. One of the founding principles guiding their approach was that if a technical system was developed at the expense of the social system, the results would be sub-optimal (Mumford & Beekman, 1994). Essentially, this perspective considered the joint optimization of both the social and technical systems to be important. The US socio-technical approach placed considerable emphasis upon the goodness of 'fit' between the social and technological aspects of the organisation, where work and user satisfaction would be ensured. This perspective enabled the users to contribute to a high level of technical efficiency during the development process (Mumford, 1994). Also, it placed considerable emphasis on the psychological needs of the workers (Katz & Kahn, 1966). It recognised that socio-psychological factors were built into work technology and that the organisation itself had its own social and psychological properties that were independent of that technology (Burrell & Morgan, 1979).

However, there were several limitations to these theoretical perspectives when applied to this study. Instead of using the existing work structures that were already in place within the organisation, socio-technical 'fit' sought the discovery or invention of a new work-group structure to use the new technology (Katz & Kahn, 1966, 717). Gill (1996B) argued that users' knowledge and their practices, namely the work structures in place, needed to be supported by the system rather than be replaced by it. Also, for Scott, this theory was only "deemed suitable to mechanized organisations with moderate levels of uncertainty and interdependence" (1987, 233). Embedded knowledge was dynamic. It was created and used across social networks and was 'held' in the minds and practices of various different individuals, each of which perceived the knowledge differently. Therefore, although the social-technical approach emphasised the social organisation of work groups, it failed to place significance on the design of individual practices (Scott, 1987). For these reasons, the socio-technical systems theory was disregarded from consideration.

2.4.2 Human Centred Systems Theory

A second development of traditional open systems theory was the human-centred systems approach. This theory considered "human development, human creativity and human knowledge as the central basis for technological developments" (Gill, 1986, 8). It recognised that systems were developed to take into account and complement the human skills of the user(s) and that they must be adaptable to the changing needs of those users (ibid). It acknowledged that systems were composed not only of information, but also the social relationships that were intrinsic within the organisation. Human centred systems perceived individuals as an integral part of society rather than as an organisational component reducible to a set of rational steps (Gill, 1996B).

The dominant focus of most systems developers had been a positivist approach to development. At the heart of this perspective were the concepts of the separation of the human user from the system, rationality and the notion of rule following. In this context, rules were seen as "a structured knowledge representational vehicle… for passing on knowledge on how best to carry out some task, function or activity" (Klein & Hirschheim, 1996). However, human knowledge, particularly embedded knowledge, which cannot be explicated in the form of rules, was neglected by systems developers. This in turn, led to technology being developed which did take into account all of the knowledge and reality of the users, thus resulting in vulnerable and brittle systems (Gill, 1996A; 1996B).

Technological advances needed to consider change and the social dimensions in the work place, such as learning and living (Brandt & Cernetic, 1998; Gill, 1996B). Embedded knowledge was not only inherent within the individual but also resided in the user community in the form of a social knowledge base or a network of social knowledge bases (Brandt & Cernetic, 1998; Gill, 1996B). This theory challenged the traditional notions of separating the individual from the community. It was only through the sharing of experiences that a shared image of desirable futures could be envisioned (Damodaran, 2001). For Dougherty, "technology provided us with incredibly useful tools for efficient information transfer, but IT should only be seen as that, as a tool" (1999, 263). The human centred systems perspective questioned not only the objectification of experiential knowledge, but also the social and professional knowledge of the users at all levels (Gill, 1996B). Technology needed to come second in priority to the embedded knowledge residing in the community.

To counter these problems of rule following, the human centred systems theory was based upon the premise of a symbiosis between the human and the machine, technology and knowledge, 'objective' knowledge and the 'embedded' dimension of knowledge (Gill, 2002). A balance was sought between the organisation's human skills in relation to automation. For Cooley (1996A), this symbiotic relationship would allow the human to handle the qualitative, subjective judgements and the machine the quantitative elements. The system would then support human skill and ingenuity instead of the objectivisation of the knowledge held by the users (Brandt, 2007; Cooley, 1989). Thus, this theory argued that the development of technology needed to be concerned, not only with the technical feasibility of the system, but also with the social desirability of the system (Rasmussen, 2007; Gill, 1996B). It emphasised collaboration rather than the separation between the human and the machine in the development of socially useful technology. This was a major contribution of this theory to the study of embedded knowledge transfer as the users must be included in the development process at the earliest possible stage (Brandt & Cernetic, 1998;

Rosenbrock, 1992). They were the ones who know their practice, their reality and their knowledge.

For technology to be deemed socially useful, its development must be centred upon human needs and skills. These systems must enhance human opportunities, assist humans in the decision-making process and in turn, enhance social communication, cognitive competences and skills within the community that the users are a part of (Brandt, 2007; Gill, 1986). Essentially, systems must be developed that would take into account not only knowledge of the users' needs and expertise, but also knowledge concerning their social and cultural environments (ibid). For Gill (1996), the development of such systems would ensure that the existing skills of the users would continue to develop through experience with the new system and into skills which the changing technology requires. Thus, existing skills were seen as dynamic and relevant, rather than static and useless. This was necessary for the transfer of embedded knowledge between users, as it was a dynamic process that changed with new practices and people entering into and out of the community.

In addition, it was recognised that if technology were to be designed as an efficient tool for system users then there had to be a move from user-centred systems design to user-involved design (Gill, 1996A). To develop systems using this approach, user collaboration, cooperation, coordination at the work place and other group and participatory activities would be better facilitated between the developers and the system users. The main reason for this move from user-centred towards cooperative design was in the way systems developers would perceive the user (ibid). With the user-centred approach the user was regards as a human factor. However, in the user-involved perspective the user was deemed a human actor. By only viewing the user as a human factor, the human was only perceived as a component of the machine system that could be factored into the design equation, where all human characteristics were neglected by the system developer (Gill, 1996A). However, by adopting the human actors approach, the human would be regarded as an autonomous agent by the developer. This approach emphasised the holistic nature of the person acting in their context rather than as merely an information processing mechanism for technology (ibid).

Systems designers adopting a human centred systems approach have adopted the user-involved perspective and have tried to produce systems that satisfy the users' needs, desires and expectations, by establishing a genuine understanding of the various user groups in the organisation, based on the context of their activities, competences and desires (Damodaran, 2001). Designing information systems based upon this theory required user participation and dialogue in the development process at a very early stage. This was due to the fact that it was the users who can best judge the degree of human-centeredness to be included in the system being developed in its working context (Brandt & Cernetic, 1998). For Damodaran (2001), it was the clarity of the users' requirements that provided the foundation for the exploration of appropriate design solutions, which was crucial to achieving a human-centred system. In accordance with the human-centred systems theory, the development of an IS must consider the situated context and the embedded knowledge needs of the users to ensure that the developed information system successfully complemented and supported the users' needs and requirements. The following discussion looked at how the human centred systems theory was applied to this study.

2.5 A Human Centred Systems View of the Embedded Knowledge Transfer Process

Approaching a human centred view of the transfer of embedded knowledge was not a simple task. Depending on the ontological position of the researcher, different perspectives of what a human centred system was began to materialise (Mingers & Willcocks, 2004). For example, an ontology that took the view that the social world predated humanity and that it existed independently of an individual's appreciation of it (objectivist), would produce a fundamentally different perspective of a human centred system, than an ontology positing that the social world was an emergent social process created and maintained by the individuals involved in it, whose social world cannot exist as anything other than a subjective construction (interpretivist).

From an objectivist perspective, a human centred system would be perceived as linear and static. The knowledge transfer processes between the developer and the users would be conceptualised as occurring in an orderly progression from one phase to another, since the social world comprised of concrete artefacts and relationships that could be identified and studied through rational explanations, without any reference to the emotions, meanings and constructions people attributed to their experiences and reality (Easterby-Smith et al, 2001; Burrell & Morgan, 1979). For example, the models of Kwan & Cheung (2006), Tuggle & Goldfinger (2004) and Gilbert & Cordey-Hayes' (1996) would be synonymous with this perspective. Viewing human centred systems from this perspective would allow the researcher to explain and predict the nature of relationships among constituent elements within the users' social world (Burrell & Morgan, 1979). Valid knowledge obtained from such a concrete view of knowledge transfer could only be discovered through measurement, such as with quantitative analysis (Morgan & Smircich, 1980).

For interpretivists, the perspective of human centred systems as depicted above was inadequate. Interpretivists perceived individuals as a fundamental part of society, not an organisational element reducible to a set of rational steps (Gill, 1996B). From this perspective, knowledge transfer was perceived not as a linear process but rather as dynamic processes that might occur simultaneously (Boland & Tenkasi, 1995). For proponents of the interpretivist perspective, the social world and reality of the systems users was a projection of individual cognition and imagination and how these individuals structured their world within the realm of their own experiences. Thus, the focus was on the meaning of social phenomena rather than its measurement. Essentially, the goal was to understand and explain a problem within its contextual setting instead of cause and effect, as the phenomenon being investigated was undergoing a process of continual creation (Easterby-Smith et al, 1991; Hirschman, 1986). Therefore, in contrast to the objectivist's linear depiction of the knowledge transfer processes, the interpretivist would view the concept as an iterative process that continuously cycled and recycled until embedded knowledge had successfully been transferred from one individual to another.

All this raised the following question: *which view of human centred systems was applicable to understanding the embedded knowledge transfer process for successful elicitation of users' embedded knowledge requirements for information systems development?* §2.1 showed how the objectivist perspective led to significant problems in IS development due to its neglect of the social aspects of development in relation to the systems' users embedded knowledge requirements (Murphy & Stapleton, 2005; Alvarez, 2002; Clegg et al, 1997; Hirschheim & Newman, 1991). Therefore, using the schema developed by

Morgan and Smircich (1980) (Figure 2.2), the position put forward by this research was that of an interpretivist perspective of human centred systems but not from the extremist position as depicted above.

The interpretivist view adopted by this research was as follows. Members of communities created their own reality through the use of a common language, shared experiences and belief systems and by performing and shaping their practices. Accordingly, in terms of ontology for this research, the world was viewed as a continuous process that was socially constructed by the individuals who happened to share it. Reality was contained in the world of the social subject and intersubjective experiences and meanings.

Figure 2.2: The Four Paradigms for the Analysis of Social Theory
(Source: Adapted from Morgan & Smircich, 1980).

	Interpretivist Approach to Social Science					**Objectivist Approach to Social Science**
Core Ontological Assumptions i.e. Reality	Reality as a projection of human imagination	Reality as a social construction	Reality as a realm of symbolic discourse	Reality as a contextual field of information	Reality as a concrete process	Reality as a concrete structure
	Nominalism					**Realism**
Basic Epistemological Stance	To obtain phenomenolog ical insight, revelation	To understand how social reality is created	To understand patterns of symbolic discourse	To map contexts	To study systems, process, change	To construct a positivist science
	Subjectivism					**Positivism**
Assumptions about Human Nature	Man as pure spirit, consciousness, being	Man as a social constructor; the symbol creator	Man as an actor; the symbol user	Man as an information processor	Man as an adaptor	Man as a responder
	Voluntarism					**Determinism**

In relation to the researcher's view of human nature, Burrell and Morgan (1979) argued that one may take an intermediate position, as it allowed for the influences of both situational and voluntary factors in understanding the activities of individuals. Thus, for this research, individuals were seen as both deterministic and voluntaristic. Humans were born into a structured society, yet this reality evolved through their interaction with it. Man may freely come and go within societal divisions, reject or accept existing reality structures, and use knowledge in accordance with the ways they see as appropriate. Thus, the position adopted for human nature perceived man as a social constructor and creator of symbols, which in turn, was directly related to the researcher's ontological perspective. For Morgan and Smircich (1980), epistemology focused on identifying the methods used by individuals in their everyday life to subjectively create an agreed or negotiated social reality. The epistemological position of the researcher was to understand how the users' social reality was created and how they transferred their embedded knowledge needs to the systems developers. As can be seen, the epistemological stance of the researcher directly related back to the ontology and view of human nature perspectives as illustrated previously.

Adopting this outlook of human centred systems allowed the study to derive a deeper understanding of what knowledge transfer processes were needed for the successful elicitation of users' embedded knowledge requirements for information systems development[5]. Thus, by taking this analytical view, it was felt that the research should yield deeper insights into the processes needed for successful knowledge transfer to occur. The following chapter provided a review of the embedded knowledge transfer literature from this theoretical perspective.

---

[5] However, it should be noted that this view is not exclusive and that other paradigms in the schema may be integrated to widen the approach taken by the researcher.

Chapter 3: Embedded Knowledge Transfer

3.1 Introduction

The purpose of this chapter was to examine the embedded knowledge transfer process between the users and the developers, that is consistent with an interpretivist philosophical position as argued in Chapter two. As previously discussed, the rationale for this study concerned the inclusion of the users and their situated context in the development of the IS. The rest of the chapter was organised as follows. In the following section, there was a brief discussion of where the literature was located and its extensiveness, which was followed by an examination of the current state of the literature. Next, the transfer of embedded knowledge from a community of practice perspective was presented, where several themes that would enable embedded knowledge to be successfully transferred were identified and discussed.

3.2 The Embedded Knowledge Transfer Literature

The literature review encompassed empirical research and conceptualisations by researchers published in over 61 journals from a variety of specialisations, with years ranging from 1961 to 2007. The studies finally presented for review were selected after conducting an exhaustive search of business, computing, psychology and sociology databases (e.g. Emerald, ABI/Inform, ACM Digital Library and Science Direct). These articles were identified using key words and checking each piece of referenced literature to ensure that no other works were omitted from the review. The journal catalogues where the articles appeared were systematically examined and studied to ensure that no important articles were omitted from the review process. Articles not contained in databases were ordered through inter-library loans. In total, 129 journal articles, conference papers and books were reviewed for this literature. Table 3.1 provided an overview of the list of journals that were used for the embedded knowledge transfer literature review and the number of articles from each journal.

From the review of the knowledge transfer literature, it was identified that most of the research centred on the inputs needed for knowledge to be transferred, the characteristics of the transfer process, consequences of transferring knowledge and management of the transfer process (Table 3.2). Furthermore, while conducting this literature review, the researcher became aware that very little systematic attention had been devoted to understanding the transfer processes that occurred during the elicitation of embedded knowledge requirements between the analyst and the users during the ISD process. However, as can be seen in Table 3.2, notable exceptions existed within the literature (Kwan & Cheung, 2006; Garrety et al, 2004; Selamat & Choudrie, 2004; Tuggle & Goldfinger, 2004; von Hippel & Katz, 2002; Flynn & Jazi, 1998; Darke & Shanks, 1997; Gilbert & Cordey-Hayes, 1996; Boland & Tenkasi, 1995) and a critique of each would be now presented.

3.2.1 Knowledge Transfer Process Perspective

From a knowledge transfer process perspective, Kwan and Cheung (2006) proposed a four stage process model for the successful transfer of knowledge for technology development. Their model comprised of the following steps:

Table 3.1: Key Journals Used for the Embedded Knowledge Transfer Literature Review

JOURNAL NAME	NUMBER
Administrative Science Quarterly	4
AI & Society	2
California Management Review	3
Communications of the ACM	1
Corporate Communications	1
Decision Support Systems	1
Ergonomics	1
European Management Journal	1
Harvard Business Review	1
Human Relations	1
Human Systems Management	1
IBM Systems Journal	1
Information & Management	1
Information & Organisation	2
Information & Software Technology	1
Information Society	1
Information Systems Journal	2
International Journal of Accounting Information Systems	2
International Journal of Human Resource Management	1
International Journal of Information Management	3
International Journal of Project Management	2
International Journal of Technology Transfer & Commercialization	1
Ivey Business Journal	2
Journal for Quality & Participation	1
Journal of Database Management	1
Journal of Economic Geography	1
Journal of Engineering Technology Management	1
Journal of Enterprise Information Management	1
Journal of High Technology Management Research	1
Journal of Intellectual Capital	1
Journal of Knowledge Management	10
Journal of Management Information Systems	1

JOURNAL NAME	NUMBER
Journal of Managerial Issues	1
Journal of Marketing	1
Journal of Organisational Change Management	1
Journal of Product Innovation Management	2
Journal of the American Society of Information Science & Technology	1
Journal of the Operational Research Society	2
Journal of Workplace Learning	1
Knowledge & Process Management	1
Knowledge Management Research & Practice	1
Logistics Information Management	1
Management Decision	2
Management Learning	1
Management Science	7
Mind	1
MIS Quarterly	1
Organisational Behaviour & Human Decision Process	1
Organisational Dynamics	1
Organisational Science	7
Organisational Studies	4
Organisations	1
Performance Improvement Journal	1
Project Management Journal	1
Research & Development Management	1
Research Management	1
Strategic Change	2
Strategic Management Journal	3
Technology Analysis & Strategic Management	6
Technovation	1
The Information Society	1
Conferences Papers / Books	20
TOTAL	**129**

Table 3.2: Approaches to the Study of the Concept of Eliciting Embedded Knowledge Requirements

Research Focus	Authors
Inputs necessary to transfer embedded knowledge	Brachos et al (2007); Kalla (2005); Desouza (2003); Engström (2003); Reagans & Mc Evily (2003); Freidus & Hlubinka (2002); Augier et al (2001); Linde (2001); Swap et al (2001); Argote & Ingram (2000); Gupta & Govindarajan (2000); Roberts (2000); Wenger (2000); Hansen (1999); Blackler (1995); Orlikowski & Yates (1994)
Consequences of transferring embedded knowledge	Jasimuddin et al (2005); Joshi et al (2004); Droege & Hoobler (2003); Hansen (2002); Lubit (2001); Subramaniam & Venkatraman (2001); Gallivan (2000); Mascitelli (2000); von Hippel (1998); Szulanski (1996); von Hippel (1994); Kogut & Zander (1992)
Characteristics necessary to transfer embedded knowledge	Joshi et al (2007); Parent et al (2007); Wang et al (2007); Yakhlef, (2007); Foos et al (2006); Huysman & Wulf (2006); Ruuska & Vartiainen (2005); Connell et al (2004); Levin & Cross (2004); Alshawi & Al-Karaghouli (2003); Connell et al (2003); Malone (2002); Jarvinen & Poikela (2001); Augier & Vendelo (1999); Swan et al (1999); Howells (1996); Kogut & Zander (1996); Brown & Duguid (1991); Cohen & Levinthal (1990); Polanyi (1961)
Management of embedded knowledge transfer	Eskerod & Skriver (2007); Jasimuddin (2007); Hsiao et al (2006); Sherif et al (2006); Cabrera & Cabrera (2005); Davis et al (2005); Duguid (2005); Kimble & Hildreth (2005); Østerlund & Carlile (2005); Karlsen & Gottschalk (2004); Malik (2004); Wenger (2004); Bresnen et al (2003); Gertler (2003); Kalling (2003); Koskinen (2003); McInerney (2002); Orlikowski (2002); Johannessen et al (2001); Haldin-Herrgard (2000); Lam (2000); Platts & Yeung (2000); Wong & Radcliffe (2000); Ferran-Urdaneta (1999); McDermott (1999); Scarbrough (1999); Bennett (1998); Leonard & Sensiper (1998); Madhavan & Grover (1998); Grant & Gregory (1997); Lam (1997); Grant (1996A); Grant (1996B); Herstatt & von Hippel (1991); Urban & von Hippel (1986); von Hippel (1986)
Attention directed at eliciting the embedded knowledge requirements of the users	Kwan & Cheung (2006); Garrety et al (2004); Selamat & Choudrie (2004); Tuggle & Goldfinger (2004); von Hippel & Katz (2002); Flynn & Jazi (1998); Darke & Shanks (1997); Gilbert & Cordey-Hayes (1996); Boland & Tenkasi (1995)

(i) motivation, (ii) matching, (iii) implementation and (iv) retention, and was based upon an extensive and critical literature review. While these authors did focus on the determinants for successful knowledge transfer at each stage of their model, they failed to go into any great detail on the actual processes that could be used to transfer the knowledge for technological development. Nonetheless, it did not take away from the importance of their view that the transfer of knowledge was a sequence of events, with several iterative steps, continuing until all knowledge had been successfully transferred to and retained by the analyst. They argued that the organisation must actively encourage the transfer of their users' embedded knowledge to the developers in order to ensure the success of the knowledge transfer process (Kwan & Cheung, 2006; Koskinen, 2003).

3.2.2 Knowledge Management Perspective

From a knowledge management position, Selamat and Choudrie (2004) proposed a conceptual model for the diffusion of embedded knowledge grounded in the role of the meta-abilities of the individuals involved. For these authors, embedded knowledge resided in an individual's mind. Capabilities such as cognitive skills, self knowledge, emotional resilience and personal drive, must be developed in order to externalise the embedded knowledge in the form of ideas, actions, reactions and reflection. Knowledge stewards would then be able to document the externalised embedded knowledge and transfer them into explicit knowledge (such as business reports, written descriptions and instructions etc.), which in turn could be used by a systems analyst to codify. Particularly noteworthy about Selamat and Choudrie's work was that it offered a theoretical framework for capturing embedded knowledge through the use of meta-capabilities, resulting in information that might be uncovered and used by the entire organisation. However, their conceptualisation was incomplete. Their focus was based on documenting and externalising embedded knowledge, rather than allowing the analyst to understand the knowledge and its uses within its context. In essence, in their model the analyst was still removed from the transfer process, which raised a serious doubt on the ability of the analyst to understand the nature of the externalised knowledge in relation to its context and content (Wood & Wood-Harper, 1993).

Also, from a knowledge perspective, Gilbert and Cordey-Hayes (1996) argued that the transfer of embedded to embodied knowledge involved the diffusion throughout the organisation of its knowledge and faith, which in turn, allowed the individuals within it to learn and communicate that knowledge to the organisation. They recommended a five stage process: (i) acquisition, (ii) communication, (iii) application, (iv) acceptance and (v) assimilation. For these authors, knowledge was "not conscious, it is part of the natural and spontaneous process of belief and attitude formation that continues throughout life" and it was through the reinforcement of these beliefs and attitudes that facilitated the development of practices, codes and languages that the organisation and its members learned to transfer their knowledge and core beliefs (Gilbert & Cordey-Hayes, 309). The importance of Gilbert and Cordey-Hayes' work was the notion that communal practices, codes and languages created the environment for the transfer of knowledge. However, while their model did provide an insight into the stages needed for the transfer process to be a success, it nevertheless failed to address the critical issue of w*hat actually occurred within those stages?* Consequently, their model lacked the depth needed to explain the process of knowledge transfer.

3.2.3 Human Systems Perspective

Adopting a human systems management point of view, Tuggle and Goldfinger (2004) presented an interesting concept for mining embedded knowledge from process maps. They proposed that embedded knowledge could be extracted from key organisational processes by: (i) focusing attention on those processes, (ii) mapping them, (iii) verifying that the process map was an accurate one and (iv) identifying the knowledge capture opportunities and deriving inferences from them. While this study did provide a framework for capturing embedded knowledge, it did not necessarily provide a clear understanding of how embedded knowledge was transferred. Its over-dominance of mechanistic processes led to a generic explanation of how knowledge was transferred and so did not provide an in-depth understanding of the complexity that was involved in the transfer. Nevertheless, it did not negate the importance of Tuggle and Goldfinger's insight that embedded knowledge could be elicited through a sequence of events.

From a more user-centred perspective, toolkits were offered by von Hippel and Katz (2002) as a mechanism of transferring need-related aspects of development to the users. For these authors, a basic package could be developed as a standard, allowing users to customise the package based upon their needs using personal toolkits. Yet, the toolkit approach proposed by the authors had a number of problems. First, it tended to ignore any interaction between the analyst and the user, as the user would become the developer. Second, the users were essentially fitting their contextual needs to a standard package, which raised the issue of how the developer understood the users' needs in the first place. Von Hippel and Katz's novel application of user toolkits did provide an important contribution to understanding the knowledge transfer process, through the insight that knowledge was embedded in the user and it could be incorporated into a system through appropriate toolkits. Also, this study incorporated von Hippel's earlier work on the importance of lead user involvement in identifying 'sticky information' (von Hippel, 1998). Lead user involvement in the development of a system allowed for the incorporation of needs that would become general use, months or years in advance (Herstsatt & von Hippel, 1991; von Hippel, 1986; Urban & von Hippel, 1986). For von Hippel and Katz, it was these key users that would use the toolkits to develop the system to meet their needs. In essence, this was a very similar idea to Selamat and Choudrie's (2004) concept of the use of meta-capabilities and Wenger's (1998) notion of a knowledge broker to diffuse embedded knowledge. However, the study did not explicitly explain what these toolkits were, how they worked and thus, failed to elucidate the knowledge transfer process.

Also, taking a user-centred perspective, Darke and Shanks (1997) proposed a user viewpoint model for capturing and representing the perspectives of users during the requirements elicitation stage of the development lifecycle. Their approach aimed to facilitate communications and collaborations between the developer and users by taking into account the emerging nature of the users' requirements. The importance of Darke and Shanks' (1997) model was that it helped users and developers overcome cultural and language difficulties between them and assisted them in achieving a shared understanding of the requirements for the system being developed. While this study provided a framework for capturing user requirements and relied heavily on the involvement of users in the development process; it did not provide a clear understanding of how the users' embedded knowledge requirements were transferred. Essentially, it failed to provide an explanation of what knowledge transfer processes were required by systems developers to identify the users' knowledge needs.

3.2.4 Systems Development Perspective

From a systems development perspective, Flynn and Jazi (1998) proposed a model for overcoming the user-developer culture gap in relation to gathering user requirements and adopted the view that social, not technical factors were more important to systems development. The focus of their model was on "user involvement, commitment and ownership of the requirements process" (Flynn & Jazi, 1998, 54). Like von Hippel and Katz (2002), these authors placed great emphasis on users building their own requirements model through an iterative process, which in turn, allowed for the inclusion of the social factors into the elicitation of requirements. Their argument centred on training users in a technical language in order for the requirements elicitation process to occur and placed significant emphasis on the use of technical diagrams by the users in mapping these requirements through an iterative process. Nevertheless, while this study emphasised the inclusion of the social element of the users for systems development and the involvement of users iteratively in the development process, it failed to provide a clear understanding of how users' embedded knowledge was transferred. Indeed requirements gathering was only depicted as occurring prior to the use of a structured development methodology, such as SSADM, which as argued previously was an unsuitable approach for the inclusion of user embedded knowledge requirements for systems development (Murphy & Stapleton, 2005; Alvarez, 2002; Clegg et al, 1997; Hirschheim & Newman, 1991). Consequently, this study failed to identify in any great detail the knowledge transfer processes needed to elicit users' embedded knowledge requirements for systems development.

3.2.5 Community of Practice Perspective

From a community of practice perspective, Boland and Tenkasi (1995) argued that electronic communications forums might provide a means for strengthening community identity and assisting specialized knowledge workers in making sense of other community perspectives (Hayes & Walsham, 2001). They proposed a conceptual framework for the design of electronic communications systems, which was based on the language games model, a narrative mode of cognition and reflexivity. What was particularly noteworthy about Boland and Tenkasi's work was the premise that organisations consisted of multiple communities of specialised knowledge workers that performed tasks through interacting with each other to create patterns of understanding and display behaviours in relation to their social reality (Boland et al, 1994). For these authors, it was the community of practice that underlined the transfer of embedded knowledge within an organisation because it facilitated the construction of a social reality in which users cooperated and shared their embedded knowledge (Garrety et al, 2004; Wenger 1998; Boland & Tenkasi, 1995). However, while this theoretical study did provide valuable insights into how knowledge was shared through the process of perspective making and perspective taking and identified different ways that embedded knowledge could be understood, it failed to provide any deep understanding of how the requirements of the users were supported by development of the system. Consequently, it lacked the profundity needed to understand how the analyst could elicit the users' embedded knowledge requirements and incorporate them into the development of a system.

Approaching a similar vein of thought was Garrety et al's (2004) study. They argued that, through community relationships, knowledge users cooperate and share their embedded knowledge. What was particularly interesting from this research was the idea of knowledge brokering, in that, knowledge flows between systems developers and end users could be managed more effectively through brokering[6]. Indeed, for these authors, different perspectives and interpretations in the design of projects were critical because "different groups, [and] project participants need to construct integrating institutions based on effective mental maps of the social landscapes in which projects are conducted" (Garrety et al, 2004, 357) and it was through the use of a broker that embedded knowledge was successfully transferred and interpreted correctly (Pawlowski& Robey, 2004; Brown & Duguid, 1998; Wenger, 1998). Although the study did highlight the influence of communities of practice on project development, it failed to explore in any great detail the strategies that would be used by the brokers in facilitating

[6] Brokering is "the use of multimembership to transfer some element of one practice to another" (Wenger, 1998, 109).

productive relationships between the developers and users and the influence social dimensions played in the development of new technologies.

3.3 Embedded Knowledge in ISD & Emerging Themes

From the literature review carried out, several themes emerged that would enable the user's embedded knowledge to be successfully transferred to the analyst and in turn elicited by the analyst for systems development. Identifying the themes for successful knowledge transfer was an iterative process with many revisions and refinements. For instance, Boland & Tenkasi (1995) argued that knowledge from a community of practice perspective was transferred via good communication, narratives and conversations and through dynamic interactions. Taking the communities of practice approach, Wenger (1998; 2000A; 2000B; 2000C; 2004) went further and argued that the knowledge transfer processes used within a community of practice are many and could include the following: informal conversations, social relations, direct interaction with others, contexts, participation, interpersonal relations, engagement in practice, observation, explanations and stories to name a few. Whereas, from an interactionist perspective, Madhavan and Grover (1998) argued that knowledge transfer included the sharing of cognitive mental models, personal interaction and a shared understanding of the situation in which the developers find themselves in.

Systems and their development cannot be separated from organisational life. "Much of the information needed for requirements is embedded in the social world of users… It is informal and depends upon context for its interpretation" (Goguen, 1996, 102). Thus, in order for the developers to elicit the users' embedded requirements they must participate with the users in their social context (Wenger, 1998; Goguen, 1996). Therefore, the users must play a crucial role in the development process and by deliberately involving them in this process the developers were ensuring the successful introduction and usage of the system (Clegg et al, 1997; Blacker & Browne, 1985; Ives & Olson, 1984). Indeed, the requirements elicitation phase was at its core a communicative act. However, while the users might understand what functions they want the new system to perform, when questioned about their working practices, they may be unable to identify the knowledge required to meet their practical needs. These significant knowledge requirements were part of their embedded knowledge and cannot be separated from their working practices (Schön, 1987; 1983).

3.3.1 Participating in the Situated Context

For the analyst to successfully elicit the embedded knowledge requirements of the users and in turn, for the users to transfer their embedded knowledge needs to the analyst, it was important that the analyst entered into and understood the environment of the users (Busch & Richards, 2005; Coughlan et al, 2003; Engström, 2003; Goguen, 1997; Blacker & Brown, 1985). Recall from earlier discussions, requirements were embedded in the social world of users and to understand these needs required a context for their interpretation (Busch & Richards, 2005; Coughlan et al, 2003; Engström, 2003; Darke & Shanks, 1997; Goguen, 1997; 1996). This implied that in order for the analyst to understand the working context of the users, namely their working community, the analyst needed to actively participate with the users (Wenger, 1998).

The difficulty of sharing and transferring this knowledge was further compounded by the terminology used by participants in the transfer process

(Haldin-Herrgard, 2000). The lead user or source[7] of the knowledge had to put meaning to a world that was part of their unconsciousness and in a language that the analyst would understand. However, the analyst was not versed in the language of the practice and therefore could not understand the language being used without 'seeing' on some level where its existence came from. Also, the user may be unaware of their frames of references of their roles or problems and so they did not attend to the way that they constructed their reality (Schön, 1982). In essence, the language of the users had now become part of their professional knowledge. It was this knowledge that takes on the character of the system where the problem was set, explicitly the context. It consisted of embedded elements in itself, such as the strategies employed, the facts treated as relevant and the interpersonal theories of action, all of which were bound up in the way the users' roles were framed (Brown & Duguid, 1991; Schön, 1982). Essentially, transferring embedded knowledge required the use of a professional language on the part of the user. Problems arise for the analyst as they might not know the vocabulary being used or the embedded elements that were part of that knowledge and language.

The users' context would provide clues for the analyst, which would facilitate the analyst's understanding of how the users constructed and interpreted events within the organisation (Salancik & Pfeffer, 1978). It was through a connection with society that humans developed common interests, traditions, and beliefs etc. that governed their role and place in their environment. Social learning governed the assumptions users' make about themselves, others and their community. Thus, by participating in the users' environment the analyst could identify what the users' attitudes and opinions are (Swan et al, 2002; Teigland & McLure Wasko, 2000; Salancik &

[7] The [knowledge] source is the equivalent to Schön's (1982; 1987) 'master' or 'coach', and von Hippel's (1986) 'lead user', and each will be used interchangeably.

Pfeffer, 1978), the language that they used, the customs and traditions they have (Lesser & Storck, 2001) and the rituals they employed in a wide variety of situations (Schein, 1992). In essence, participation in the social world of the user was fundamental for embedded knowledge to be successfully transferred to the analyst.

3.3.1.1 Observing

Embedded knowledge was practice-based knowledge that was highly skilled and could not be learned from reading user manuals or books (Baumard, 1999). Complex working practices were frequently carried out using procedural knowledge that was embedded in the users' psyche and often, they themselves did not know that these practices were occurring naturally. This knowledge could be successfully transferred via proficient execution on the part of the user and through observation and collaboration with the users on the part of the analyst (Gertler, 2003; Mascitelli, 2000; Roberts, 2000; Fleck, 1997; Schön, 1987; 1982). Nevertheless, to actively transfer this knowledge, the analyst's sensors need to be stimulated by "listening to and observing others" (McInerney, 2002, 1010).

Normally, when an individual is asked how they would behave under certain conditions they would present their espoused theory of action for that situation (Argyris & Schön, 1974). However, the theory that actually governed the actions the individual would carry out was his theory-in-use. This theory may not be compatible with the espoused theory and furthermore the individual may not be aware of the incompatibility that existed between the two (ibid). Thus, in order to uncover the users' theories-in-use, the analyst would be required to carry out observations. Essentially, by observing the users carrying out their work practices, the analyst would be able to identify ritualistic behaviours, their mental models or discrepancies that existed between their theories-in-use and their espoused theories. Consequently, the analyst could refine his or her modus operandi so that more appropriate questions could be asked of the users about their knowledge needs and what they are doing.

The analyst should then confront the user with "data aimed at showing signs of the existence of processes or knowledge which they have been unable or have not wanted to express" (Baumard, 1999, 91). In turn, by getting the user to reflect on what has taken place, a description of the embedded knowledge required to carry out the task could be made (Goguen, 1997; Schön, 1987; 1982). Thus, by utilising the process of reflexive practice the analyst could provide the lead users with the means to reflect on their experiences, the embedded knowledge used to carry out their task and to further identify their embedded knowledge requirements. Essentially, the analyst would be providing the lead users with the opportunity to think about their actions and to analyse them in a critical manner (Baumard, 1999). The lead users must then 'look' at themselves independently and as external watchers to determine how they performed their work practices and then, to reason why they performed the task the way they did for the analyst. By giving the lead users the opportunity to analyse how they framed their work practices, solved problems and to identify their theories-in-use, the embedded knowledge used to carry out their task could be revealed. It is users' frames of reference that determined their attention strategies, the directions taken to change current situations and the values that influenced their work practices (Schön, 1982). Additionally, these frames helped the community shape their reality and the analyst must be aware of these if they are to become participants within the community and understand its working practice.

However, the analyst must be mindful when using observational techniques as the user's behaviour could differ from their behaviour when liberated from all external observation (Baumard, 1999). What was suggested here was that the analyst must be immersed in the organisation being studied to ensure that the practices being observed are correctly identified and understood. By participating in the context of the community, supplemented with use of observational techniques, the analyst should be able to identify the community of practice's embedded knowledge requirements. Without knowledge or an understanding of these working practices and the embedded knowledge requirements of the system users, the analyst could not ensure that the developed system would meet and support the working practices and knowledge needs of the users (Bentley et al, 1992).

3.3.2 Investigating Informal Networks

Practice involved a history that was based upon a combination of participation and reification intertwined over time and not on personal or collective experiences. Indeed, individuals were not remote and were not an autonomous source of knowledge (Wenger, 2004; Augier et al, 2001; McDermott, 1999; Gilbert & Cordey-Hayes, 1996; Tenkasi & Boland, 1996; Boland & Tenkasi, 1995). Certain areas of embedded knowledge were based solely upon knowledge that was socially obtained (Warne et al, 2002). This knowledge resided in the individual user, but was also part of the wider community. Droege & Hoobler (2004) argued that, it was the community's social networks that allowed them to create and share their knowledge within the community. Brown & Duguid (2001) essentially made the same point when they stated that, the creation of common practices allowed people to form social networks where embedded knowledge could be transferred rapidly.

By participating in the users' context, the analyst would gain an insight into the history and social customs of the community and how the embedded knowledge was used to carry out their practices (Lave & Wenger, 1991).

Also, the analyst would become aware of the social (institutional) facts that made up the community. The attitudes adopted by the community towards phenomena created and made those phenomena, thus creating their social facts (Searle, 1995). These facts remained in existence within the community until their beliefs were changed according to new phenomena being encountered. Users' experiences informed and transformed others in the community and it was that, which created the 'present' practice. In essence, the community attributed their own beliefs and attitudes towards certain phenomenon, which were accepted within the community[8]. Nevertheless, for social facts to remain part of the community ethos, a sufficient number of the community's members must recognise and accept the continuation of such facts (Wenger, 1998; Searle, 1995). The analyst would not need to know the community's social facts per se to understand them. All that was required was an understanding of how the community's embedded knowledge was used by its members to behave in a certain way and to allow practices to be carried out. In addition, the analyst would gain an insight into how this knowledge shaped the members' identities, values, language and culture (Gertler, 2003; Wenger, 1998; Weick, 1995). By identifying the social networks within the community, other key users may be acknowledged and their embedded knowledge requirements that the system might need to support could also be explored. Thus, the identification of these informal networks as a vital infrastructure to observe how knowledge was transferred and used between the users' community would be paramount to the knowledge transfer process (Busch & Richards, 2005).

3.3.3 Personal Interacting

Most of the community's embedded knowledge was interactively produced through social interaction and collaboration between workers within their

[8] See Searle, 1995, Chapter two, for discussion on how institutional facts are created.

shared context (Mascitelli, 2000; Roberts, 2000). Thus, for the community's embedded knowledge to be transferred, some form of interaction process must occur between the user and analyst. Interacting with the user would provide the analyst with access to the required knowledge needed to perform the practice. The ties that bound the user to the analyst could impact upon this process and therefore affect the level of embedded knowledge that was transferred between both parties. Successful interaction, where a good and personal relationship had been established, would allow the informal embedded knowledge of the community to be transferred, such as the basic assumptions, beliefs etc. that were held in esteem. For Schein (2001), it was these basic assumptions that defined what the community paid attention to, namely the meanings of different things, emotional reactions to situations and the actions they took when various types of situations arose.

In the interaction process, each individual would bring their own medley of skills, knowledge and strategies, which in turn affect and could be affected by the situation at hand (Madhavan & Grover, 1998). Associating new ideas with existing ideas was the way most people identify what knowledge was important and needed to be retained. The accumulation of knowledge in relation to the users' context increased the ability of the analyst to put new knowledge into memory. Essentially, links were created between the new events and pre-existing concepts (ibid). However, it was easier to transfer embedded knowledge between the user and analyst if they both shared a common knowledge base and understanding.

Gertler further argued that embedded knowledge transferral occurred best, where the parties involved "share some basic similarities; the same language; common 'codes' of communication; shared conventions and norms; personal knowledge of each other based on a past history of successful collaboration or informal interaction" (2003, 84). Mascitelli (2000) essentially made the same argument, in that the transfer process would be improved through personal contact and the sharing of common experiences and emotions. Katz & Tushman (1981) argued that misperceptions and misinterpretations could arise due to a lack of a common coding scheme and language difficulties, resulting in a less efficient knowledge transfer process occurring.

3.3.3.1 Collaborating

Droege & Hoobler (2003), on the other hand, maintained that interaction was often only superficial with little sharing of knowledge and ideas. They suggested that collaboration was important, as it would intensify the interaction between both parties, increasing the chances of the residing knowledge of one person to be successfully transferred to the other. Through collaboration a greater understanding can be achieved, as the developers would be provided with the opportunity to observe and experience the users' applications of their embedded knowledge while performing their working practices. Thus, collaborating with the users would provide the depth and focus needed to understand the community's embedded knowledge, along with their interpretations of their world based upon their embedded knowledge, which would result in strong ties being created between the user and analyst (Teigland & McLure Wasko, 2000; Augier & Vendelo, 1999; Hansen, 1999). Strong ties developed though frequent contact would result in both parties putting in greater time and effort into the interaction process to transfer the embedded knowledge (Reagans & McEvily, 2003).

A special bond would need to be established between the user and the analyst, as it would afford for the sharing of actual experiences and allow the analyst to gain an understanding of the users' world and how their embedded knowledge was used effectively in it. From interacting and collaborating with the users, the analyst and user would develop a strong tie which could facilitate a greater understanding between them throughout their interactions, as they would share similar cognitive structures and develop familiar heuristics (Augier & Vendelo, 1999; Boland & Tenkasi, 1995). Also, it would enable the analyst to understand what was important to the users, to learn what was necessary to carry out their practices and the language that was in use within their working context. However, the language used to transfer this type of knowledge would be difficult to interpret without prior knowledge of the context of the task at hand. Thus, contextual knowledge would be imperative for new knowledge to be acquired on the part of the analyst and to be made fully intelligible between all parties involved.

Only through the processes of continuous personal interaction and collaboration could the analyst fully understand the requirements of all the users which the developed system was to support (Al-Karaghouli et al, 2005; Alshawi & Al-Karaghouli, 2003; Coughlan et al, 2003; Darke & Shanks, 1997). By directly involving the users in the development of the system, the analyst was guaranteeing that their working practices and embedded knowledge needs would be supported by the developed system and thus ensuring the successful introduction and usage of the developed system into their community (Clegg et al, 1997; Blackler & Browne, 1985; Ives & Olson, 1984).

3.3.4 Storytelling

Stories were socially constructed accounts of past events that were based upon other social constructions such as language, shared meanings and values and were perceived as a way of encoding data about the environment (Connell et al, 2004). Stories may be used by practitioners to transfer knowledge concerning past exploits, problems and how they were overcome (Rasmussen, 2005; Linde, 2001; Lubit, 2001; Swap et al, 2001; Mascitelli, 2000;

Brown & Duguid, 1991) and it would be an important process in the transferring, exchanging and sharing of embedded knowledge within a situated context (Connell et al, 2004; Linde, 2001). For Connell et al (2004) stories about organisational performances might be rich in embedded knowledge, which may only become evident from a transcript of the narrative. In essence, stories were repositories of accumulated insight and knowledge. By listening to the users telling their stories, the analyst could understand how the users' practices came about (Brown & Duguid, 1991). In turn, they would allow users to reaffirm their theory-in-use and how they handled relationships within the community (Schein, 1992).

It was important to note that in this context, stories are narratives of events that have occurred within the community. They showed how the users' embedded knowledge enabled them to deal with mistakes and with the logic and assumptions that underlined their decision-making process to overcome these mistakes (Wenger, 1998). In addition the analyst would gain an understanding of the users' behaviour which they might adopt in different situations (Connell et al, 2004). Essentially, stories contained *essences of experiences* that led to the working practices currently in place within the community (Linde, 2001; Swap et al, 2001). However, it was the shared interpretation between community participants that would make stories an effective medium to transfer the community's embedded knowledge (Brown & Duguid, 1991). For Weick (1995), a good story would be similar to a workable cause map[9]. It would show patterns that may exist and it would be a way to make the unexpected believable and manageable.

Storytelling reflected the complex social web within which the community of users worked and was an "under-constrained means to interpret each new

---

[9] This is concept is similar to Schön's frames of reference which determines how practitioners shape problems and roles for different situations in order to meaningfully understand them and what happened (Schön, 1982).

situation in the light of accumulated wisdom and constantly changing circumstances" (Brown & Duguid, 1991, 45). In order to identify the user's embedded knowledge through the use of storytelling, the analyst would be required to play a more active role in the process. Clarifications must be sought and interruptions made about the knowledge being transferred. This in turn would allow the user to modify the story in take into account such feedback, resulting in the analyst gaining a greater understanding of the story's content.

Although embedded knowledge cannot be fully articulated, sometimes the tacit could present itself in explicit forms through differences between two texts (Baumard, 1999). Therefore, by listening and examining the different versions of the story, the analyst would be able to confront the users with these inconsistencies. Furthermore, through the use of reflective practices the analyst would be able to provide the users with the opportunity to think about these differences and further analyse the stories and what occurred within those situations. By critically examining the stories the users could identify why those practices were performed in that manner and any decisions that led to those actions being taken. Thus, they could identify the embedded knowledge that was used. Essentially, through the use of retrospective reconstruction the users could identify a complete set of requirements that they needed the system to support (Goguen, 1997; Schön, 1987; 1982). Storytelling allowed the user community to communicate its principles or fundamental assumptions to the analyst, particularly as stories have an intrinsic capability to capture rich embedded knowledge (Connell et al, 2004; Linde, 2001). Thus, they would be an invaluable source of embedded knowledge requirements for the analyst, as they could enable the analyst to identify patterns and make connections between the stories and the users' working practices (McLellan, 2006).

3.4 Conclusion

Table 3.3 provided an overview of the literature review that was used in this thesis based on the research focus of the article, its year of publication and the author's name (s). From the review of the literature, it was apparent that little attention had been directed at understanding how embedded knowledge requirements elicitation could be carried out during information systems development. Most researchers directed their attention towards the inputs, characteristics, management and consequences of transferring embedded knowledge (Table 3.2). However, if research was to gain an understanding of the embedded knowledge requirements of the users directly affected by the new system, then processes must be developed that would enable the analyst to recognise the existence of and to successfully elicit from the users those knowledge needs.

The analyst must have a clear understanding of the users' working environment, their practices and their interaction with each other within the system. This was what made the interpretive approach so critical to the elicitation of the users' embedded knowledge requirements. In essence, by adopting an interpretivist approach to systems development, the developer could seek to realign the human with the machine and to place the machine back in its rightful place, as a tool – an extension of the human user (Dahlbom & Mathiassen, 1993; Gill, 1996A). Developers who adopted this perspective believed that there was a widely shared set of structures in place within the organisation that were subjective in nature and it was these which enabled users to derive the knowledge they needed to perform their working practices (Boland, 1987). In addition, the role of the user was clearly established with regards to the use and design of the system. These themes were further explored in the following chapter and the conceptual framework that emerged from this literature review was also illustrated.

Table 3.3: Summary of the Literature Review

Year	Knowledge & Communities of Practice	Systems Theory, Philosophy & ISD
2007	Brachos et al Eskerod & Skriver Jasimuddin Joshi et al Parent et al Wang et al Yakhlef,	Brandt Forfás Rasmussen
2006	Foos et al Hsiao et al Huysman & Wulf Kwan & Cheung McLellan Sherif et al	Forfás
2005	Busch & Richards Cabrera & Cabrera Davis et al Duguid Jasimuddin et al Kalla Kimble & Hildreth Østerlund & Carlile Rasmussen Ruuska & Vartiainen	Al-Karaghouli et al Forfás Murphy & Stapleton Shore
2004	Connell et al Garrety et al Joshi et al Karlsen & Gottschalk Malik Pawlowski& Robey Selamat & Choudrie Tuggle & Goldfinger Wenger	Hickey & Davis Mingers & Willcocks
2003	Bresnen et al Connell et al Desouza Droege & Hoobler Engström Gertler Kalling Koskinen Reagans & Mc Evily	Alshawi & Al-Karaghouli Avison & Fitzgerald Burstein & Linger Coughlan et al Goulielmos
2002	Brown & Duguid Fleck Freidus & Hlubinka	Alvarez Browne & Ramesh Gill

Table 3.3: Continued

Year	Knowledge & Communities of Practice	Systems Theory, Philosophy & ISD
2002 Cont.	Hansen Jarzabkowski & Wilson Malone McInerney Orlikowski Swan et al von Hippel & Katz Warne et al	
1997 to 2001	Argote & Ingram Augier & Vendelo Augier et al Baumard Bennett Brockmann & Anthony Darke & Shanks Ferran-Urdaneta Flynn & Jazi Gallivan Grant & Gregory Gupta & Govindarajan Haldin-Herrgard Hansen Hayes & Walsham Jarvinen & Poikela Johannessen et al Lam Leonard & Sensiper Lesser & Storck Linde Lubit Madhavan & Grover Mascitelli McDermott Platts & Yeung Roberts Scarbrough Schein Subramaniam & Venkatraman Swan et al Swap et al Teigland & McLure Wasko von Hippel Wenger Wong & Radcliffe	Avison et al Brandt & Cernetic Checkland Clegg et al Daft Damodaran Dougherty Easterby-Smith et al Goguen Stapleton Yu

Table 3.3: Continued

Year	Knowledge & Communities of Practice	Systems Theory, Philosophy & ISD
1987 to 1996	Bentley et al	Cooley
	Blackler	Dahlbom & Mathiassen
	Boland	Easterby-Smith et al
	Boland & Tenkasi	Gill
	Boland et al	Goguen
	Brown & Duguid	Hirschheim & Klein
	Cohen & Levinthal	Hirschheim & Newman
	Gilbert & Cordey-Hayes	Iivari & Hirschheim
	Grant	Klein & Hirschheim
	Herstatt & von Hippel	March
	Howells	Mumford
	Kogut & Zander	Rosenbrock
	Lave & Wenger	Scott
	Orlikowski & Yates	Wood & Wood-Harper
	Schein	
	Searle	
	Szulanski	
	Tenkasi & Boland	
	Turner	
	von Hippel	
	Weick	
pre 1987	Argyris	Boulding
	Argyris & Schön	Buckley
	Blacker & Brown	Burrell & Morgan
	Katz & Tushman	Gill
	Pfeffer & Salancik	Hirschman
	Polanyi	Ives & Olson
	Salancik & Pfeffer	Katz & Kahn
	Schön	Klein & Lyytinen
	Urban & von Hippel	Miller
	von Hippel	Morgan & Smircich
		Vickers

Chapter 4: A Working Theory of Eliciting User Embedded Knowledge Requirements for ISD

4.1 Introduction

The purpose of this chapter was to present a working theory of how embedded knowledge could be transferred from the user to the analyst during requirements elicitation. This working theory was based upon the themes that emerged from the literature discussed in the previous chapters. It was important to note that the aim was to understand, rather than measure, how users within a community transferred their embedded knowledge to the analyst during the requirements elicitation stage of development. The focus was on the activities and stages that unfolded over an extended period that enabled the developers to learn and understand the knowledge inherent within the user community.

The developer should seek to create a balance between the organisation's human skills and knowledge in relation to the development of the system, to ensure that it supports all the requirements and needs of the users. As §2.4.2 argued, developed systems must take into account and complement the human skills of the users. Systems must be flexible to the users' changing needs, as the users' work practices cannot be reduced to a set of rational steps. Thus, as §2.4.2 stated a balance must be sought between the organisation's human skills and automation, which would allow the developed system to support human skills and ingenuity instead of objectifying the knowledge held by the users. In essence, this symbiosis between the users, their knowledge and the technological system being developed would ensure that the users' needs and requirements would be met and supported by system. However, in §2.4.2, to produce systems that satisfy the users' needs and desires, the analyst must gain an understanding of the user groups within the organisation, their work practices and their embedded knowledge needs. The following sections discussed what knowledge transfer processes the analyst might utilise in order to determine the embedded knowledge needs of the users, thus ensuring that the developed system would successfully meet, support and complement all the users' needs and requirements.

4.2 Eliciting User Embedded Knowledge Requirements for ISD

With the material in Chapters two and three as background, a tentative *a priori* conceptualisation of how the analyst would go about eliciting the users' embedded knowledge requirements started to emerge from the literature. Although the conceptual framework was developed *ex post* from the review of the literature, it was useful to present it here as a working theory of the knowledge transfer processes required to elicit the users' embedded knowledge requirements during systems development.

From the literature in §3.3, the following transfer processes were identified that would successfully enable the transfer of the users' embedded knowledge requirements to the analyst during the systems development process. These were: participating in the situated context using observations, investigation of informal networks, personal interactions and collaboration, and storytelling. The following sections explored these transfer processes and proposed several relationships between them which provided a basis for a tentative theory for the transfer of embedded knowledge during requirements elicitation.

4.2.1 Participating in the Situated Context

The literature in §3.3.1 suggested that, users' embedded knowledge was bound up in their situated context. Therefore, it was possible to postulate that in order to elicit these requirements the analyst must begin the transfer process by participating in the users' working environment. Embedded knowledge was considered to be part of users' natural behaviour and thinking and is bound up in their working context. Thus, there was an underlying difficulty with sharing and transferring this knowledge, particularly in relation to the language used by the system users. As highlighted previously in §3.3.1, the user must interpret their unconscious world in a language that can be understood by the analyst. However, the analyst would be unlikely to attend to the world in the same manner as the users and would not know the language of their practice. Therefore, they were unlikely to understand the language that was being used without 'seeing' on some level how the users' created this knowledge, as this language would now be part of the users' professional knowledge.

The literature in §3.3.1 indicated that, the situated context of the user would provide clues which can assist the analyst in determining how the users constructed and interpreted events that governed the assumptions users have concerning themselves, others and their community. Connecting with society allowed humans to create common interests, traditions and beliefs etc. that governed their role and place in their environment. Hence, by participating in users' situated context, the analyst might be able to explore the attitudes and opinion of the users, their customs, rituals and traditions that enabled them to carry out their work practices. The analyst may also gain an understanding of the language used by the users in their situated practice. The following working proposition was formulated in order to test these postulates:

WP1: The analyst actively participates in the users' situated work context in order to understand the users' embedded knowledge requirements.

4.2.1.1 Observing

§3.3.1.1 showed how embedded knowledge could not be learned from books and was a highly skilled and practice-based form of knowledge. §3.3.1.1 also indicated that, although this knowledge assisted users in carrying out their complex work practices, it was embedded in their psyche and they often did not realise that these practices were occurring naturally. Thus, opportunities to observe the user carrying out their practices within their working context would greatly improve the analyst's understanding of the users working practices and their embedded knowledge requirements.

Observing these practices would enable the analyst to identify any ritualistic behaviour that may occur and inconsistencies between what the users said they did with what was actually observed by the analyst. As §3.3.1.1 suggested, by refining his or her techniques, the analyst could ask more direct questions of the users about their knowledge requirements and work practices. This would allow the users to reflect on the discrepancies between their espoused theory and their theory-in-use, thus allowing them to become aware of the embedded knowledge required to carry out their practices. By immersing themselves in the users' situated context, supplemented with use of observational techniques, the analyst should be able to identify the embedded knowledge requirements of the user community. This gave rise to the following propositions:

WP2: When analysts participate in user situated contexts, they use observational techniques.

WP3: Analysts use observational techniques to distinguish between the users' espoused working practices and actual working practices.

4.2.2 Investigating Informal Networks

The literature reviewed in §3.3.2 suggested that, individuals used embedded knowledge intersubjectively and were not self-sufficient individual sources of knowledge. Embedded knowledge would primarily be created and used across social networks and these informal community networks enhanced the transfer process and promoted embedded knowledge sharing to others. From this, it could be postulated that, by participating in the situated context of the users the analyst could gain an understanding of the social customs that comprised the users' community and how embedded knowledge was utilised by the users while their work practices were carried out. §3.3.2 also indicated that, through their investigation of the users' informal networks, the analyst might acquire an insight into how the user community's embedded knowledge was used by its members to behave in a certain way, which in turn, shaped the users' language, values, work culture and their identities within the community. In order for the analyst to elicit these embedded knowledge requirements from the users, the informal networks within the user community must be examined. Moreover, by identifying these internal knowledge transfer processes, the analyst would ensure that the developed system would be able to support the informal embedded knowledge transfer processes and the working practices in use within the community. The following working propositions were drawn up:

WP4: Analysts participate in user contexts in order to gain insight into the social customs of user communities.

WP5: Analysts investigate informal social networks in order to understand how embedded knowledge is used in the users' community.

4.2.3 Personal Interacting

§3.3.3 illustrated how the embedded knowledge of users was interactively created and shared through social interaction and collaboration within their situated context. For the analyst to identify these embedded knowledge requirements, some for of interaction process must occur between the analyst and the users. The level of personal interaction that occurred between both parties would impact upon the level of embedded knowledge that was transferred. As §3.3.3 indicated, successful interaction that allowed a personal relationship to be established, would allow the user community's informal embedded knowledge to be transferred.

Through the creation of these personal relationships, the analyst and users would establish a common knowledge base and understanding. As §3.3.3 previously discussed, embedded knowledge transfer was likely to be successful where both the analyst and users have personal knowledge of each other, based upon a past history of successful interactions and collaborations. This would create shared conventions, a common language and communication codes between the users and analyst, which ensured that embedded knowledge could be transferred successfully. As §3.3.3 stated, personal contact and the sharing of common experiences could improve the transfer of knowledge between the analyst and users. Without personal contact and a common coding scheme, language difficulties, misperceptions and misinterpretations were likely to arise resulting in a less efficient knowledge transfer process. In order to examine these postulates, a series of working propositions were drawn up as follows:

WP6: Analysts forge personal interactive relationships with users over an extended period.

WP7: Personal relationships between analysts and user communities help analysts appreciate the role of embedded knowledge in the users' situated context.

WP8: The personal relationship facilitates embedded knowledge transfer between analysts and users.

WP9: Where personal relationships between analysts and users do not emerge, there are ISD problems related to the transfer of embedded knowledge.

4.2.3.1 Collaborating

The literature in §3.3.3.1 suggested that, collaboration between the analyst and users was important as it would improve the transfer of knowledge between both parties. Through collaboration, the analyst would be provided with the understanding required to appreciate the user community's embedded knowledge. Additionally, personal interactions coupled with collaborative efforts from both parties would achieve a mutual understanding, resulting in a level of trust being established between the analyst and the user. Trust, in turn, would be reflected in strong ties between the analyst and users. As §3.3.3.1 illustrated, the more successful and frequent the collaboration and personal interactions between both parties, the stronger the ties and the greater the time and effort the analyst and users would put into the collaboration process. The outcome of this should be a more successful transfer of embedded knowledge between them.

Through the development of strong ties, similar cognitive structures and heuristics would emerge between the analyst and users. This would enable the analyst to gain an understanding of what the users' valued and what they required from the system in order for their working practices to be carried out. However, as §3.3.3.1 suggested, contextual knowledge was important for the analyst to gain an understanding of the users' embedded knowledge, which in turn, would assist the embedded knowledge transfer process. Through continuous personal interaction and active collaboration on the part of the users in the development process, the analyst could ensure that their working practices and embedded knowledge requirements were more likely to be supported by the system

WP10: Users actively collaborate with analysts during development of the system.

WP11: During ISD, analysts actively encourage users to collaborate with them in the development of the system.

WP12: The active collaboration of users and analysts during ISD facilitates embedded knowledge transfer.

4.2.4 Storytelling

§3.3.4 indicated that, in order to explain how their working practices were carried out, users may transfer their knowledge via a process of storytelling. Stories acted as repositories of accumulated insight and were a rich source of user embedded knowledge. They provided a coherent version of how the current state of practice was created and they allowed the analyst to understand what problems the user community were experiencing and how those issues were resolved historically. Essentially, the analyst could explore the users' logic, assumptions and the behaviour that they enacted in certain situations. The literature in §3.3.4 suggested that, the analyst must play an active role in the storytelling process in order to identify the users' embedded knowledge. Through interruptions and clarifications, the analyst could force the user to modify the story to take into account the analyst's questions. The outcome would be a more coherent story that the analyst could understand and through this process obtain a greater understanding of the story's content.

To fully explore and identify the embedded knowledge within the users' stories, the analyst must compare different versions of the story. As §3.3.4 suggested, only by presenting these differences to the users and giving them the opportunity to reflect on these inconsistencies through the use of reflective practices, could the analyst achieve an understanding of the embedded knowledge at use. Through reflection upon and reconstruction of the past in light of these discrepancies could the users obtain a complete set of their embedded knowledge requirements that the developed system must support. In order to test these postulates the following working propositions were formulated:

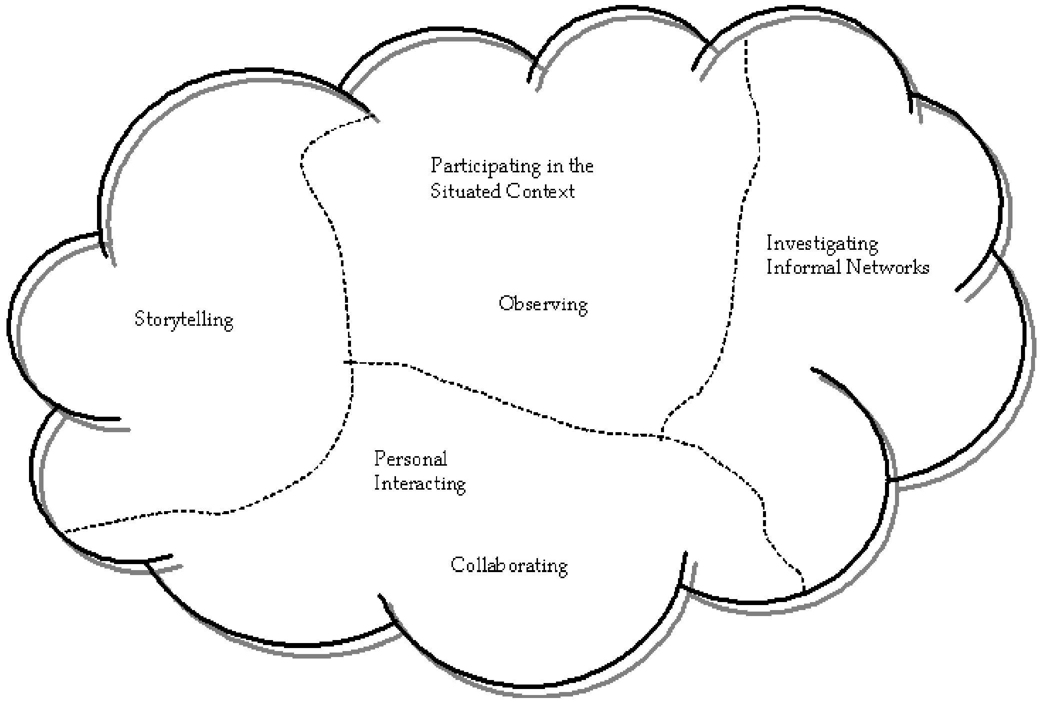
WP13: Analysts gather users' stories in order to uncover the embedded knowledge associated with their work practices which the developed system must support.

WP14: The use by analysts of reflective practices helps uncover embedded knowledge requirements.

4.3 A Framework for Conceptualising the Literature on Eliciting User Embedded Knowledge Requirements

Figure 4.1 provided a diagrammatical representation of the main components of the embedded knowledge transfer theory as set out in this chapter:

Figure 4.1: Conceptual Framework of the Embedded Knowledge Transfer Processes from the Literature

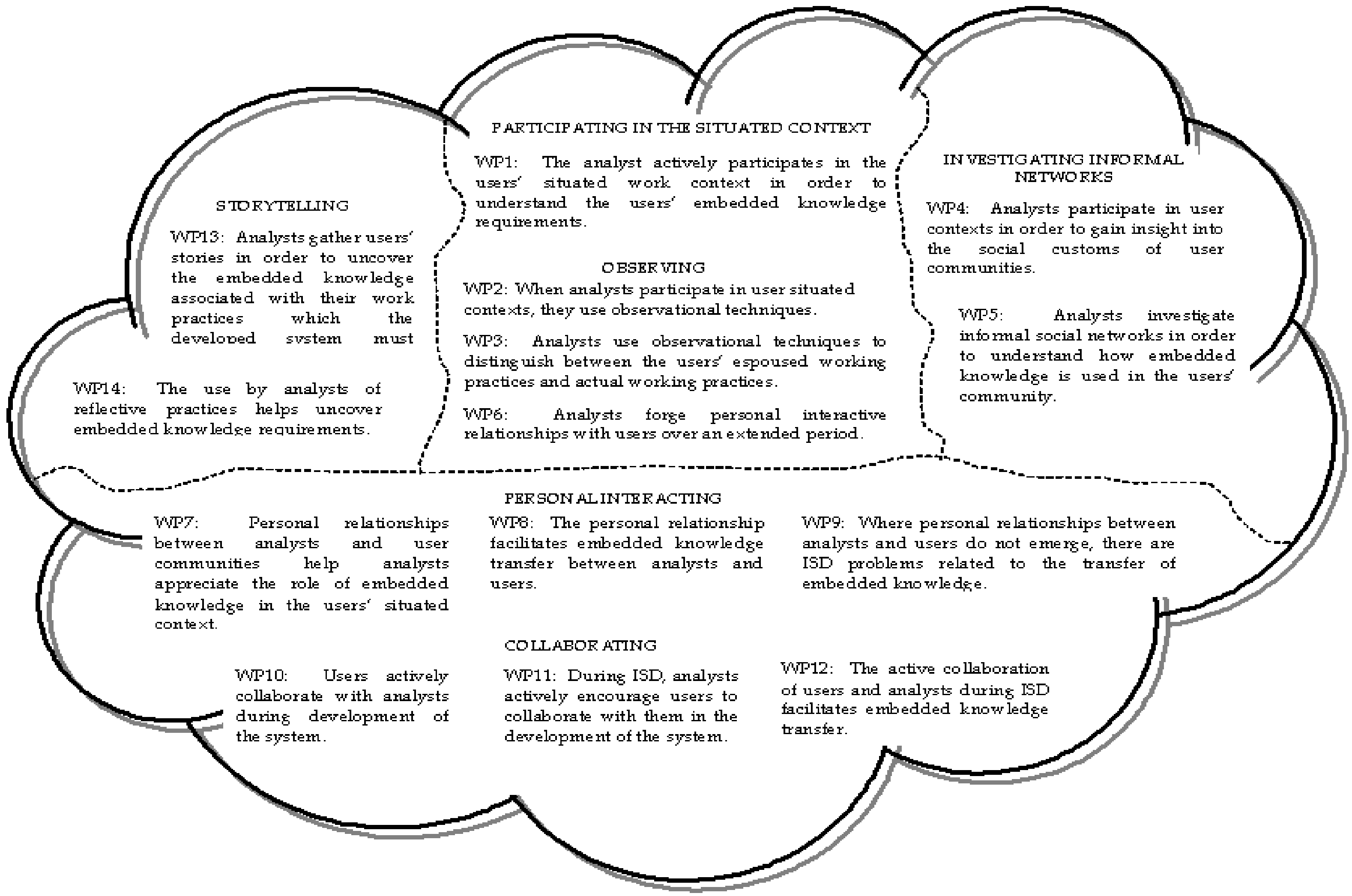


From the outset, it was important to realise that even though the term component implied a part that was separate and distinct from others, this was not the case. Unlike the models presented in §3.2 by Kwan & Cheung (2006), Tuggle & Goldfinger (2004) and Gilbert & Cordey-Hayes (1996), the conceptual framework presented here was not conceptualised as a linear stage model. Indeed, the knowledge transfer processes were likely to occur simultaneously and even overlap as they interacted with each other. The relationships between the key embedded knowledge concepts were not clearly set out in empirical research covered in the literature to date. Consequently, the propositions as set out here could only be tentative in terms of which concepts related to which other concepts. Furthermore, the exact nature of the relationships between the propositions could not confidently be postulated from the literature. Accordingly, the task ahead involved establishing that any relationship existed between the key concepts set out in the propositions and from here, the importance of various 'components' of the schema could be ascertained and explored more fully. The conceptual framework was not about seeking cause and effect. Instead, the purpose here was to understand the nature of how embedded knowledge could be transferred between the user and analyst during requirements elicitation. In line with this interpretivist philosophical thinking, the conceptual framework presented here took the form of a large indistinct mass of intertwining components (Hirschman, 1986) that could lead to the transfer of embedded knowledge between the analyst and the user during systems development. Figure 4.2 provided an overview of the conceptual framework in relation to the working propositions identified from the literature that this research would explore.

4.4 Conclusion

A tentative framework was constructed that integrated key aspects of existing research into overlapping events that would enable embedded knowledge requirements to be elicited and supported by the system being developed. In essence, a symbiosis was envisaged between the users' knowledge and the developed information system to ensure that it complemented, satisfied and supported all the requirements and needs of the users. The key to this symbiosis would be the incorporation of the users' deep knowledge processes during ISD – the most human-centred of knowledge.

Figure 4.2: Conceptual Framework of the Working Propositions identified from the Literature



It should be noted that the conceptual framework presented in this chapter was only a guide for the exploration of the research into understanding how analysts would elicit embedded knowledge requirements from users for systems development. The methodology chosen to conduct this research needed to rely upon the ontology, epistemology and view of human nature taken by the researcher and would be discussed in greater detail in the following chapter.

Chapter 5: Research Methodology

5.1 Introduction

The purpose of this chapter was to set out the research methodology adopted for this research. The following section began with a discussion on the research methodology. Next, the research design adopted to conduct this research was explored in greater detail. The latter part of the chapter argued for the data collection methods used and how the gathered data was analysed and interpreted for this study. The chapter concluded with a discussion on the credibility, dependability, transferability and confirmability of how the data was gathered, analysed and interpreted.

Recall from earlier, the philosophical position underlining this research espoused an interpretivist position (§2.5), thus the methodological approach adopted was ideographic (Figure 5.1). It was believed that the social world could only be understood by obtaining first-hand knowledge of the subject under investigation. Hence, this research would have a heavily qualitative bias and would need to incorporate a flexible design strategy. The following section presented a more detailed discussion of the research methodology adopted, based on the interpretivist position.

5.2 Research Design

The research design was the plan that guided the research study towards its objectives (Gill & Johnson, 2002). There were many different types of interpretive approaches such as, ethnography, action research, grounded theory and biography. In order to understand the knowledge transfer processes that were occurring in eliciting users' embedded knowledge requirements for information systems development, a case study methodology was the most appropriate approach. The justification for adopting this research approach was grounded in a number of interrelated factors.

First, the type of research questions posed in this study were exploratory in nature and required a methodological approach that allowed for the exploration of issues that arose during ISD. In particular, that would allow the researcher to delve deep into the phenomenon of interest in order to gain an understanding of that phenomenon (Perry et al, 1999). Second, the case study method was preferred over other approaches when it was necessary to understand the dynamics present within events (Eisenhardt, 1989), over which the researcher had little or no control. In addition, it allowed multiple sources of evidence to be used (Yin, 2003). Fourth, practical constraints also played a part in determining methodological choice, which theoretically could be overcome, but in practicality could be more difficult to surmount. The main constraint experienced was gaining access to companies who actively involved their clients, the system users, in the requirements elicitation stages of information systems development. This meant that research approaches such as, ethnography and grounded theory would be inappropriate choices for this study, due to the time limitations associated with each approach. Also, in most client companies, there was a concern over confidentiality as companies did not want their competitors to gain access to valuable knowledge concerning their system. In such circumstances, research approaches such as, action research and ethnography were inadvisable. Additionally, client companies did not want a researcher interfering with the delicate negotiations that occurred during requirements elicitation, which also ruled out action research. With these criteria in mind, this study adopted a case study approach as it allowed the researcher to develop an understanding of complex phenomenon (see Figure 5.1).

5.3 Case Research Design

For this study, the research design chosen was an exploratory interpretive case study approach. The exploratory nature of this research was evident in its general objective: to understand how users' embedded knowledge requirements could be transferred between the user and analyst and elicited by the analyst for the system development process. This objective did not lend itself well to quantifiable methods of research. In addition, as highlighted in Chapter three, research investigating this phenomenon were non-existent and thus, the research method chosen had to be flexible, unstructured and qualitative in its approach, as the researcher began without a firm preconception of what the outcome would be (Malhorta, 2002). Emblematic of exploratory research, the sample was small and unrepresentative, with a highly flexible and informal process.

In order for the case study to be deemed interpretive, a clear distinction between qualitative and interpretive research needed to be made. As argued by Klein and Myers (1999), interpretive is often used synonymously with qualitative. However, "qualitative research may or may not be interpretive depending upon the underlying philosophical position" of the researcher (ibid, 69). Qualitative research could be both objectivist and interpretivist. For instance, studies that have involved in-depth interviews have often been considered only as an interpretive method (Remenyi et al, 1998). However, researchers that have utilised this method have quantified themes using an encoding process that allowed them to use statistical analysis on the case study's results. Knowledge transfer research could be classified as interpretive if it was assumed that our knowledge of reality was embedded in a social world of subjective experiences. This view was consistent with the focus of this research and the ontological position of the researcher as argued in §2.5. In essence, this research adopted the perspective that in order to understand how embedded knowledge could be transferred successfully by the users to the analyst and how the analyst could elicit that knowledge, the meanings people assigned to those processes and actions had to be the focus of this research (Miles & Huberman, 1994). Therefore, this research was interpretive in the sense that it explored a complex phenomenon and attempted to create a picture of it in its natural setting, based upon the interpretation of meanings made by the research participants and the researcher (Creswell, 1998; Miles & Huberman, 1994).

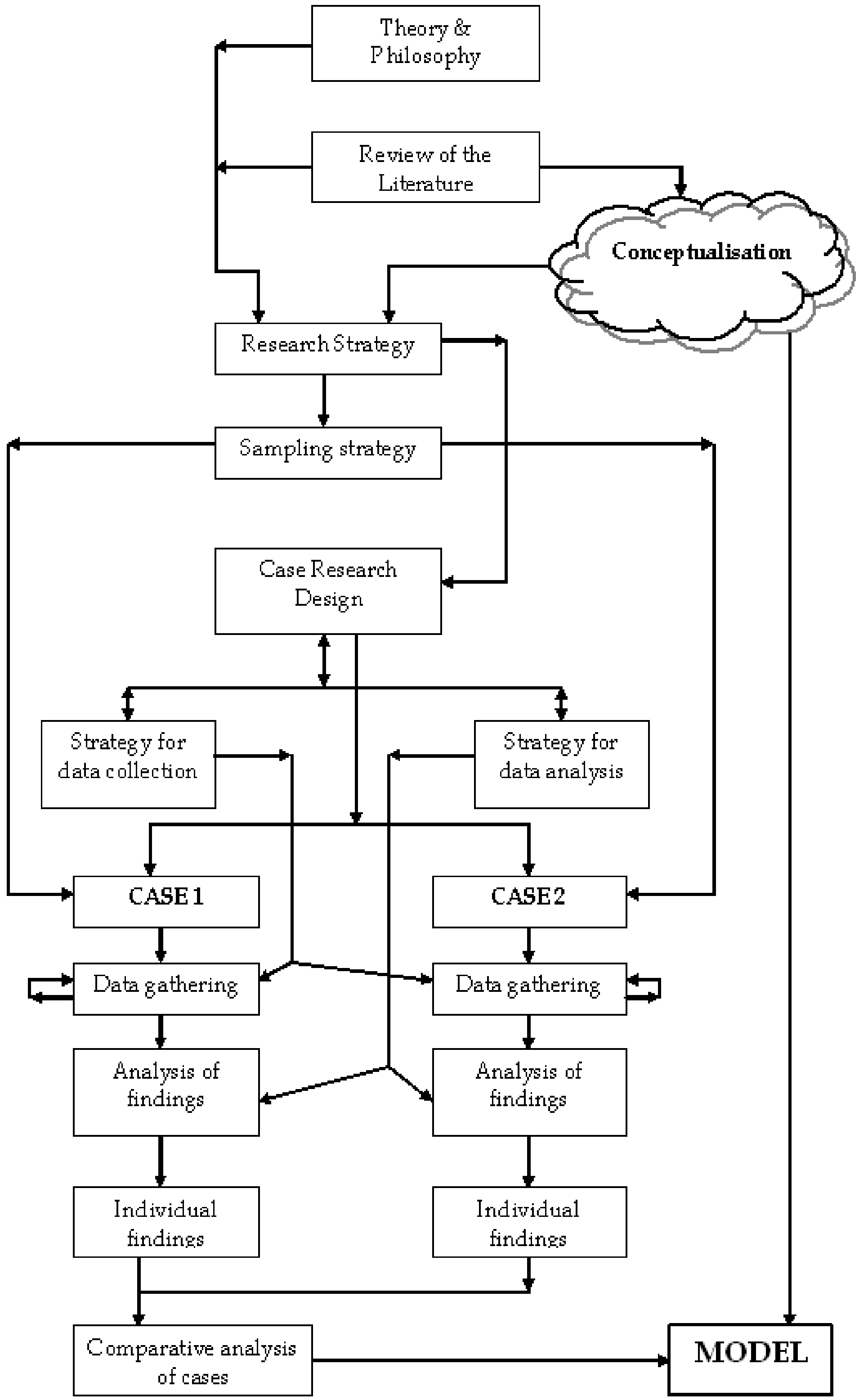
The rationale behind using interpretive case study research was that it was concerned with the complexity and nature of the case being studied within its real life context. This was useful when an understanding was needed in greater detail and where information rich data could be explored (Patton, 1980). In essence, it allowed for more valid portrayals and personal understandings of what was going on within each case and across cases. For Valdelin,

> The detailed observations entailed in the case study method enable us to study many different aspects, examine them in relation to each other, view the process within its total environment and also utilise the researcher's capacity for 'Verstehen'. Consequently, case study research provides us with a greater opportunity than other available methods to obtain a holistic view of a specified research project (1974, 47).

However, opponents to case study research have argued for its unsuitability for generalisation and its lack of validity and reliability due to poor research designs. Yet despite this, case research was one of the most common ways of conducting interpretivist research (Stake, 2000). It should be stressed that there could not be a standard format for interpretative case research designs. In essence, interpretive research was "exploratory, fluid and flexible, data driven and context sensitive" (Mason, 1996, 25). Nevertheless, a good research design should make answerable, decisions concerning the research questions, unit of analysis, sampling strategy, data collection strategy, analysis and management of data, and justification for conducting the research using this methodology from the beginning to enable further strategic decisions to be made if needed (Mason, 1996; Miles & Huberman, 1995).

In addition, case study research allowed for theory-construction and theory-building (Perry et al, 1999; Walsham, 1995; Eisenhardt, 1989). Although the researcher had identified the most important concepts in the literature concerning knowledge transfer processes (see Chapters three & four), the researcher nevertheless had to approach data gathering with a considerable degree of openness and a willingness to change or modify any pre-held assumptions. Indeed, following good theory-building practice as depicted by Walsham (1995), the researcher had to constantly keep in mind that no concept was guaranteed a place in the resultant theory. In essence, for this project, theory-building involved continuously resetting the boundaries of understanding and continuously re-adjusting tentative concepts to take into account new ideas and disconfirm others that were deemed not necessary (Weick, 2005; Perry et al, 1999). This approach was consistent with Eisenhardt's logic that "a strong theory-building study yields a good theory which emerges at the end, not the beginning of the study" (1989: 549). Indeed, the process of theory-building used in this study was iterative and involved the integration of past research and empirical evidence to build a theory on the knowledge transfer processes used by systems developers to elicit users' embedded knowledge requirements.

Figure 5.1: A Pictorial Representation of the Research Process Undertaken for this Study



5.3.2 Defining the Unit of Analysis

In conducting case research, the main difficulties were in deciding "*what is my case*" and "*where my case leaves off*" (Miles & Huberman, 1995; Yin, 1995). Case research was the investigation of a phenomenon that occurred within a real life context, when the boundaries between the phenomenon and context were not clearly obvious. For Palys (1997), all studies required identification of the unit of analysis. The case was directly related to the specified research questions for the proposed study. However, poor description of the primary research questions may lead to confusion and incorrectly defining the unit of analysis (Yin, 1995). If confusion arose over identifying the unit of analysis, the research questions were either too vague or too numerous (ibid). Marshall and Rossman (1999) argued that, the unit of analysis depended on the focus of the research and the adopted research strategy. The "key issue in selecting and making decisions about the appropriate unit of analysis is to decide what it is you want to be able to say something about at the end of the study" (Patton, 1980, 168).

For this study, the research questions that were to be addressed dealt with, understanding the embedded knowledge transfer processes that occurred between the users and the analyst during the requirements elicitation stage of systems development and how those processes interacted with each other. Thus, the unit of analysis for this study was the knowledge transfer relationship between the systems developers and the client organisation.

5.3.3 Sampling Strategy

Once the unit of analysis had been defined, the sampling strategy needed to address the research questions must be identified. For Mason (1996), sampling should not only be associated with and limited to statistics and probability. Interpretive case studies tended to rely upon purposeful sampling rather than random sampling. Purposeful sampling involved an in-depth study or studies of small samples of people that were situated in their context (Miles & Huberman, 1995). It demanded that the parameters of the wider population were critically examined and that the sample case was chosen carefully on that basis. Thus, people or locations were intentionally chosen to be part of the sample because they met some pre-specified criterion (Palys, 1997). Essentially, the sample chosen should help to provide the researcher with the data needed to address the research questions, regardless of the selection strategy used (Mason, 1996; Patton, 1980). The literature provided numerous different approaches to purposive sampling that researchers may use to select their cases (summarised in Table 5.1). Whatever sampling strategy may be chosen, the common underlying principle of each was to provide information-rich cases that would allow a theory to be developed (Patton, 1990) and would yield cases worthy of an in-depth study.

For the purpose of this study, the resources available and considering the primary research questions being asked, the sampling strategy adopted was criterion sampling. The rationale behind adopting this sampling approach was based upon a number of issues. First, the cases were likely to yield information-rich data. Second, it was critical that the organisations chosen for this study engaged in systems development projects with the user company. Third, they had to actively involve the users in the development of the project, particularly at the requirements elicitation stage.

Table 5.1: Typology of Sampling Strategies in Qualitative Inquiry
(Sources: Miles & Huberman, 1995; Patton, 1980).

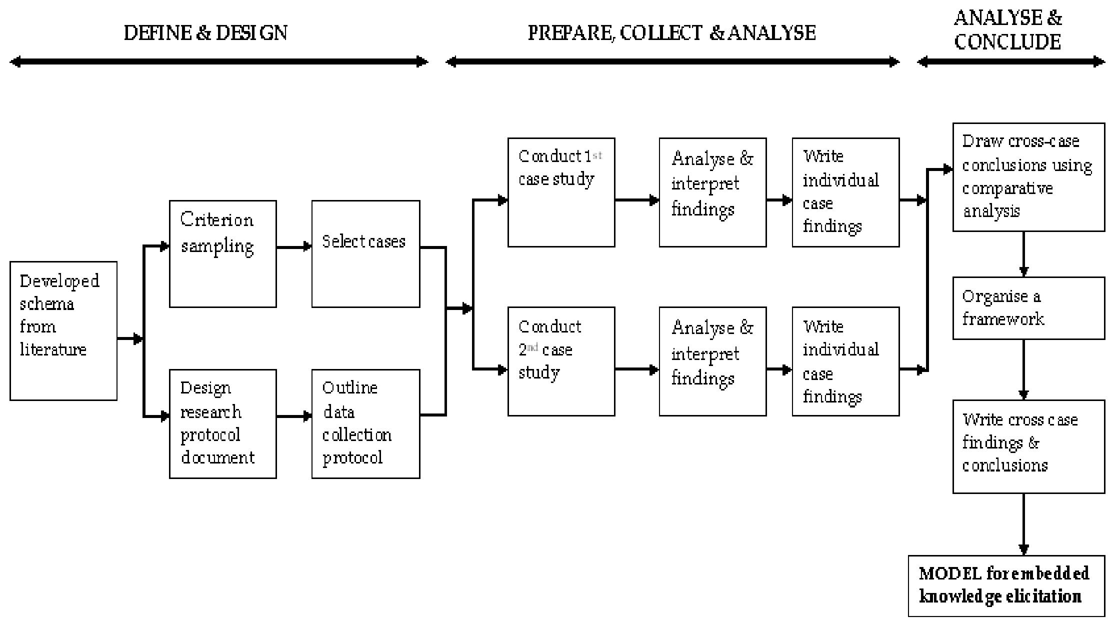
Type Of Sampling	Purpose
Combination / Mixed Purposeful	Triangulation, flexibility, meets multiple interests and needs
Confirming & Disconfirming Cases	Elaborating and deepening initial analysis, seeking exceptions, testing for variation
Convenience	Saves time, money, and effort but at the expense of information and credibility. Poorest rationale. Yields information-poor cases
Criterion	Picking all cases that meet some criterion; useful for assuring quality data
Critical Case	Permits *logical* generalisation and maximum application of information to other cases because if it's true of this one case it's likely to be true of all other cases
Extreme / Deviant Case	Learning from highly unusual manifestations of the phenomenon of interest
Homogeneous	Focuses, reduces variation, simplifies analysis, facilitates group interviewing
Intensity	Information-rich cases that manifest the phenomenon intensely, but no extremely
Maximum Variation	Documents unique or diverse variations that have emerged in adapting to different conditions. Identifies important common patters that cut across variations - purposefully picking a wide range of variation on dimensions of interest
Opportunistic	Following new leads during fieldwork, taking advantage of the unexpected, flexibility
Politically Important Cases	Attracts attention to the study (or avoids attracting undesired attention by purposefully eliminating from the sample politically sensitive cases)
Random Purposeful (Still Small Sample Size)	Adds credibility to sample when potential purposeful sample is larger than one can handle. Reduces judgement within a purposeful category. (Not for generalisations or representatives)
Snowball Or Chain	Identifies cases of interest from people who know people who know people who know what cases are information-rich
Stratified Purposeful	Illustrates characteristics of particular subgroups of interest; facilitates comparisons
Theory-Based / Operational Construct	Finding manifestations of a theoretical construct of interest so as to elaborate and examine the construct
Typical Case	Illustrates or highlights what is typical, normal, average

Fourth, the system developed must have successfully met all the performance objectives and knowledge needs of the users for whom it was developed. Fifth, the developed system must still be in use within the organisation. Sixth, due to resources and the purpose of the research, only companies that engaged in systems development projects with users in Ireland could be included.

This research utilised two cases to investigate the research problem at hand. The use of the second case could corroborate the findings from first case study. Figure 5.2 depicted an overview of the case method employed for this research. The rationale behind using a two case study design was five fold. First, since the research was interpretive in nature, it focused on *understanding* rather than on *generalising* (Hirschman, 1986). Second, by concentrating solely on two cases the researcher was able to give more in-depth and detailed attention to the research phenomenon under investigation. Third, it was the researcher's contention that since both case studies satisfied the pre-established selection criteria they should enable the researcher to successfully answer the research questions and thus, understand the phenomenon being investigated in greater detail (Mason, 1996). Finally, in practice, decisions regarding case selection and the appropriate number of sample units needed were largely dependent on practical issues such as the possibility of gaining access (de Weer-Nederhof, 2001).

Several potential companies were contacted; some refused to participate in the study, while others failed to satisfy the pre-established criteria. For this study, one development company was chosen, Enki, and access to two separate client companies, Hathor and Matuta, where successful systems were developed and implemented where chosen to corroborate the data and provide multiple perspectives of the requirements elicitation process used in the development of the system under review.

Figure 5.2: Overview of the Case Study Method
Adopted from Yin, 1994, 49



5.3.4 A Strategy for Data Collection

Thus far, the focus of the research design has been on *what* to find out, from *whom* and *why*. Knowing what you want to discover inevitably leads to the question of *how* you will obtain that information (Miles & Huberman, 1995). A research protocol document was developed for this study to answer this question and was set out in Appendix A. Although the protocol document was desirable under all circumstances, it was deemed a necessity for studies undertaking multiple-case design (Yin, 1994). It was a necessary instrument for interpretive case research, as it outlined the parameters of the research that the researcher must abide by.

For this study, the importance of developing a research protocol document was further necessitated as the sampling sites targeted wanted to know answers to questions concerning what the project was about, including the impact upon the company, data confidentiality and anonymity, and the time span needed by the researcher in gathering the data. These questions needed answering prior to the researcher gaining access to the site, hence the significance and usefulness of the research protocol document for this study. Also, this document ensured that all parties involved in the study understood their role, what was expected of them and any misunderstandings were clarified prior to site entry. A good data collection strategy would be of further benefit if the following three critical principles (using multiple sources of evidence, using a data management strategy, and using a data audit trail) were incorporated into its design and if properly used would increase the reliability and validity of the case study (Yin, 1994).

5.3.4.1 Principle 1: Using Multiple Sources of Evidence

One of the major strengths of case study research was the opportunity for using several different sources of evidence, more commonly referred to as triangulation (Yin, 1994). It was widely argued that, for interpretative case research, the use of individual sources of evidence was not recommended as it questioned the validity of the findings due to the lack of data triangulation (Denzin & Lincoln, 2000; Mason, 1996; Yin, 1994). Following Mason's (1996) advice, a table was developed to assist the identification and understanding of what data collection methods would be most beneficial to this study (Table 5.2). The purpose of this table was to help eradicate inconsistencies between what the method could yield and what kinds of data were needed to answer the research questions of this study. It forced the researcher to ask important questions such as: *how well will these methods and sources address the research questions?* And *what type of claims will they enable me to make?* (Mason, 1996). The table also allowed the researcher to consider how the choice of each data collection method was going to help the study achieve credibility, transferability, dependability and confirmability in relation to the objective and research questions of this study.

Table 5.2: Data Collection Methods

(*Sources: Mason, 1996; Yin; 1994; Patton, 1980; Lincoln & Guba, 1985*).

Research Questions	Data Sources	Sources Of Evidence	Justification For Use	Physical Constraints	Issue Of Ethics
What are the knowledge transfer processes used by systems developers to elicit the embedded knowledge requirements of the lead systems users during the development process?	Analyst	Documentation - This type of information can take many forms such as letters and other communiqués such as e-mails; agendas, reports, minutes of meetings; Formal studies; rough notes, progress reports, newspaper clippings, pictures and other internal records.	Unobtrusive in that they are not created as a result of the case study Can provide the formal expression of the interaction that is occurring between the actors Long span of time, covering many events and many settings Can verify or contradict evidence from other sources Are exact since they contain exact names; references; and details of an event Stable as they can be reviewed repeatedly	Can be low biased selectivity if collection is incomplete May not be accurate Access may be deliberately blocked, thus retrievability may be low	Concerns regarding confidentiality, privacy and anonymity need to be clarified
		Archival Records – computerised records; lists of names; service records; organisational charts; budgets; maps & charts; survey data; census records; other data collected about 'site'; diaries; calendars; phone listings; other personal records	Can provide context to the case study Precise and can verify or contradict evidence from other sources	May not always be accurate Access may be an issue due to privacy reasons	Privacy needs to be addressed
		Interviews – face to face communications with the informant	Targeted as they focus directly on case study topic Allows the researcher to probe further into certain areas Can clarify issues emerging from other sources	Bias due to poorly constructed questions Problems with response bias and reflexivity as the interviewee gives what the interviewer wants to hear Inaccuracies due to poor recall Time constraint – Interviews to be recorded and transcribed Scheduling may be problematic Scheduling and access may be an issue	Anonymity issues need to be tackled with this method
How do these knowledge transfer processes interact with each other to enable the transfer of the users' embedded knowledge requirements to the systems developer during the development process?	Users	Direct Observation – studying relevant behaviour or environmental conditions as they are occurring at the 'site'	Covers events in real time Contextual by providing insights into behaviours and motives underlying events occurring within the development of the system	Time consuming and costly as long hours are needed by human observers Problem with reflexivity as the event may proceed differently since it is being observed Cost – hours needed by human observers	Confidentiality issues need addressing particularly in relation to proprietary information
		Participant-Observation – observation where the researcher is not just a passive observer but may participate in the events being studied	Events occur in real time Insightful into interpersonal behaviour and motives of the participants involved in the development process	[same as above for direct observation] Issue of access Bias due to investigator's manipulation of events Problem getting both developer and user companies to agree	Concerns regarding confidentiality and privacy
		Reflexive Journals – diaries in which the informant records a variety of information about interactions with others concerning the topic of interest, the decisions made and the rationale behind those choices – subjective questioning of the self	Provides insights into the thinking, motives, assumptions, uncertainty and expectations of the informants. Makes them question their own actions and how they influence others	Time consuming process for the informant Very personal and they may feel uncomfortable Issue of ambiguity and structure	Ensuring privacy and confidentiality are important for this method
		Physical Artefacts – includes technological device; a tool or instrument; a work of art that may be observed or collected at the 'site'	Insights into cultural features Insights into technical operations	Problem of selectivity Availability and access to artefacts may be an issue	Issues over ownership
		Literature Review – A thorough review of the existing literature on the topic being researched	Being completed in conjunction with the case research should allow the researcher to see the theory emerging from the data	Access to literature review is critical and important Researcher must spend time and effort on understanding and accomplishing the task	Literatures must be properly recorded

As identified previously, the unit of analysis for this study was the organisation, namely the relationship between the development and the user companies. Thus, both systems developers and users were the primary data sources. To gather the required information from them, eight different data collection techniques were identified (Table 4.2). Based upon their justification for use and practicalities, two were opted not to be used, namely, participant observation and physical artefacts. All others were adopted as methods of data gathering for this research. The raison d'être behind not using participant observation was that it would be extremely problematic in obtaining access to development companies and their users while being involved in the development of the project, particularly since the system had been previously developed and was successfully in use within the user company. Not opting for the use of physical artefacts was based upon common sense, no development or user organisation would allow a researcher to obtain a physical copy of their software or computer system. Nevertheless, the remaining six sources of evidence (documentation, archival records, interviews, direct observations, reflexive journals and literature review) would provide ample data for this research. The procedures for collecting each type of data was discussed in §5.4.

5.3.4.2 Principle 2: A Strategy for Data Management

Data gathered from case research commonly comprised of transcripts, narratives, observation notes, written documentation, transcribed audio tapes and tabular materials (Ritchie & Lewis, 2003; Yin, 1995). Thus, an important component of case research prior to data analysis was the management of the collected data. Proponents of quantitative research would be more familiar with data management strategies, however, it was perhaps more important for interpretive studies (Miles & Huberman, 1995). A strategy for data management answered the question of how the gathered data would be organised and documented (Yin, 1994). Computer programs have been developed to help with this process and they have now become an invaluable part of the data management strategy.

"The researcher is faced by a mass of unwieldy, tangled data and so the first task is to sort and reduce the data to make them more manageable" (Ritchie & Lewis, 2003, 215). This study made use of the NVivo computer package in order to make data analysis more manageable. Essentially, it reduced many of the problems often associated with organising large amounts of interpretive data. In addition, it provided an organised file system so that material could be quickly and easily accessed (Creswell, 1998). The data gathered from the interviews, observations, documents, records and journals were transcribed and scanned into NVivo. Each were dated, timed and labelled according to case site and interviewee name where applicable. This forced the researcher to look at the data line by line, to think about the meaning of each sentence and the idea behind it. This software package supported this analysis. It enabled the researcher to synthesise and handle vast amounts of rich data through coding, searching and retrieving, annotating, linking data to other categories and the use of memos, and by removing the rigid divisions that exist between 'data' and 'interpretation' (Richards, 1999).

5.3.4.3 Principle 3: Using a Data Audit Trail

The last principle, a strategy for data collection, should include the maintenance of a chain of evidence (data audit trail). An external observer must be able to follow the derivation of any evidence from the primary research questions to the final case study conclusions and vice versa (Yin, 1994). In essence, the process of analysis must be tight enough that the data gathered is the same data presented in the findings and that no data should have been lost due to bias or carelessness. For this study, an audit trail function provided by NVivo tracked data collection, analysis and the interpretation process. NVivo automatically attached identifiers to the data including names, addresses, dates, creation/modification times, paragraph and line numbering. Whenever a unit of information was referred to in a document, NVivo cited the document source, paragraph number and its line location, thus providing the "ultimate chain of evidence" and enhancing the quality of the case (Yin, 1994, 99).

5.3.5 A Strategy for Data Analysis

Although using NVivo was essential in managing the collected data, it was no substitute for the interpretive skills of the researcher when it came to analysing the data (Easterby-Smith et al, 2001). NVivo was only a tool, it was up to the researcher to "reduce the volume of information, identify significant patterns and construct a framework for communicating the essence of what the data reveal" (Patton, 1980, 371-72). In order to categorise and identify the embedded knowledge transfer processes that occurred between the user and the developer, comparative analysis between the cases was utilised in this research. This analytical model used convergence and divergence to initially identify recurring regularities within the cases, leading to the creation of categories and the development of a classification system, which the cases were then analysed by (Patton, 1980). Discovering the processes used to transfer embedded knowledge began with initial observations and preliminary interviews. Further data collection and processes of analysis allowed the researcher to continuously refine these classifications, since these research processes occurred simultaneously with interpretation of the data. Constantly comparing new data with previous events, led to the discovery of new insights, which were then investigated. These in turn led to uncovering the knowledge transfer processes used by the users to transfer their embedded knowledge requirements to the analyst.

5.4 Data Collection

In relation to data collection, all case companies and informants were told that the information provided by them would be treated with the utmost confidentiality[10] and that none of the informants or their respective companies would be recognised in any publication from the research project. Hence, all names used in this study are fictitious. Data collection continued until theoretical saturation was reached, namely when insights provided by additional interviews were judged to be insignificant. The six data collection methods utilised in this study will now be discussed in turn, namely, interviews, reflexive practices, direct observations, documentation, archival records and literature review.

5.4.1 Interviews

Interviews were carried out between June 2006 and May 2007. In total, 44 interviews were conducted, and Table 5.3 provides an overview of these. All in all, 29 were personal in-depth interviews and 16 were telephone interviews. The personal interviews ranged from 1 to 3 hours in length and were not taped. It was felt that the participants opened up more if they saw the researcher taking notes, so notes were taken while the interviewee was discussing the topic with additional notes being added later on. The telephone interviews lasted on average between 10 to 30 minutes, with the shortest telephone interview merely being aimed at validating existing information obtained via interviews, documentation, etc., or at alleviating confusion. Telephone interviews were carried out after the personal interview.

[10] A copy of the Confidentiality Agreement given to the informants is presented in Appendix B.

Table 5.3: Overview of Interviews

	Case Study 1	Case Study 2
Interviewing Period	*[Preliminary Interviews - February 2005]* June 2006 – May 2007	November 2007 – May 2007
Personal Interview	Enki – 4 Hathor – 6	Enki – 5 Matuta – 7
Telephone Interview	Enki – 4 Hathor – 7	Enki – 1 Matuta – 4
Group Interview i.e. 2 people or more	Enki – Not Applicable Hathor – 6	Enki – Not Applicable Matuta – 1
Interviewee Description	Key informants in both companies: Enki – MD [Lead Analyst] Hathor – Production Manager; Production Supervisor; Grading Manager; Systems Administrators (2); Accountants (2); MD	Key informants in both companies: Enki – MD [Lead Analyst] Matuta – Financial Team Leader; Production Planning & Logistics Manager; QA/QC Manager; Laboratory Manager
Information Gathering	Retrospective	Retrospective

Initially, the personal interviews were conducted on a one-to-one basis, with this practice continuing throughout data collection for Enki and Matuta. However, the researcher set up 6 group interviews in Hathor and 1 in Matuta, where multiple informants were interviewed at a time. The reason for opting to conduct group interviews was due to the fact that multiple informants were identified who were involved in the development of the system from one particular aspect. It was felt that to obtain a better picture of what had occurred the group interview would be most suitable between the parties involved. By carrying out this type of interview, the researcher was provided with very reliable and valid data, because one informant was confirming what the other had said and if one forgot something, the other filled in the missing pieces. Thus, a more comprehensive, richer picture was obtained by the researcher.

The interview selection process was relatively simple. Once agreement to participate in the research had been obtained from both companies, initial discussions identified the key players and interviews could be set up with the relevant participants. Due to its size, preliminary interviews were conducted in Hathor to identify which system to further investigate and which best met the criteria. Once the system was chosen, Enki was informed and all participants involved in the development of the project were interviewed. Informants were selected by referral from those interviewed earlier.

For both cases, various documents were used to prepare participants for the interviews. In accordance with Perry et al (1999) and prior to each interview, an interview guide (Appendices C, C1 & C2) was presented to each participant setting out the focus of the interview. This document was used in order to contain the difficulties associated with selective retrospective bias. Adhering to best practices as detailed by Doz, the interview guide was used to "challenge interviewees' memories and cross-check their *ex post* data and perceptions" (1996, 58). Nevertheless, the interviews were informal with very little structure or direction placed upon the discussion (Carson et al, 2001), except where they were interrupted by the researcher to follow up on some issue. Essentially, the role played by the interviewer was only that of a guide. For instance, when it was felt that the interviewee had exhausted the topic, the researcher introduced a new topic on the interview guide.

5.4.2 Reflexive Practices

Over the past few years, the literature dealing with interpretative methods has increasingly become sensitive to the role reflective practices can play in researching social phenomenon (Gardner, 2001; Klein & Myers, 1999; Altheide & Johnson, 1994). In essence, reflective practice was "the activity of thinking *about* one's own actions and analysing them in a critical manner, with the purpose of improving a professional practice" (Baumard, 1999, 96). This would mean that the interview participant must look at themselves independently and as external watchers to see how they performed their tasks and then to reason why they performed the task the way they did. Thus, meanings and frameworks arise retrospectively and reflection allowed individual thinking about what they were doing to be captured by the researcher, which in turn provided valuable insights into what was going on (Denzin, 2001; Weick, 1995).

In this research study, it was originally conceived that all participants would maintain a reflective journal documenting their actions and reasoning's during the development process with particular focus upon why they needed certain requirements, how were those needs met, if conflict or misunderstandings arose how were they overcome. The reason for opting to use the journals was to allow the researcher to obtain a clearer insight into the development process and whether the overall system was a success or failure. Also, it was thought that the informants would be more open about how they felt throughout the process if they were reflecting and writing rather than being in a formal setting of an interview. However, at the beginning, it became clear that the use of journals would not work. The respondents did not have the time to make the journal entries due to work commitments and despite the researcher's best efforts no data using this collection method was forthcoming.

To overcome this difficulty, the researcher and the respondents decided together to use *reflective interviews* (Denzin, 2001). This practice involved the researcher analysing the data gathered from the in-depth interviews, documents and archival records, putting it into a story and then presenting that narrative to the respondent. Any gaps in understanding that were evident in the story and any further data required to make the narrative complete were subsequently filled in by the respondent. In essence, the participant became the analyst of the data and by carefully listening and writing the narrative, the researcher was able to immerse herself more fully in their experiences to achieve a better sense to what was going on (Denzin, 2001; Eisenhardt, 1989).

The procedure for conducting the reflective interviews was as follows. At the start of a scheduled in-depth interview, the researcher would present the narrative about the data collected to that point, resulting in a discussion. Errors would be highlighted and understandings would emerge on any unclear issues. When the discussion was exhausted the interview would revert back to uncovering and gathering the next episode of the story. At the next meeting, this process would repeat itself with the researcher producing the updated draft of the narrative for the respondent to fill in any blanks. Once understanding was arrived at, the next episode would be examined in detail. Essentially, what emerged from those iterative in-depth reflective interviews is the final data presented in Chapters five and six.

5.4.3 Direct Observations

Direct observations of people at work also contributed to the researcher's understanding of the systems that were developed. In turn, this provided a greater contextual understanding of the role the system played within the organisation. An overview of the number of observational hours carried out per case study was set out in Table 5.4. 9.5 hours of observations were carried out for Case Study One between both Enki and Hathor. For Case Study Two, 10.5 hours of observation were conducted between Enki and Matuta. While conducting Case Study One, the researcher was brought onto the factory floor and was able to observe and experience the Cheese system that was developed for Hathor. This provided clarity to the researcher on many issues that were confusing. Prior to this, when the interviewee was discussing the 'new' system, references were made to different parts of that system that the 'old' system didn't have and how they operated, for example scanners and printers, and how they contributed to the overall success of the 'new' system. However, until the researcher had observed the system in use, it was unclear as to what the interviewee was talking about. For Case Study Two, observations were involved in most of the interviews carried out. While the informants were discussing the system and its development, they also showed the researcher the system in operation. This provided the researcher with a greater understanding of the complexity of the system that was developed and how all elements of the system integrated with each other. The observations carried out on the sites allowed the researcher to gain an insight into knowledge that was hard to communicate without experience and in turn, enriched the researcher's understanding of the concepts that the participants were talking about.

Table 5.4: Number of Observational Hours Obtained

Total Number of Observational Hours	Case Study 1	Case Study 2
Development Company: 6 User Companies: 14	Enki – 2.5 Hathor – 7	Enki – 3.5 Matuta – 7

5.4.4 Documentation

Various different types of documents, printed as well as electronic, were obtained for the case studies as illustrated in Table 5.5. In total, 24 documents were used for Case Study One and 13 were used for Case Study Two. In most cases, the documentation was studied and used as preparation for the interviews. For instance, in Case Study One, documentation on the overview of the system and its design specifications were researched in the hope that the researcher would be provided with enough knowledge to hold a dialogue with the production manager about the process, one element of the system was developed for. For Case Study Two, documentation obtained by the researcher on the industry and the company provided a greater understanding of the case and what products the company produced, which in turn, provided a greater focus on what was important in the development of the system. It also allowed the researcher to obtain and sufficient knowledge of the industry terminology and its context which was important for understanding and interpreting the case study.

Table 5.5: Overview of Documents Used for Empirical Data

	Number of Documents	Case Study 1	Case Study 2
Web – Home pages	9	9	-
Web - Articles	16	7	9
Business plan	-	-	-
Specialised documentation on company	4	3	1
Articles in press and journals	2	2	-
Company history	1	-	1
Industry reports	5	3	2

5.4.5 Archival Records

Various different types of archival documentation were provided to the researcher (Table 5.6). In total, 16 archived records were used for Case Study One and 9 for Case Study Two. For instance, in Case Study One, the researcher was presented with proposals from other development companies and the letters setting out costings, etc., from the successful development company, Enki. Also, Enki provided the researcher with presentation slides used by them when they were presenting an overview of the system to Hathor's parent company and Matuta's Board of Directors. These documents were studied in conjunction with other documentation to provide a greater understanding of the systems that were developed and were used mainly as preparation for carrying out the interviews.

Table 5.6: Overview of Archival Records Used for Empirical Data

	Number of Documents	Case Study 1	Case Study 2
Presentation documents	3	2	1
System screen shots	10	4	6
Systems design diagrams & specifications	3	3	-
Formal correspondence – proposals etc.	4	4	-
Specialised documents & drawings	5	3	2

5.5 Analysing and Interpreting the Data

As mentioned previously, this study utilised comparative analysis as its strategy for data analysis (Lincoln & Guba, 1985). The purpose of this section was to elaborate on the actual analytical process that took place, in order to provide the reader with a thorough understanding of how the gathered data was analysed and interpreted.

In accordance with recommended research practice for interpretive research, data analysis was conducted in parallel with data collection, allowing each process to inform the other (Mason, 2002; Lincoln & Guba, 1985). After the collected data was transcribed from handwritten notes, the researcher read through the transcripts in their entirety several times. This allowed the researcher to be immersed in the details of the cases. Reflective notes, comments and ideas about what was being read were entered into the margins of each transcript while the researcher was reading the text. This process allowed for familiarisation with the data to occur, thus facilitating analytical insight and reflection on the part of the researcher as to what was occurring (Miles & Huberman, 1994).

The next step was to analyse the content of the text. This was done by reducing the data through unitising and coding. The transcribed text was broken up into units or categories and a code was assigned to each. The codes resulted from keywords or labels used by the research participants to describe the topic being discussed. Each unit was coded via source, site, date and label, which allowed for fast retrieval of the information when needed.

Once similar categories began to emerge through the coding process, the units of information were put into provisional category sets that related to the same content (Lincoln & Guba, 1985) and each category was given a name that directly related to the information contained within them (di Gregorio, 2000). This process was iterated throughout the analysis until the researcher was satisfied that each category set had included all the necessary information pertaining to that particular unit of data. Initially, multiple different categories were created until a point of saturation was reached and no new categories could be created. When this occurred, each category was thoroughly examined to ensure that the data contained within them was justified. If the data was not supposed to be held within that category, it was removed and placed in a miscellaneous category or formed a new category for analysis (Lincoln & Guba, 1985).

The categories were then reviewed for possible overlap and data redundancy (Miles & Huberman, 1994) and for relationships between categories. Several of the initial categories were identified as being a subset of other categories, whilst others were further divided up. Relationships between categories allowed for parent and child categories to emerge, which in turn, allowed the researcher to organise them into category trees so the hierarchical nature of the data could be identified (di Gregorio, 2000).

In order to fully understand and correctly interpret the data, the researcher used analytical writing such as, narratives, mind maps and diagrams to help clarify and formulate the data into a coherent description of the phenomenon. As mentioned previously, on numerous occasions the researcher presented these narratives to the research subjects to ensure that the researcher had understood them or to refine and further discuss topics which were not fully comprehended. By allowing the research participant to reflect and further discuss these phenomena, the researcher was ensuring that the analysed data was correctly interpreted and fully understood.

5.6 Legitimisation of the Data

The purpose of this section was to establish the trustworthiness of the data and the rigour of the research strategy adopted for this study. Based upon the assertions of Morgan (1983), Lincoln and Guba (1985) proposed four evaluative criteria for interpretivist research, namely, *credibility*, *transferability*, *dependability* and *confirmability*, which equated to the conventional terms *internal validity*, *external validity*, *reliability* and *objectivity* respectively. The criteria for interpretivist research were now examined in greater detail in relation to the current study.

5.6.1 Credibility

Credibility was concerned with the integrity of the interpretations that were generated from the research (Bryman, 2004). Following good practice as suggested by both Hirschman (1986) and Lincoln and Guba (1985), the credibility of the research findings and interpretations was achieved through a number of different techniques.

First, the researcher ensured that there was prolonged engagement with the research sites involved, in order to detect and take account of distortions that might occur over time (Lincoln & Guba, 1985). Second, data was collected from multiple sources and different methods were used to obtain that data[11]. This allowed for the triangulation of evidence on convergent meanings (Yin, 1994). For an interpretivist researcher to establish the truth value, the composed multiple realities must be adequately presented and they must be credible to the constructors of the original multiple realities (Lincoln & Guba, 1985). For Hirschman (1986), the people most capable of evaluating the completeness of the interpretation of that world view are those who originate it. Thus, on a regular basis the gathered data, the interpretations and conclusions were sent back to the research participants for review to ensure their adequacy and credibility.

Upon completion of the findings chapter, the researcher presented each case company with the findings pertaining to their company only. Each company was asked to read their findings to ensure the validity of the data and the development process they participated in. If the company was unhappy with the findings, or if the researcher had missed or had misinterpreted something, the contact was to make these errors known to the researcher so that the findings could be rectified. However, if the company was satisfied that their findings were correct and that they were happy with them, the researcher's contact was to fill out the consent release form on the part of their company allowing the researcher to use their data[12]. Each company returned the signed consent form and indicated that no changes were to be made to their findings as the findings clearly reflected the development process that they were a part of. Finally, the findings were presented to a peer debriefer who conducted an analytic review to guarantee that the

[11] See § 5.4 for a more thorough discussion on the data collection methods used.

[12] A copy of the letter sent to each company and the consent release form is presented in Appendix D

researcher was being honest and was fully aware of her position and process (Lincoln & Guba, 1985).

5.6.2 Transferability

Transferability was analogous to external validity for positivist research. It was important to realise for this research that the findings could not be generalised to an entire population, which in the strictest sense was not impossible for interpretivist studies (Lincoln & Guba, 1985). "To assess the transferability of an interpretation one must know not only the specifics of the context in which the interpretation was generated, but also the specifics of the context to which the interpretation is to be applied" (Hirschman, 1986, 245). Transferability to a second setting was only knowable on a post hoc basis, where interpretations from both contexts could be compared. Conversely, Lincoln and Guba (1985) stated that the thick description provided by the interpretivist researcher was necessary to enable another researcher to reach a conclusion as to whether a contemplated transfer would be possible. For this study, the researcher provided a rich, thick description that would enable other researchers to assess the interpretations derived from the data gathered and reach a conclusion on whether the study could be transferred to a different context.

5.6.3 Dependability

Dependability would be equated to reliability (Kerlinger, 1973). For this study, two tactics were designed to establish the dependability of the findings, interpretations and methods used. First, taking into account the advice of Denzin and Lincoln (2000), Mason (1996) and Yin (1994), multiple sources of evidence were used to triangulate on the same findings, thus ensuring their dependability.

Second, the theoretical and philosophical basis for the research, along with the process of inquiry, the collected raw data, the findings, interpretations and recommendations were all presented to an auditor (Lincoln & Guba, 1985) or external observer (Yin, 1995) for examination. Yin argued that the process should be tight enough so that the conclusions obtained be "assuredly the same evidence that was collected at the scene… during the data collection process; conversely, no original evidence should have been lost, through carelessness or bias" (1995, 98). The task of the auditor was to review the quality of the research design and findings to assess the triangulation of evidence and to confirm or disconfirm that the conclusions derived at flowed from the gathered data (Hirschman, 1986; Lincoln & Guba, 1985). To facilitate such an examination, an audit trail from the philosophical, theoretical and methodological backgrounds, to raw data, interview notes and transcripts, documentation etc., to analytical procedures, to interpretations and conclusions were all presented for review. The auditors' reports in general, supported the conclusion that this research was trustworthy in terms of credibility, dependability and confirmability (Appendix E).

5.6.4 Confirmability

Confirmability addressed the issue of whether or not the interpretations arrived at, were logical and rational (Hirschman, 1986). This was accomplished through the audit trail and, as previously discussed the auditors attested that the interpretations drawn were logically consistent with presented documentation based upon their own knowledge and experience with the literature.

5.7 Conclusion

This chapter provided a detailed account of the research strategy and the principles underlying the chosen research methodology which was carried out to answer the research questions of this study. The research process was characterised by a reflective, iterative approach that relied on a pre-understanding of the literature, succeeded by data collection, analysis, reflecting, writing, theorising, reflecting, writing, etc., until the researcher's interpretation emerged and the research participants confirmed. The following chapter presents the rich, thick description of the findings that were gathered utilising this research methodology.

Chapter 6: Findings

6.1 Introduction

This chapter offered an individual case account and comparative analysis of the findings. The research consisted of two case studies, with the systems development company being common to both. Case Study One referred to the development of a Cheese Production and Management System between the systems development company, Enki, and Hathor, a cheese manufacturer, while Case Study Two involved the same development company and Matuta, a baby foods manufacturer and focused on the development of a Factory Floor and Laboratory Information Management System. Both cases described the knowledge transfer process that occurred between the analyst and user during requirements elicitation, with Case Study Two being used as confirmation of the knowledge transfer processes utilised by Enki.

6.2 Case Study One

The two organisations involved in Case Study One were as follows:

6.2.1 Case Study Profiles

Enki were a software development company that provided development and consultancy services in the design, construction and implementation of computer based solutions for business and manufacturing applications. Although the software industry was highly competitive, Enki has enjoyed considerable growth since its establishment in 1990. While mainly interested in bespoke systems, Enki's Managing Director (MD) felt the need to establish themselves within the hardware and networking areas as well, especially if they were to survive in a highly competitive arena. The company's main strategy was to deliver an entire package not just the software. To fulfil this strategic objective, Enki became specialists in turnkey solutions, that is, they supply the full package (both hardware and software) to their clients. The focus and profitability of the company was on its bespoke software and applications.

In terms of structure, the company adopted a simple organisational structure in that the company was designed and controlled in the mind of its co-founder and MD, with whom decision-making authority rests. The organisation's size has grown slowly since start up and there were six people working in Enki. However, their local market was limited and so they have acquired over-seas clients in Jakarta and Iran. The company had a strong loyalty base that was focused upon its quality and reputation. They believed that it was easier to keep existing customers than get new ones and 80 to 90% of their new clients have been referred to them. However, most of their business was through repeat business or upgrades. They believed that this approach allowed for a continuity of people and services. Enki's motto was 'keep it simple', as some hardware and software were not compatible. Enki's strategy was to pick clients who would be with them in the long term, and customers were carefully selected by the MD.

They believed that success was based on the right employees, continuity of those people and quality. If the right team was picked it could lead to good success and the members of the team would be mutually supportive of each other. Indicative of this company, they believed in hiring graduates who want to be based in the local community. Enki ensured that new trainees got familiar with their customers over a two year period while they were still in college, e.g. during summer work, before the MD allowed them to work with the clients on their own. Enki believed in hiring people who could be home grown rather than already fully qualified. They felt that with home grown training, the standards of behaviour and customer relations needed could also be taught and that this would enable the new staff member to represent the company to the MD's standards. Nevertheless, it has to be stressed that this approach was bound within a very formal and mechanistic software development practice. Indeed, internal procedures and development lifecycles followed clearly defined stages.

Hathor were a cheese manufacturing company that were founded in 1959 by a German dairy company. In 1963, the company was acquired by a British-based company and in 1990 Hathor extended its production to include liquid milk in order to retain its competitiveness. Therefore, in 1991, Hathor separated into two distinct companies: Cheese Production and a subsidiary dealing only with Liquid Milk Production.

In terms of structure, the company had a formal hierarchical structure, in that it was run locally by a Board of Directors, Managing Director and Senior Management Team, while the offices and production staff had a very informal and open culture. At peak times, Hathor employed approximately 120 employees. The company's raw materials were supplied by 450 local farmers. During Hathor's peak manufacturing season, further raw materials were supplied from neighbouring dairies. During the winter months, Hathor manufactured no cheese, so their milk stocks were sold onto neighbouring creameries.

The company's main strategy was to build leadership positions in quality branded and generic markets across the dairy sector. To fulfil this strategic objective, Hathor exported most of its products to the UK market, which was where most of their parent organisation's market lay. In reality, the company transferred 90% of its product to UK cold stores, while the balance remained on their premises in Ireland, which was for sale on the Irish market.

Hathor believed that top quality raw materials would result in top quality products being produced. Therefore, all raw materials were tested to ensure that they met industry regulations before they were used in the production of their products. Within Hathor, there were both formal and informal communications structures in place. Formal communications (documents) were dictated by the system in place. Nevertheless, there was a very strong, informal communication structure in the company and employees at all levels were actively encouraged to voice issues and make suggestions to management.

6.2.2 The Context

The purpose of this section was to provide a rich description of the case study, which in turn, would allow external observers the opportunity to assess the researcher's interpretation of the data in the appropriate context (Klein & Myers, 1999). The case focused on the development of a Cheese Production and Management System that occurred between 1997 and 2004. Figure 6.1 provided a diagram of the context of Hathor's system. The focal point of the system was the Stock System. It governed the amount of stock produced by the organisation in that it took daily production figures from the Production System to determine production quotas and the amount of physical stock held in storage. The Stock System also produced outputs of what cheese had to be graded within the physical stock and informed the Grading System. Once the cheese had been graded and met all requirements, the information was fed back into the Stock System and it was the Stock System that informed warehouse of the cheese that could be sold and distributed to customers. Prior to 1997, the problem with this system was that it was manual and as a consequence, the potential for human error was high. As detailed in subsequent sections, Hathor experienced severe problems in terms of cost and time inefficiencies, which resulted in the company loosing competitive advantage. To rectify these inadequacies in the production and management system, Hathor approached Enki and asked them to develop an automated version of their manual system.

Table 6.1 presented a chronological order of the development of the three main sub-systems that comprised the Cheese Production and Management System, explicitly, the Cheese Stock System, the Cheese Grading System, and the Cheese Production System, and a timeline for the development phase for each system.

Figure 6.1: Overview of the Cheese Production & Management System

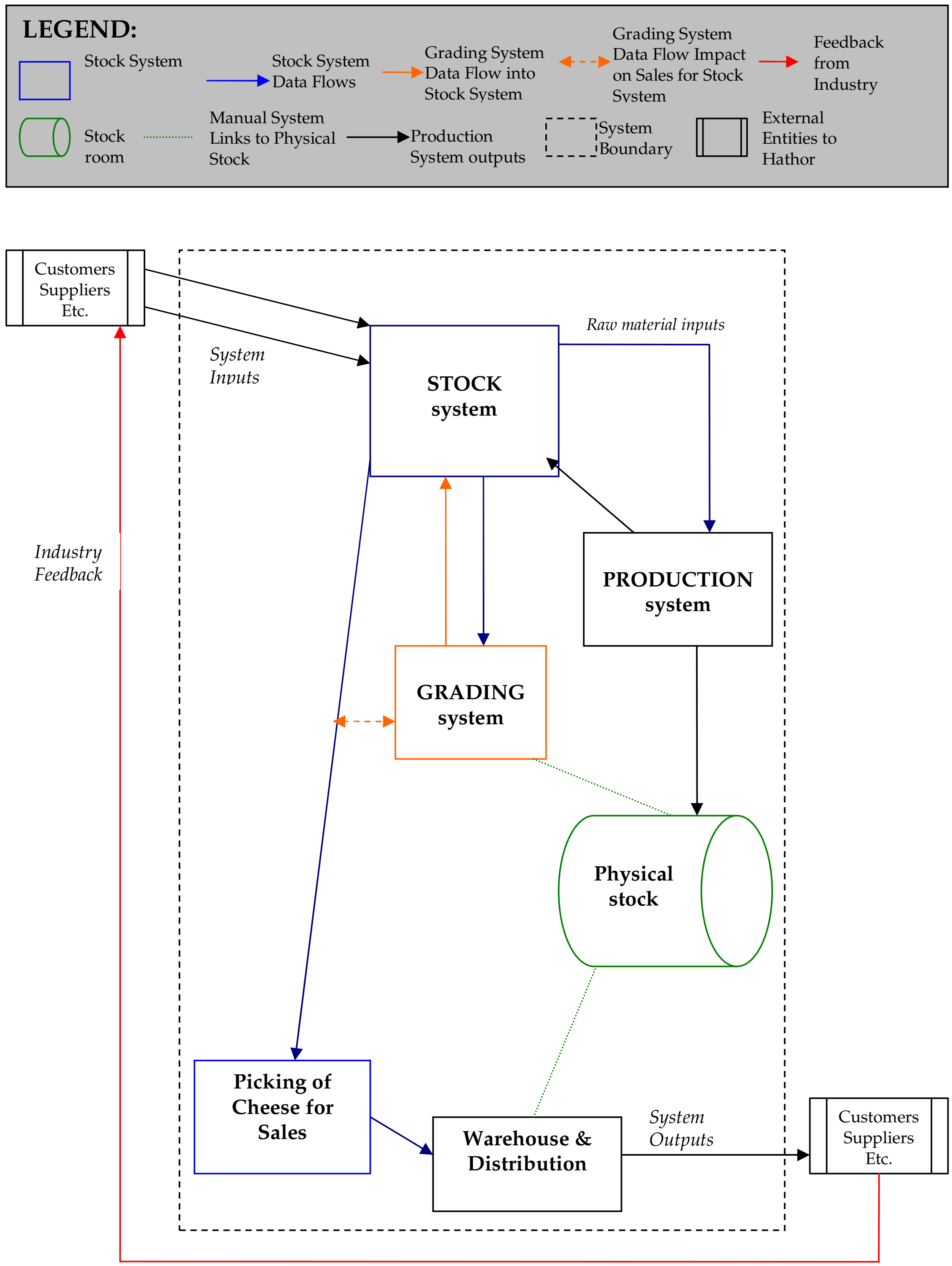


Table 6.1: Timeline of the Development of the Cheese Production & Management System

Date:	System & Development Phase:
1997 -1998	**Cheese Stock System:** Phase 1: Upgrading of Old System. Phase 2: Development of Sales Picking Sheet for the Cheese Stock System.
1998 -1999	**Cheese Grading System:** Phase 1: Development of Grading System.
1999/2000 - 2002	**Cheese Stock System:** Phase 3: Development of Handheld Technology for Stocktaking.
2002 - 2003/2004	**Cheese Production System:** Phase 1: Ordering/Batch Set Up. Phase 2: Labelling/Recording.

Figure 6.2 illustrated the operational processes employed by Hathor in the management of its cheese production prior to 1997. The flow chart detailed the different sub-systems that comprised the Cheese Production and Management System and how each sub-system integrated with the others. Also detailed were the manual information processes that occurred and the areas where potential problems happened within the system. From the beginning, it should be noted that this analysis of the system was developed ex post based upon analysis of documentation, observations and interviews carried out by the researcher in both Enki and Hathor.

Figure 6.2: Analysis of the Stock, Production & Grading Systems prior to 1997

Model is based on observations of the systems, and interviews with both Enki and Hathor – adapted for illustration.

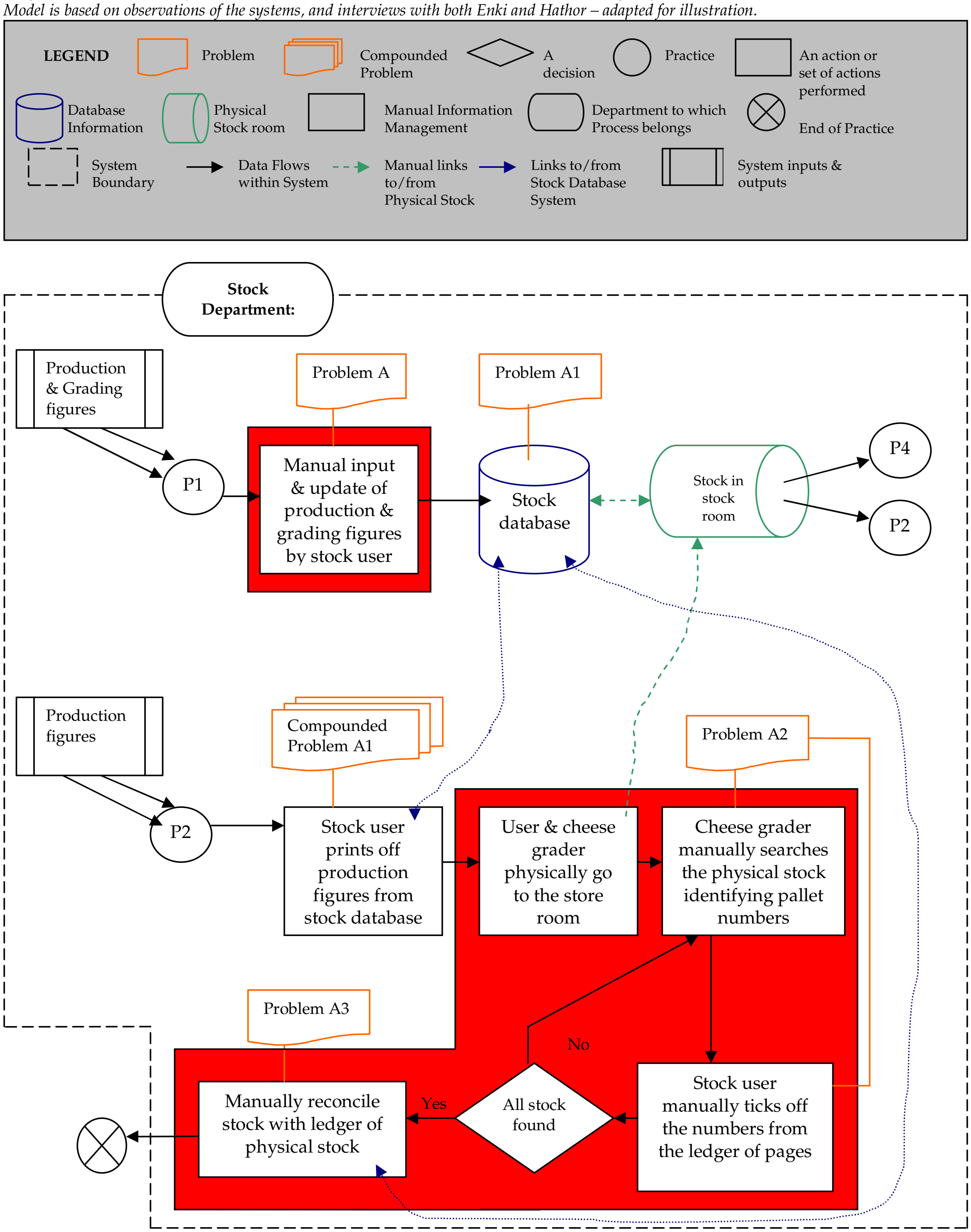


Figure 6.2: Continued

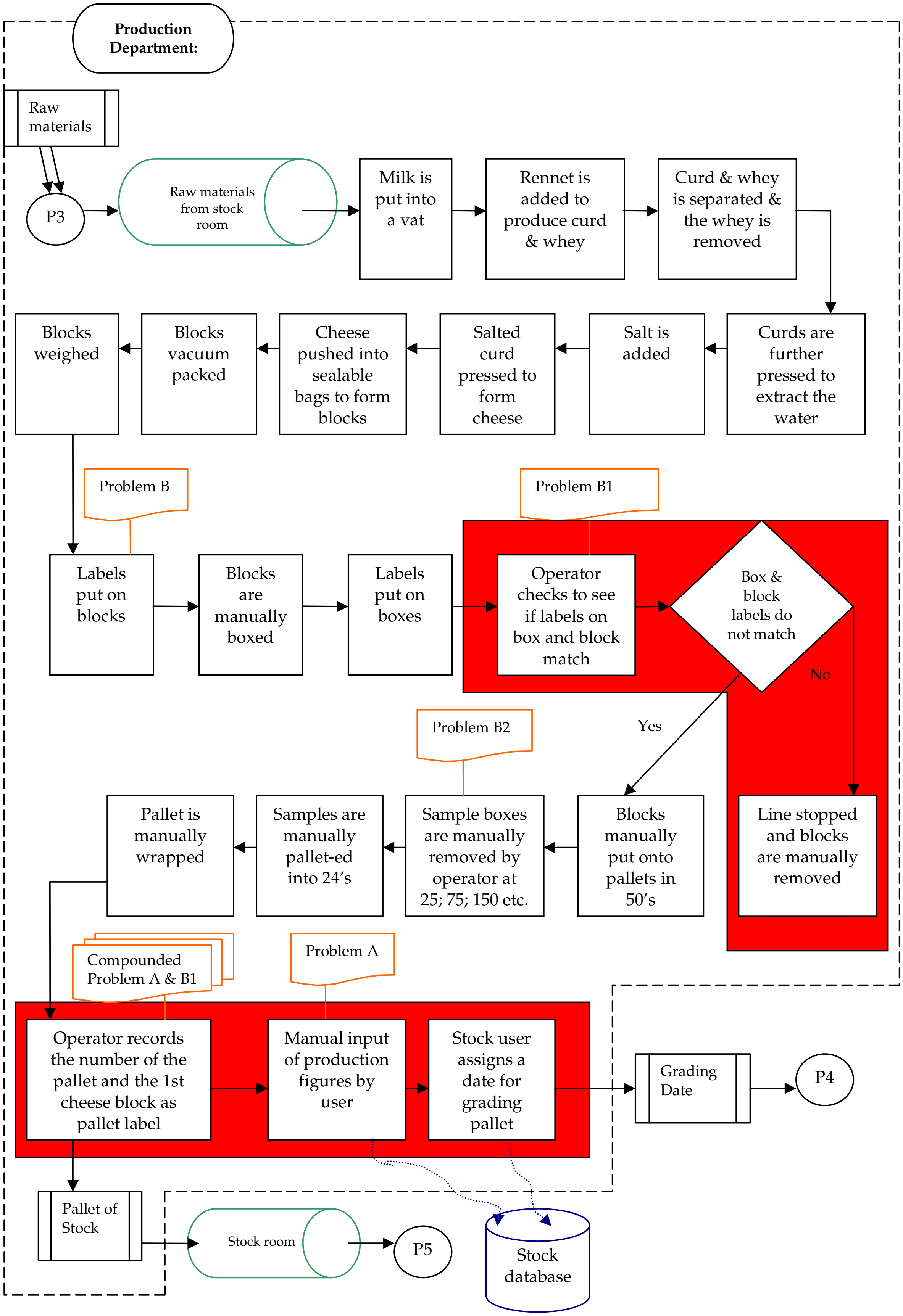


Figure 6.2: Continued

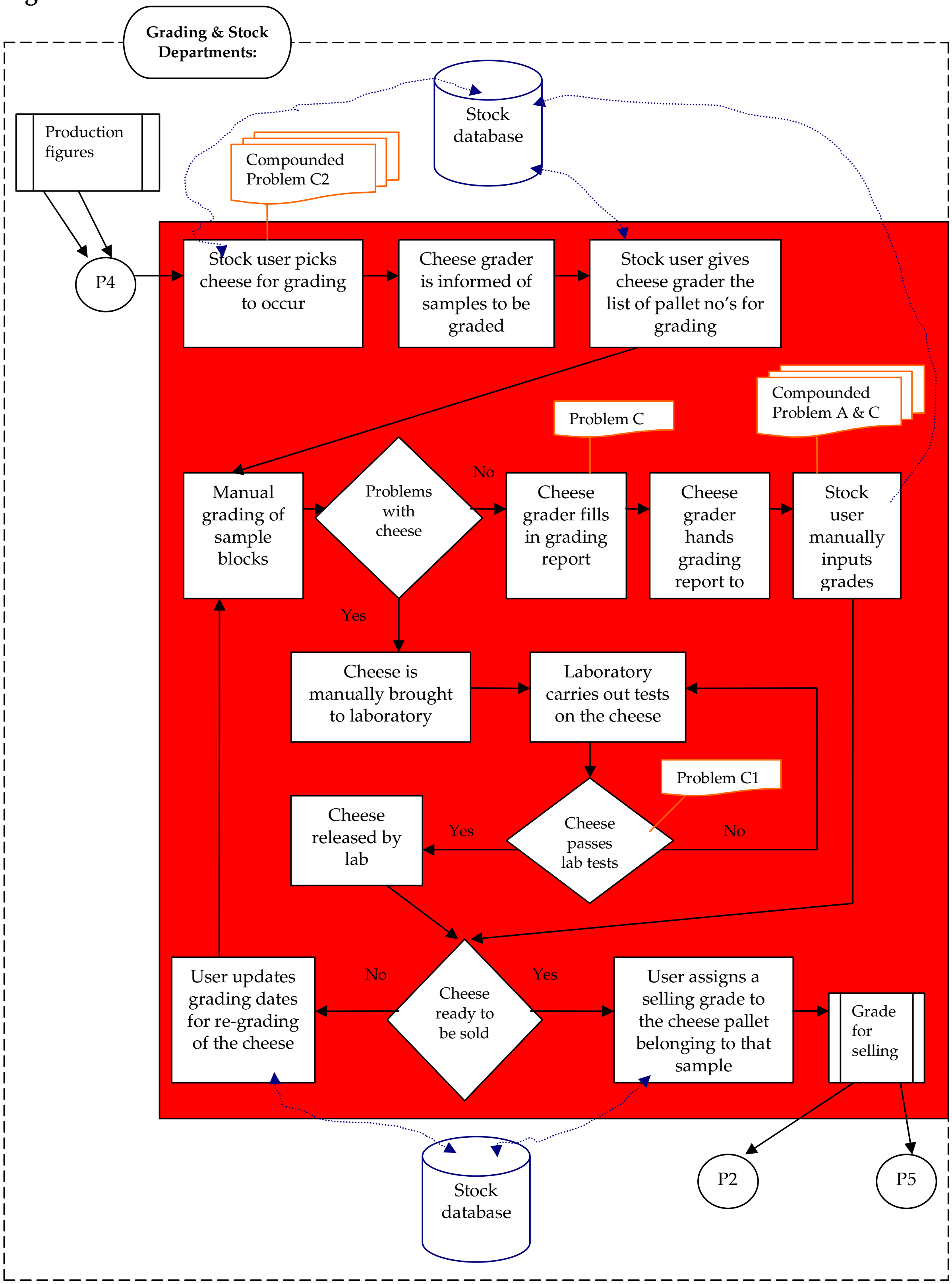
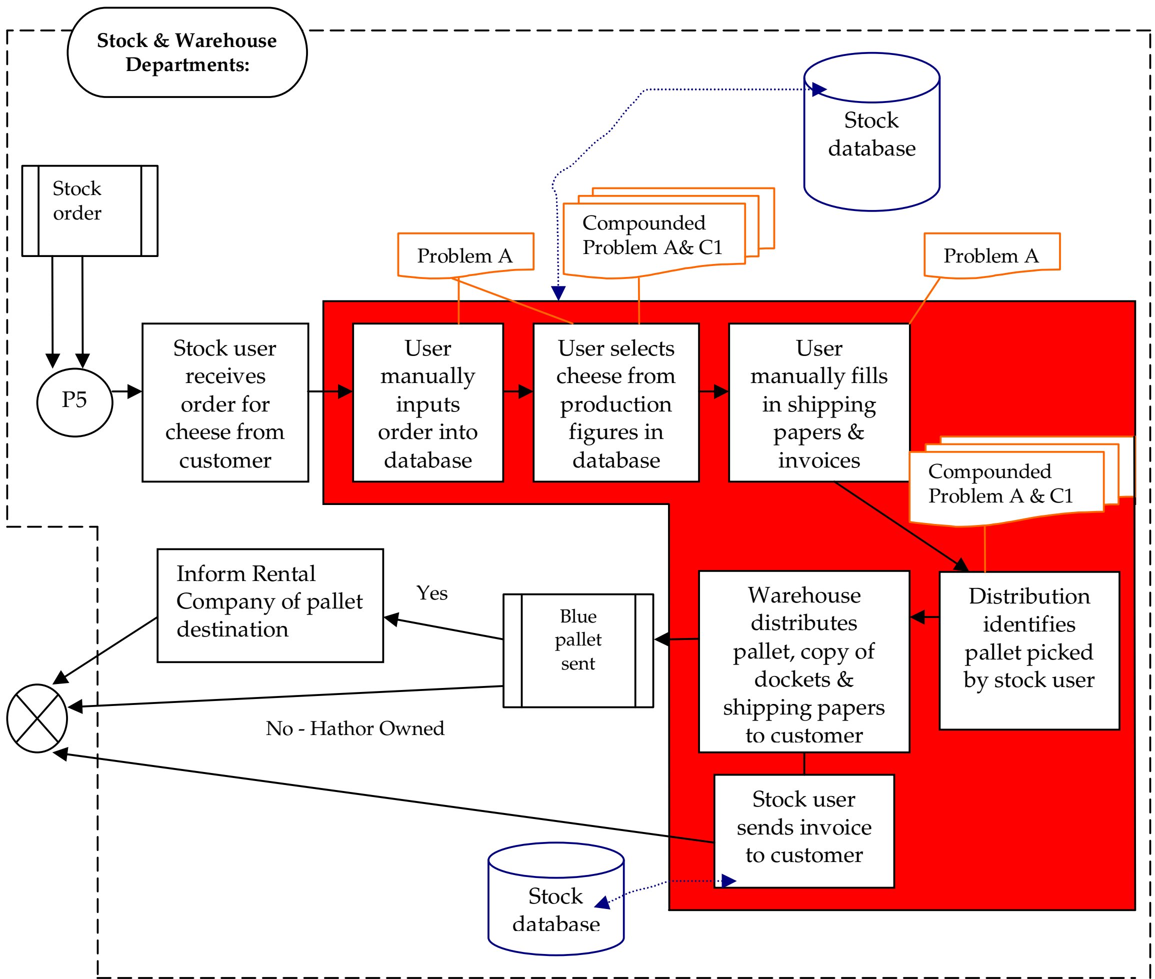


Figure 6.2: Continued



Problem – Potential for error in the system		Compounded Problem – Error in one process is used as a basis for subsequent processes, thus compounding the original error	
Problem A	Manual input of figures; misreading of data and incorrect processing	Compounded Problem A1	Misrepresentation of stock in store by system due to misreading of numbers; system inaccuracies
Problem A1	System is obsolete		
Problem A2	Manual processing of data; cost & time inefficiencies	Compounded Problem A1 & E	Replication of errors; manual searching through ledgers; not locating stock; stock also in UK; manual searching of pallets for stock; system inaccuracies
Problem A3	Inaccurate stock records due to misinterpretation & inaccurate processing of data		
Problem B	No continuous labelling; stopping & starting of the scales; manual counting of blocks to ensure correct label is put on cheese block	Compounded Problem A & B1	Wrong label on box than on block; system inaccuracies
		Compounded Problem A & C	Manual inputting of figures; illegible handwriting may contribute to wrong production quotas and inaccurate stock levels
Problem B1	Manual checking; human error		
Problem B2	Manual removal of samples; human error		
Problem C	Manual documentation of grades	Compounded Problem A & C1	Manual inputting of figures; illegible handwriting may contribute to wrong grades & dates being put on cheese stock for grading
Problem C1	No communication between lab & stock systems on whether the cheese has been stopped, passed or can be sold		
		Compounded Problem A & C2	Error is replicated

6.2.2.1 Cheese Stock System

Within the stock system (P1), Hathor's stock control users experienced several critical problems. The stock database had become obsolete and kept crashing. The main problem with this system was that it had very little RAM and storage space available for use. In addition, the organisation felt that the system's programs were restricted in terms of what they required from them [*Problem A1*].

> *There was no space, no capacity and the system was on its last legs. There was no RAM or storage capacity [left] and programs were constrained. [Hathor: AC]*

> *Also there was a problem with maintenance and support as Hathor couldn't get parts and experienced people to look at it [Enki: MD].*

Increasing the potential for human error was that all data received from cheese grading and production was in paper format and had to be manually inputted into the stock system [*Problem A*].

> *Record the number of the pallet and the 1st cheese block. These were then, at the end of the night, manually inputted into the Cheese Stock System. [Hathor: PM]*

Inherent within this process was the potential for misreading figures by the stock system users. Stocktaking was carried out manually (P2). The stock control user had to print off pages upon pages of production figures to identify the cheese that needed to be accounted for. However, if an error occurred during the manual inputting of production figures, the reports used for stocktaking would be wrong [*Compounded Problem A1*].

We extracted a detailed report on all of the cheese being held in the stock database. The report would contain hundreds of pages… [Hathor: SA]

…sheet bible specifying what system said was there - 100's of pages of stock readouts [Hathor: AC]

In terms of stock control, each pallet had to be first physically confirmed to be on-site by the stock user and second the corresponding pallet number had to be identified and ticked off from the stock records. The process was manual and therefore, it was extremely slow. The stock user had to search through hundreds of pages of data until the right pallet number was found [*Problem A2*].

The pallet card was called off by 1 person. The 2nd person would have to locate the relevant data in the report and tick it off to say the stock was there. We would have to go through all the pages until the right pallet card was found… [Hathor: SA]

In addition, if the stock users came across an error, by the time they went back to the store to check the mistake, the store had moved on. This was due to the fact that the majority of stock was transferred to the UK stores for sale on the UK mainland. Therefore, Hathor had to send stock users to the UK to carry out stocktaking there to ensure that all stock was accounted for across the business.

It took a lot of time and when you identified an error and went back to the store to check, the store had moved on. There was a problem of finding the stock. [Hathor: SA]

Errors highlighted in this process and unaccounted for were then dependent on confirmation by outside sources before being confirmed at a later date by user personnel. [Hathor: SA]

For Hathor, manual stocktaking was causing serious concerns as the possibility for human error was high. For instance, pallets were missed or the wrong pallet number was incorrectly ticked on the pages by the stock user [*Problem A2*].

> *If there were gaps for missed cheese, we would have to go back a 2nd or 3rd time to the cheese store to locate the 'unaccounted for' cheese pallets or alternatively remain in the store until it was found. [Hathor: SA]*

Also, the physical stock was not being reconciled with the database stock records as Hathor had no function available for inputting and updating the data, which meant that accurate records of stock were not available. This in turn had consequences for production and sales [*Problem A3*]. Often Hathor produced more than was actually needed.

> *The data was not put into a database as we didn't have one… With the old system there was no reconciliation and no keying in of data. It was all manually orientated. [Hathor: SA]*

Manual inputting also resulted in other inefficiencies, particularly in human-resource wastage and the costs associated with it. When Hathor received sales orders for cheese from its customers (P5), its employees had to manually input their details into the stock system [*Problem A*]. Again, there was the potential for misreading figures and inaccurate processing of data was high, which often resulted in sales orders not matching customer requirements [*Problem A*]. In addition, this caused compounded problems for both production and stock control, in that it affected production and stock quota levels [*Compounded Problem A & C*].

Once the cheese was identified to be sold, the stock system user manually created the shipping papers and invoices to be sent with the cheese to the customer [*Problem A*]. These documents were then sent to warehouse in order for them to identify the pallets for distribution. Because of the illegible handwriting on the invoices, warehouse had difficulty processing the documents and often chose the wrong pallets to be distributed to the customer [*Compounded Problem A & C1*].

6.2.2.2 Cheese Production System

In terms of production cycles, vats would be placed in an ordered sequence on a continuous production line. Each vat cycle ended when a predetermined number of cheese blocks were produced and the next cycle began. It was important to note that these vats contained different varieties of cheese, which meant that operators had to manually count the number of cheese blocks being produced from a specific vat to ensure appropriate sorting. The potential for error was high as often the wrong cheese block was allocated to the wrong cheese variety [*Problem B*].

If a problem occurred during the production process, it was standard practice within Hathor to stop production and remove a cheese sample from the vat line for laboratory analysis. The entire production line for that vat would then be sent to the warehouse for storage until the laboratory cleared the cheese for sale. Production informally communicated to stock control users that a particular cheese pallet was not to be sold until cleared by the laboratory. The problem with this was that there was no mechanism within the stock system to state that the cheese was being held by the laboratory pending the outcome of tests [*Problem C1*] and often products were sold on to customers.

> *All end users are prohibited from accessing the cheese… The cheese cannot be picked until lab comes back with results… However, there was no mechanism to put a hold on the cheese that could not*

> *be sold. Users had to remember if the cheese couldn't be picked and only the lab knew for definite what could and could not be picked. [Hathor: SA]*

> *We were unable to identify if, in fact, the product was still under laboratory control [Hathor: SA].*

Once the cheese blocks had been produced and sealed by the production system, they had to be weighed and labelled (P3). This process involved the operator stopping and starting the scales so that the cheese could be weighed and a label put on the cheese block. The lack of continuous weighing and labelling was time consuming and often delayed the production process [*Problem B*]. Next, the cheese block was manually boxed and a corresponding label was put on it. To ensure that the weights recorded on both the cheese block and the box correlated; an operator had to manually re-check the labels. If the labels did not match, the operator had to stop the line and manually remove the block, in turn, holding up the production line [*Problem B1*].

For quality control purposes, after every 50th cheese block labelled, an operator had to manually remove a sample cheese block for grading.

> *An operator checks to make sure the line is moving along properly and that each block is being labelled, after every 50… the block is removed by the operator. [Hathor: PM]*

The problem with manually performing this practice was that, if the operator lost count or got interrupted, the sample block would be removed at the wrong time, thus affecting the grading process as the sample blocks were used to identify the quality of the cheese produced for the customers [*Problem B2*].

Once the cheese blocks had been labelled properly and the grading samples removed, an operator manually put the cheese blocks on pallets. For the sample blocks, they were put on pallets of 24 for grading and the cheese to be sold was put on pallets of 50. The operator manually recorded the pallet number and the weight of the first cheese block, attached the data onto the pallet for identification and sent the records to the stock department to be manually inputted into the Stock System [*Compounded Problem A & B1*].

> *With the old system, the operator used to manually put the cheese blocks onto the pallet and record the number of the pallet and the 1st cheese block. These were then, at the end of the night, manually inputted into the cheese stock system... There was manual pallet loading [Hathor: PS]*

The problem with this identification and recording process was that it was a manual process and problems occurred with the interpretation of the handwriting on the labels. Another problem with this system was that the end of day production printouts had to be manually inputted into the stock system [*Problem A*]. Indicative of manual data recording were the problems associated with time, incorrect recording of data and the possibility of human error.

6.2.2.3 Cheese Grading System

Directly linked to the cheese stock system was the cheese grading system (P4). The first grading of the cheese was carried out by the cheese grader when the sample cheese blocks were 10 to 12 weeks old. It was up to the stock user to identify the cheese that was ready for grading, inform the cheese grader and give him the grading sheet. Numerous problems occurred at this stage of the grading process. Due to the illegibility of handwriting and inaccurate input of the data [*Compounded Problem A & C*], the information given to the cheese grader was often incorrect [*Compounded

Problem C2]. Hence, the cheese was frequently graded on the wrong date [*Compounded Problem A & C*].

Once the grading process[13] had occurred, the cheese grader manually documented the cheese grades on the grading sheet in a ledger, stating whether the cheese was to be sold as it had matured, or if it was to be listed as a holding grade, which required it to be stored so that it could mature and then graded in a further six weeks. The grading sheet was then handed to the stock user who manually inputted the grading results into the Stock System.

> *The Cheese Grader grades the cheese and puts a new grade on it on his sheet. He gives the sheet to the stock user and she puts these results into the system against various batches. [Hathor: CG]*

Problems associated with manually documenting grades for cheese was illegibility of handwriting which often led to incorrect processing of the data by the stock user (Figure 6.3.) [*Problem C*].

Having discussed the problems Hathor were experiencing with their Cheese Production and Management System, Hathor's managers approached Enki to automate the system and the following narrative details the development process used.

6.2.3 Project Narrative for Cheese Production & Management System

In order to produce an account which accurately reflected the participants' stories, the narrative was set out in rich thick descriptions substantiated by the empirical data.

[13] The cheese grading process was carried out manually by the cheese grader and is described in Appendix F.

Figure 6.3: Sample Grading Sheet

Date: 13-OCT [redacted] Grading Sheet

Batch No	Pallet	Brand	Starter Loc		DC Grade	Curr	Grade	Use By	Comm Code	Remarks
26072006	48	[redacted]	223	PEN	DCSTD	UNG	601	0907		
26072006	49	[redacted]	223	PEN	DCSTD	UNG				
26072006	50	[redacted]	223	PEN	DCSTD	UNG				
26072006	51	[redacted]	223	PEN	DCSTD	UNG				
26072006	52	[redacted]	223	PEN	DCSTD	UNG	✓	✓		
26072006	53	[redacted]	638	PEN	DCSTD	UNG	604	0707		
26072006	54	[redacted]	638	PEN	DCSTD	UNG				
26072006	55	[redacted]	638	PEN	DCSTD	UNG				
26072006	56	[redacted]	638	PEN	DCSTD	UNG				
26072006	57	[redacted]	638	PEN	DCSTD	UNG				
26072006	58	[redacted]	638	PEN	DCSTD	UNG				
26072006	59	[redacted]	638	PEN	DCSTD	UNG				
26072006	60	[redacted]	638	PEN	DCSTD	UNG				
26072006	61	[redacted]	638	PEN	DCSTD	UNG				
26072006	62	[redacted]	638	PEN	DCSTD	UNG				
26072006	63	[redacted]	638	PEN	DCSTD	UNG				
26072006	64	[redacted]	638	PEN	DCSTD	UNG				
26072006	65	[redacted]	638	PEN	DCSTD	UNG				
26072006	66	[redacted]	638	PEN	DCSTD	UNG				
26072006	67	[redacted]	638	PEN	DCSTD	UNG				
26072006	68	[redacted]	638	PEN	DCSTD	UNG				
26072006	69	[redacted]	638	PEN	DCSTD	UNG				
26072006	70	[redacted]	638	PEN	DCSTD	UNG				
26072006	71	[redacted]	638	PEN	DCSTD	UNG				
26072006	72	[redacted]	638	PEN	DCSTD	UNG				
26072006	73	[redacted]	638	PEN	DCSTD	UNG				
26072006	74	[redacted]	638	PEN	DCSTD	UNG				
26072006	75	[redacted]	638	PEN	DCSTD	UNG				
26072006	76	[redacted]	638	PEN	DCSTD	UNG				
26072006	77	[redacted]	638	PEN	DCSTD	UNG				
26072006	78	[redacted]	638	PEN	DCSTD	UNG				
26072006	79	[redacted]	638	PEN	DCSTD	UNG				
26072006	80	[redacted]	638	PEN	DCSTD	UNG				
26072006	81	[redacted]	638	PEN	DCSTD	UNG				
26072006	82	[redacted]	638	PEN	DCSTD	UNG	✓	✓	BO	
28072006	10	[redacted]	21A	PEN	DCSTD	UNG	201	0707		
28072006	11	[redacted]	21A	PEN	DCSTD	UNG				
28072006	12	[redacted]	21A	PEN	DCSTD	UNG				
28072006	13	[redacted]	21A	PEN	DCSTD	UNG				
28072006	14	[redacted]	21A	PEN	DCSTD	UNG				
28072006	15	[redacted]	21A	PEN	DCSTD	UNG				
28072006	16	[redacted]	21A	PEN	DCSTD	UNG				
28072006	17	[redacted]	21A	PEN	DCSTD	UNG				
28072006	18	[redacted]	21A	PEN	DCSTD	UNG				
28072006	19	[redacted]	21A	PEN	DCSTD	UNG				
28072006	20	[redacted]	21A	PEN	DCSTD	UNG				
28072006	21	[redacted]	21A	PEN	DCSTD	UNG	✓			

For Case Study One, the development process between the user and developer was mapped in chronological order through 6 phases. These were:

Phase 1: Initial Requirements Gathering;

Phase 2: Identify Lead Users & Requirements Gathering;

Phase 3: General User Involvement & Further Requirements Gathering;

Phase 4: Systems Design & Requirements Gathering;

Phase 5: Prototype Testing & Requirements Gathering; and

Phase 6: Systems Implementation & Requirements Gathering.

The data gathered for each of these phases was then set out according to the following narrative.

6.2.3.1 Phase 1: Initial Requirements Gathering

The development relationship between Enki and Hathor began when Hathor approached Enki to develop their Cheese System. To identify the initial requirements for the new system, Enki interviewed Hathor's senior management team to discuss the company's overall objectives for the eventual system.

> *You design: top - down, but you build: bottom - up. You have to start with management. [Enki: MD]*

To clearly understand the issues that Hathor were experiencing with their manual system, Enki listened to the stories that the managers had in relation to the system. These analogies and metaphors contained valuable information about critical events that occurred within the system from a management perspective and provided deep insights into the problems and working practices inherent within the system. These interactive meetings often evolved into brainstorming sessions in which both actors discussed in detail the problems with the system and potential solutions. The dialogue between the two companies and the level of intertwining between them was very regular, frequent and intense. Both parties openly communicated and shared ideas. Indeed, it was stated by both companies that their interactions were characterised by a sense of honesty and openness

> *At the very beginning we would have, with the analyst, sat down at the white board and explained that this is what we want, but obviously there will be changes later on. Overall this is what we really want to achieve and in terms of this, he [Enki's MD] is very good. Then we would come in the next day and we might make a little tweak to [what was on the white board] and he would have done that with us from the beginning. [Hathor: AC]*

Hathor wanted the new system to be modelled along similar lines to their current systems, but with far greater scope and flexibility.

> *We called in Enki and showed them what we had, and asked them to develop a cheese stock system on similar lines. [Hathor: AC]*

> *There was plenty of flexibility, capacity, versatility and scope for development and Hathor wanted everything to be linked in together. [Hathor: SA]*

> *We tried to replicate what we had, which we did do, but we changed the actual handling of the cheese, of the system itself. [Hathor: PM]*

Thus, the initial requirements specification that Hathor gave to Enki for the development of the stock system was to move the data on the ICL streamer tapes to floppy disks; to upgrade their Ingres database to a database with more memory and power; and to upgrade the current system from a mainframe to a PC-based system.

> *Hathor wanted the data on the ICL UK streamer moved to floppy and the Ingres database updated to the Oracle system. They also wanted better traceability of the product from the raw milk, to the*

> *production of quality cheese, to it being graded, and finally for the cheese to be sold. [Hathor: SA]*

In relation to the stocktaking element of this system, Hathor's main aim was an easier reconciliation of their physical stock to their book stock, and having this confirmed by a Store Certificate.

> *Essentially, we wanted the processes they used to carry out the stocktaking automated through the use of handheld technology. This was to ensure that any errors or discrepancies between the physical and book stocks could be rectified earlier while the stock was still present in the cold store. [Hathor: SA]*

> *We wanted reconciliation against our physical stock with the book stock. At the end – we wanted the stock reconciliation to reflect the stock balance confirmed by the Store Certificate…. We brought in handheld technology. [Hathor: AC]*

Enki was asked to develop an entire grading system. With the old stock system there were no grades. There was only a manual process for grading cheese that was in turn used for manually selecting cheese for sales.

> *The reason why it was needed was that it was an all-manual exercise prior to the development of the new system. With the Ingres database there were no grades. We only had when the cheese was manufactured i.e. date, the pallets, and the type of cheese. [Hathor: SA]*

The main requirement Enki received for the development of the grading system was that the new system had to produce a grading sheet. This sheet had to contain all the necessary categories needed by Hathor's cheese grader to successfully grade their cheeses. The grading sheet was then to feed back into the new stock system so that Hathor would know what cheeses had reached maturity and could be sold under their given grade.

The reason for the development and for the Enki system was when new grades for each category were required. Several grades for each category already existed, but more were coming in for various factors and we needed the systems to cater for them. For example, instead of just having a T or J grade per category, we could have had L; M and N grades as well. The requirements were done on the grades needed for each category. [Hathor: SA]

Hathor's ultimate requirement for the development of the overall Cheese Production and Management System was that the system had to provide complete traceability. Hathor wanted to be able to trace the product from raw materials, to production, to grading, to distribution, and finally, to each individual customer to whom the product was sold. This was of paramount importance to the company, particularly if customers came back with problems.

We wanted a system that would provide ultimate traceability, particularly if customers came back with problems. [Hathor: AC]

The new system allowed for traceability and the history of the product. Its whole purpose was to provide complete traceability. [Hathor: CG]

Enki's main objective was: The quality of the product and the information about the product. [Enki: MD]

We had traceability but not to the extent they have it now. [Hathor: PM]

6.2.3.2 Phase 2: Identify Lead Users & Requirements Gathering

Once Hathor's management team had identified the initial requirements, the next phase was to identify who the key players were in the development of the system. Enki asked Hathor to appoint a project leader for the development of the system and the identification of the key users from each department that would be needed during the different stages of development. It was felt that these users were in a position to understand and forecast the requirements of the general system users.

> *The key element of this project was the internal project team. For us the most important thing is: who is the project champion (who wants the system the most) and project leader? Hathor identified these for us. [Enki: MD]*

There was evidence that there were two user groups within Hathor. There was a building for Hathor's administration offices, and the Financial Controller and MD offices. There was a second building where the production lines and warehouse were located. The cheese grader and production manager frequently went between buildings, although they were based in the second building. Interactions between these groups were frequent and informal. It was evident that people were good friends leading to informality of exchanges within their working environment. For example, during one observed interaction, the cheese grader and the stock user were trading jokes with one another while they were carrying out stocktaking in the warehouse. On another instance, one of the production workers called over the production manager: *"hey [PM's first name], we have a problem on the line, have you got a second?"* This first name casualness and the informal nature of the relationships within Hathor existed between all employees, from the Financial Controller to lower grade workers. Within Hathor, there was a very open attitude. People would go on their coffee break in order to discuss issues or problems they were experiencing. These informal networks in the community of practice were important in helping to overcome these issues. By observing the lead users' informal interactions, Enki were able to identify who the users went to get assistance on overcoming problems when they arose, or when they wanted to discuss or get advice on different issues. For example, the cheese grader would often join the administration staff on their coffee break to get them to sample a new cheese Hathor was thinking of manufacturing in order to obtain their opinions on the taste of the cheese.

By involving and incorporating the lead users of each group into the internal project team, Enki ensured that all informal networks within the system were included in the development process and that their knowledge and requirements of the system could be identified.

> *The internal project team were called in during appropriate stages by the project leader when it was felt that they knew more than he did. [Enki: MD]*

To examine the system, Enki met with each key user and observed them carrying out their daily practices. Explanations and rationale for current practices were given in the context of the overall system. This provided Enki with a holistic understanding of what actions were performed and why they were performed in a certain manner.

> *We looked at the old system: what could be retained; what modifications were required; and what enhancements were needed in future developments. [Hathor: SA]*

> *We had the prototype – i.e. the old system - which was primitive in terms of what we wanted. It all evolved from old manual system, we knew what was needed and kept it. [Hathor: AC]*

Communication was important between Enki and Hathor's internal project team when identifying lead user requirements for the system. At different stages during the development process, the level of communication between the lead users and the development company became intense with frequent contact between both parties. This was done to ensure that all requirements were successfully understood and elicited.

> *There was ongoing interaction at different/various stages of development … [where] we had huge contact with Enki. [Hathor: SA]*

> *Communication was very important between the development team and us. [Hathor: PS]*

The identification of lead user requirements was gathered through a number of data collection mechanisms such as interactive whiteboard sessions using diagrams for explanations, storytelling, documentation and in-depth interviews. The information gathered was then put into a story by the analyst and the analyst's interpretation of the lead users' working practices and their information systems requirements was then presented to them. Gaps of understanding that were evident in the narratives were subsequently corrected by the lead users in further cycles of data collection. This iterative process allowed Enki to immerse themselves in the lead uses' experiences and to ensure that identified requirements matched users' needs.

> *We discussed these requirements with Hathor's system users in interactive sessions that used diagrams for explanation purposes. [Enki: MD]*

> *You have a look at it and say no that's not what I wanted at all and so they'll say you have to go through with me then the steps you are taking. Then you go through the steps as they may have misunderstood something that you've said. It is about communication really between yourself and the developer to make sure he understands all of the steps you are taking and that you understand exactly what he is saying and what he can do for you. It clarifies both sides that he knows exactly what you are doing and what you want and that you know exactly what he is going to do. Even if I might have to say it two or three times and then he might say well if that happens [this will occur] or if that happens you do this. [Hathor: AC]*

Documentation also facilitated Enki in gaining a deeper understanding of lead user requirements through retrospective reflection, where the documents were used as a cue to memory recall and as a mechanism to challenge lead users' memories and cross-check their ex post data and perceptions. Consequently, the lead users' reflection was more accurate concerning their working practices within the system and so a more realistic understanding of the system and user needs emerged.

> *Previous documentation was used by Enki for developing the systems. It was an evolution of old documents. [Hathor: AC]*

> *Old documents are used [and] it ensures that nothing is overlooked and no opportunities are missed. [Enki: MD]*

> *You would be looking at it [the system] pretty much all the time, looking at what you did and maybe rethinking it and saying maybe we could do this another way. And then possibly ringing up and saying could we do this way and he'd say yes or no. Then maybe what you would have said could have triggered something in him and he could say well yeah, you could do this and this and we'd say yeah go with that or go with this and see how far he gets. [Hathor: AC]*

Through the richness of continuous and frequent personal interaction with Hathor's lead users, Enki were able to identify the informal communications and the patterns of information flow that occurred within the current system. This was critical as it allowed Enki to understand how information was transferred within the community, who gets what kind of information, when and for what purposes. This understanding of the informal network provided Enki with a deep insight into how knowledge embedded within the system is used by its users and how they are connected.

> *There was a lot of contact with Enki. We used both formal and informal meetings… Enki listened and gave their suggestions as they had the experience and expertise. There was ongoing interaction at different stages…. We had huge contact with Enki. [Hathor: AC]*

> *We were assured by the developer that yes we can do this and we can give what you want. We had worked with them before so we knew that if they said it then they wouldn't say later, oh we can't do it. [We knew that] they would if we said that we wanted it. [Hathor: AC]*

The regularity of interactions between Hathor and Enki also facilitated the formation of close personal relationships between key individuals in both companies. As a consequence, both parties began to trust one another and so the level of communication was said to be high. In addition, through these interpersonal relationships, both parties were able to gain a greater understanding of each others' perspectives on critical issues. Nevertheless, this did not prevent communication problems. For instance, the lead users knew what they wanted but were speaking in their own industry language which the development company found difficult to comprehend. Conversely, the developers were communicating their understanding of the system back to the lead users in their technical language which the lead users did not understand.

> *[We found there were] differences with the production language and the development language. [Hathor: AC]*

> *Essentially [Hathor] and Enki were speaking the same language but there was no understanding... Terminology was a problem and clarity was needed. [Hathor: AC]*

Part of the problem was that Hathor did not have a traditional IT department and so understanding of technical language was difficult. To overcome this communication barrier, a knowledge broker was appointed as an intermediary between Hathor and Enki. Because Hathor had no formal IT department, IT responsibility devolved down through the organisation to their middle managers and so, it was a middle manager that understood technology and their system that was appointed as the knowledge broker.

> *In Hathor they have opted not to take on IT people. They have devolved IT responsibility throughout the organisation. Since there is no IT manager, there is no problem concerning who controls IT use. All [middle] managers go to us, and any significant changes or cost increases go to the top managers. [Enki: MD]*

> *There was a link who worked between Hathor and Enki in the development of the systems... The link related the understanding to Enki of what was wanted, and built up the relationship. [Hathor: AC]*

The main role of the knowledge broker was to ensure that communications between both companies was articulated in a fashion so that both sides could clearly understand each other. The broker could speak, interpret and explain the languages of both the lead users and the development company and so communication and language difficulties between the project team and the developers were overcome.

> *Everything was done through a link as he had a better grasp of it and could explain what was wanted better... The link brought in Enki and told them what was needed. This was done in various meetings. Enki had no idea what was required. The link sat in between both i.e. the user – the link - Enki, and explained what was required. He made the link between both parties as he knew what the user wanted. [Hathor: AC]*

> *[The broker] expanded on [the production manager's] needs, and could provide a greater understanding, particularly in relation to overcoming the language barrier. Also [the production manager] wasn't familiar with the Cheese Stock system. [Hathor: AC]*

6.2.3.3 Phase 3: General User Involvement & Further Requirements Gathering

Once Enki had identified what the lead users wanted from the system, they carried out a full analysis of the needs of the general users. Enki believed that '*wants do not equal needs*', and the needs of the general users on the floor have to be investigated and identified, otherwise the development process would result in a failed system. Thus, in order to identify the needs of these users, Enki believed that they needed to go down to their place of work, develop a relationship with them and participate in Hathor's environment, so that the general users' situated working practices could be fully explored and examined.

> *To gather requirements you have to go out on to the floor i.e. the factory floor. That is generally where you start. [Enki: MD]*

> *It is easier to get a spec and requirements from the guy who needs it, whereas the financial controller wants financial results. Needs do not equal Wants. A system based on wants is useless… The primary requirements are the tools needed by the users. You have to develop the tools and to provide for the financial area. [Developing a system that] only deals with the financial side and not the tools needed by the users… is a bad way of developing. [Enki: MD]*

Enki's participation was mainly carried through interactions with the general users, observational techniques, interviews and discussions, storytelling and general user involvement in the development process. Enki believed that by participating in the general users' working environment and involving them in the development process was critical for not only capturing requirements but also ensuring that users did not turn against the system once it was designed and implemented. By listening to their needs and requirements, Enki provided an opportunity for the general users to partake and feel important in the development process and consequently take ownership of the system.

During the development process, the analyst would ask the users *'what do you do with the system?'* The users then physically walked the analyst through their work process.

> *We got Enki to walkthrough what we do on the production line and problems we were having with it. [Hathor: PM]*

During these walkthroughs the users would tell the analyst the story of what happened as they did their job. Sometimes these stories were general in nature, sometimes they referred to particular experiences and sometimes to what could happen if problems were encountered. They described decision making processes and the stories that emerged often included principles by which the organisation would deal with particular matters. For example, the cheese grading process described in Appendix F. With this process, the cheese grader has to judge the cheese based on touch, taste and the colour of the cheese what the cheese will turn out to be, that is, whether it will be a generic cheese or a branded cheese and whether the cheese should be sold on or held for maturity. For Hathor, the quality of the cheese they produce is not just an ISO issue. To determine the maturity of the cheese, it must be tasted and touched by the cheese grader. For this organisation, it is not about science, it is about the personal experiences of the cheese grader and his judgement.

Some of the stories referred to causes and their effects and the interactions between people in the processes around which the stories crystallised. For example, when the users encountered problems with the cheese blocks on the production line, particularly in relation to labelling the blocks, the scales had to be stopped, the user had to manually remove the block and send it back up the production line then he had to reset the scales to work again for the rest of the blocks on the line. Thus, when asked, the analyst described the lists of processes, which provided placeholders for what they understood as regards the processes and stories the users described to them while they were walked through Hathor's work practices. It was through the use of stories, that Enki was able to determine the functional working practices of the general users and how they were interconnected.

> *We go to every person and asked them to list the functionality of what they do with the system. [Enki: MD]*

Also identified in these stories were practical suggestions concerning how the systems operations could be made more effective and how they could be incorporated into the design of the new system.

> *We would do it on-the-job… somebody might have a suggestion and we take it out, what that might mean, and how it can be incorporated and that would mean: is it a benefit, is it practical or is it possible even... Just people saying well if we did this, we wouldn't have to do that, or and if we did this, this wouldn't happen and that's how you'd get around it, and then [Enki] would try to put that into computer language and put in something or other to cover it. [Hathor: PM]*

Subsequently, general users were then interviewed individually to gain a deeper understanding of their requirements. Group sessions were also carried out by the development team in order to ensure that individual user requirements are consistent with community requirements for the system.

> *I try to do it both ways [group and individual interviews] really because the group … gives it sort of a discussion type thing, which helps. But in an individual type basis I try to see if they'd contribute something… if they do want to I try to take it onboard. [Hathor: PM]*

Once the working practices of the general users were understood, Enki then observed these users in their working environment. Although this caused consternation, Enki believed that it was an important step as it allowed them to identify any inconsistencies between what the general users said they did and what practices they actually carried out. Additionally, through their course of observations the general users carrying out their working practices, Enki were able to identify who these users went to when advice was needed or when they needed help in solving a problem.

> *I always argue to the management staff that 'what they do and what you say they do are different' and I always opt to spend time on the factory floor. I try to observe the people working in the natural environment and some do not like it. They argue that 'we told you what we wanted already'. [Enki: MD]*

While they carried out observations on the practices of the users, Enki were able to identify the key recording points within Hathor's process. Identification of Hathor's key recording points allowed Enki to determine how their information was created, transferred, updated and retrieved within the system. In addition, they were able to identify who the potential knowledge sources were and how knowledge was transferred within the system.

> *Within any organisation there are usually 10-12 key recording points, where information is either created, updated or retrieved. [Enki: MD]*
>
> *You monitor their operations and identify the key recording points. Generally you watch where the operator goes to get the information and what he wants it for, and the logs he fills in when finished the operation. Also you look for fellows with combo-release i.e. they do operation work and first stage administration work. You sit in the factory as long as it needs to get these requirements. [Enki: MD]*

Through their observations, the developers were able to identify critical operations and repetitive processes that existed within the system. The discovery of repetitive processes was important as it ensured that Enki gave the users what they needed to carry out their daily operations. In addition, Enki was able to isolate the recovery steps taken by the general users if systems failure occurred. Monitoring how these users coped when something went wrong was paramount as it would have cost Hathor more if it needed to be changed at a later stage. Also the system would have been developed without all the general users' needs being incorporated.

> *You have to establish what's repetitive and the critical cases. One of the techniques used is to replay the spec of requirements to other members, i.e. middle management. But you have to get what the operator requires. Give him something he wants. He is the user so involve him; give him something even if it is only to say to his friends that he had to explain to you what it is he does. You have to have pro-active involvement. This gives the users a level of satisfaction and makes the process easier. [Enki: MD]*

> *Also you need to be there for critical times e.g. production change, start up, and when things go wrong, particularly to see system recovery. This is very important to analyse and it can cost twice as much to change the system when development has begun on it if system recovery hasn't been identified prior to it. [Enki: MD]*

For Enki, these steps were on-going until they were satisfied that they had gathered and identified all user requirements and processes needed for the development of Hathor's Cheese System. However, Enki knew that further requirements would be identified at later stages as processes might change and users' needs might also change upon reflection.

> *At the end of 1st season, there were somewhere between 5 - 10% enhancements to be made to the system. Mainly, due to changes in the process or the project may have to be changed midway through development e.g. pre-grading. Time also enforces new requirements. However, one of the advantages of developing*

systems for Hathor is that they have a fairly established process already in place. [Enki: MD]

In terms of managing the elicitation of general user requirements, Enki had to ensure that all suggestions, whether they were deemed impractical or not, were perceived by the users as being important and would be considered. Any suggestions that were removed from consideration, Enki responded in a logical fashion and explained why they were not incorporated. This process encouraged users to continuously provide suggestions and prevented adverse feelings towards the development team and the system.

> *The only disadvantage of having somebody that's on the floor as such is that you can have lots of people requesting lots of different things and sometimes they are not practical, but you have to be careful that if somebody asked for something they are showing interest. You're better off having somebody like that, but then if you can't deliver he can feel that you're dismissing him so… you have to be careful how you handle that. That's the thing of managing people you have to get the max from them, you have to take it all onboard, you have to decipher which you want, which you don't want to use and yet not offend them in any way by not using that advice. So I find I have to go back and try to explain why I wouldn't do it and I try to do that to keep them onboard because they're the best thing you can have. [Hathor: PM]*

> *If they have suggestions, at least we listen to them, and you know you have to pick 1 out of every 5, or 2 out of every 5 and work with them, but you have to try to explain to them why the other 3 you can't run with them, or you don't want to run with them, or you won't run with them… other than that they'll dry up and you won't get any suggestions and they'll turn against the whole thing. [Hathor: PM]*

6.2.3.4 Phase 4: Systems Design & Requirements Gathering

Once Enki had clearly identified what Hathor wanted from the new system, they conducted market research to assess technology options.

Could we do it? Or was a 3rd party needed? If 3rd party is chosen: we determine our role i.e. we do the technical aspects at the key milestones… We then commence with the project. This includes liaising and management of other IT suppliers. Or else we do the shopping for the hardware and software needed for the system. We give the option of 4 different suppliers so that the company can negotiate with them for the best deal… we conducted research within Enki of the technology (IT) - current and projective - that would apply to the technical needs of the system i.e. a functional spec was created. [Enki: MD]

Enki then developed and presented to Hathor's managers and lead users, a functional specification for the new system based on management, lead and general users' requirements and what technology was needed to develop the system. The functional specification included diagrams of the new system, the roles of all the IT people concerned and the costings involved in the development of the system.

We brought this spec back to the client by doing a presentation for them. The report included a schedule of costs; resources (internal and external… As part of the proposal for project development, we started off with overview schemas of the system, followed by drill down schemas and including an outline spec for each system. [Enki: MD]

The importance of the functional specification was that it facilitated discussions on the systems' requirements and ensured that any gaps in understanding were rectified. After numerous revisions, Hathor's management team signed off on the proposal and prototype development commenced.

In essence, we created a proposal for Hathor. For us the resources element of the proposal is critical. Hathor signed off by agreeing this is what they wanted. [Enki: MD]

6.2.3.5 Phase 5: Prototype Testing & Requirements Gathering

The next phase in the development process was to develop a working prototype for Hathor. For Enki, prototype development was critical to the success of the development process as it allowed the internal project team to match what they believed the system could do against what it actually did. Indeed, Enki saw it as another step in requirements gathering.

> *We place a great emphasis on prototype development particularly for our bespoke systems. We believe in developing a product as soon as possible and showing it to our customers. [Enki: MD]*

> *We then prototype and demonstrate it to get their reaction. We kept going back until we got it right. [Enki: MD]*

Once the prototype had been developed, unit testing was carried out with the knowledge broker and users to ensure that all their requirements were met and that none were overlooked or had been forgotten.

> *The link did the testing to make sure it met all our needs, and the general user who asks for it also gets to look at it... [Hathor: SA]*

> *The system was thoroughly tested and... Unit testing was carried out by project leader and team in interactive sessions. [Enki: MD]*

Several key problems arose and important requirements were missing.

> *Midway through the project we were told that a Chill Store existed, which had to be included for in the development process. Another enhancement was when we identified a 'System of Sampling' used by the factory floor workers, i.e. every 51st block was pushed off and pushed onto a new pallet… To overcome this we put an 'S' on the barcode label for every 51st block i.e. the Sample Block. These blocks were then put into the Chill. Once there the PC interface card would scan for the 'S' and push the sample aside i.e. we created a system for the Identification & Auto Segregation of*

Samples. These problems hadn't arisen during project analysis until samples were mentioned during a meeting. People don't recognise what they do when asked. [Enki: MD]

Neither one got it right at the beginning, well we forgot this, e.g. someone forgot the totals; restrictions on the delivery lorries. So we needed it to be taken into account for EC laws on boxes etc. [Hathor: SA]

Interactive meetings were carried out between the lead users, the broker and Enki to identify the source of the problems and possible solutions to rectify the situation. This process was repetitive until Enki were satisfied that all requirements and solutions were met and understood.

[The broker] identified glitches or problems with the system and then highlighted these to Enki. Approximately ten meetings were carried out to sort the problems. [Hathor: AC]

Once the users had carried out the tests on the prototype and were satisfied that none of their requirements were omitted, Enki carried out a full systems test. This was paramount for Hathor. Hathor had decided that the production system would be implemented and go live straight away without parallel running. To ensure that the system could operate in a production line environment, Enki set up a the system in their offices to replicate a production line in order to test if the system could effectively work within the production line environment. Hathor gave Enki a number of cheese blocks to test their system with.

Enki developed a prototype at their workplace to test the system and make sure it ran efficiently and was what we wanted. [Hathor: PM]

System testing was carried out where a batch was taken from start up and results were simulated to see if they were correct, these were then sent to Shipment to produce the papers and invoice. [Enki: MD]

It was a working prototype. However, once the system went into Hathor, the following day production was to begin using it. Therefore the system had to work properly before installation. [Hathor: PM]

However, with the production system set up on Enki's offices, a problem arose in terms of labelling which proved to be easily rectified.

We then produced a block and gave it to them to check if both operated smoothly. Once the label was placed and scanned on the block properly, we gave Enki 10 blocks to see if they could get a production line operating. A problem occurred at this stage with the labels not being put on properly i.e. upside down. [Hathor: PM]

This process was iterated until both Hathor and Enki were satisfied that the system met all of its requirements and was ready to be implemented.

6.2.3.6 Phase 6: Systems Implementation & Requirements Gathering

In the implementation phase, parallel running was carried out until both the old system and the new system mirrored each other.

Both systems were running together… until the new system was a carbon copy of the old. [Hathor: SA]

The system was thoroughly tested and parallel running was carried out. The disadvantage of doing this is that it is quite an overhead through duplication. [Enki: MD]

With this approach to implementation, Enki and Hathor were minimising the risk and disruption if problems arose.

For Hathor… it was planned better so that there was minimal interference to the daily operations. They anticipated disruption and planned for it. [Enki: MD]

However, once the system went live, problems did occur, as several critical requirements were missing.

> *Once the system went in live we had a problem with the scanners. The scanners were attached to a conveyer belt, were moving and shaking and, were not reading the labels properly. Enki wrote a system to deal with the labels not being properly read i.e. averages given per block. Scanners were put on their own stand and we have had no problems since… Enki also had to go back to the scale to set them up to do the weight checks which we were doing... Another problem with the system when it was installed was that the drive kept crashing. It wasn't able to take the speed of production. Also the operators realised that a certain space had to be maintained between the blocks or the scales would stop the line - this is now done manually by the operators. [Hathor: PM]*

> *The new system had hiccups which were expected and there was a learning curve for the users and Enki. There were also teething problems with some of the programs. [Hathor: SA]*

> *The only true test i.e. acid test is when it goes live… only then can you identify errors on the floor when you are using it e.g. the handheld shut down on the floor when in use, also it was too slow due to too many checks. [Hathor: AC]*

To overcome these problems and find acceptable solutions, Enki engaged with Hathor's lead users to discuss the problems they were experiencing with the system and possible solutions that could be implemented to overcome these difficulties. This was an iterative process until Hathor's lead users were satisfied that no further problems would occur.

> *While the mirroring occurred, we had huge contact with Enki as we were on-goingly trying to get the systems balanced and Enki were to further develop the system to get it to where we wanted it. [Hathor: AC]*

As soon as no further requirements or problems were identified, Enki integrated the system into the entire company and training of all users ensued.

> *There was parallel running for 1 month… Multi-users then came in. [Hathor: SA]*

> *We would've had the person who wrote the system and the people who are working for him doing formal training with our own [people] but more in-house formal training. Just to show them [i.e. the users] the system, to bring them up to speed on it, to try to explain to them what was happening… [Hathor: PM]*

> *Finally, we carried out training sessions with Hathor's users on the new system being implemented. [Enki: MD]*

No further problems emerged with this system and the development process ended with Hathor signing off that all their requirements had been met and that their users were happy with the system.

6.2.3.7 Epilogue

Figure 6.4 illustrated the Cheese Production and Management System that was developed by Enki. For both Enki and Hathor, the development of the Cheese Production and Management System was a success and to date, Enki have not been called upon to carry out maintenance on the system. Indeed, both companies were currently in discussions about future systems developments.

> *The system is successful and Hathor is happy with it. We haven't had any call outs for maintenance of it. But Hathor has future developments in mind to further enhance the system. [Enki: MD]*

Figure 6.4: Analysis of the Cheese Production & Management System Developed by Enki

Model is based on observations of the systems and interviews with both Enki and Hathor – adapted for illustration.

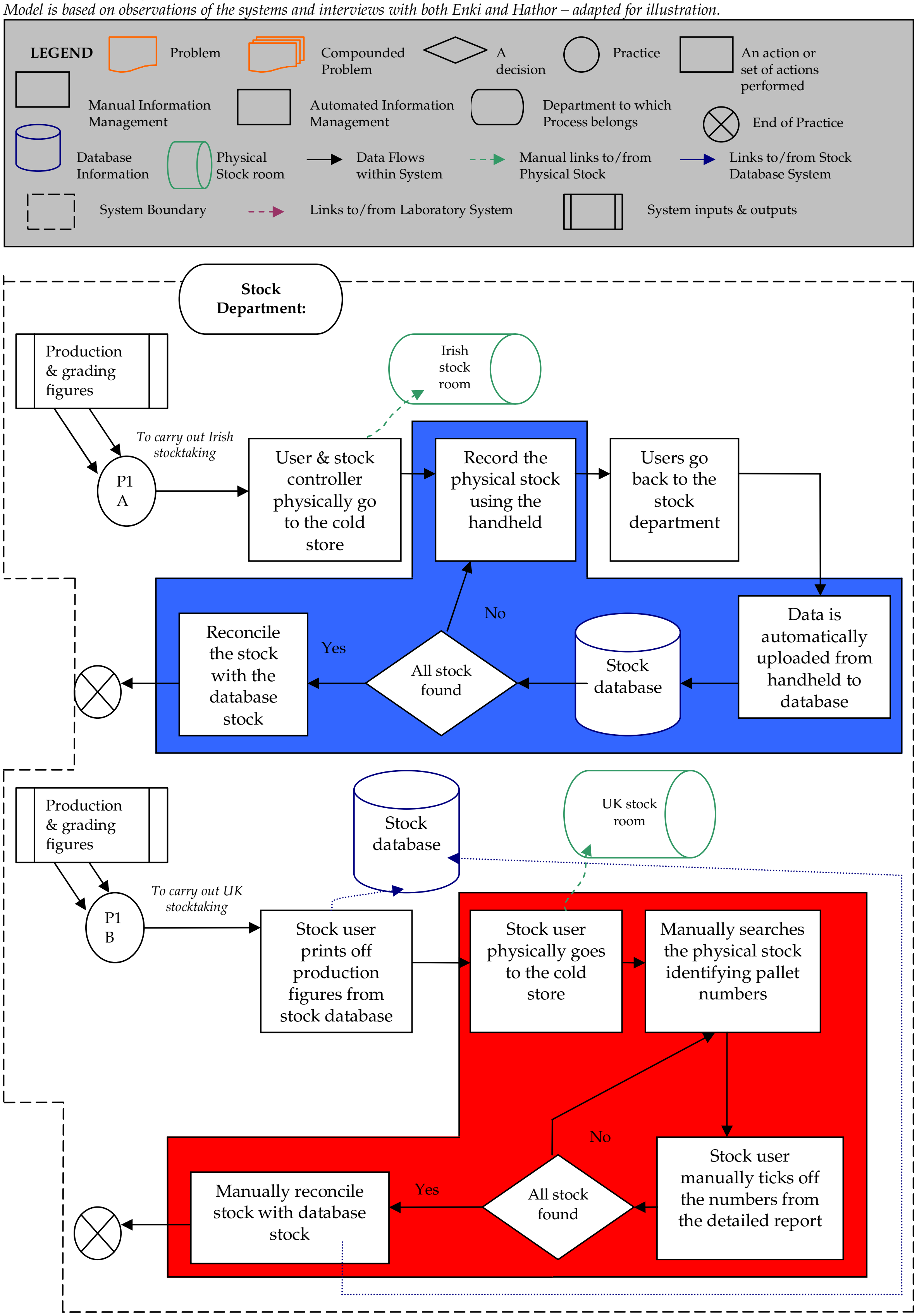


Figure 6.4: Continued

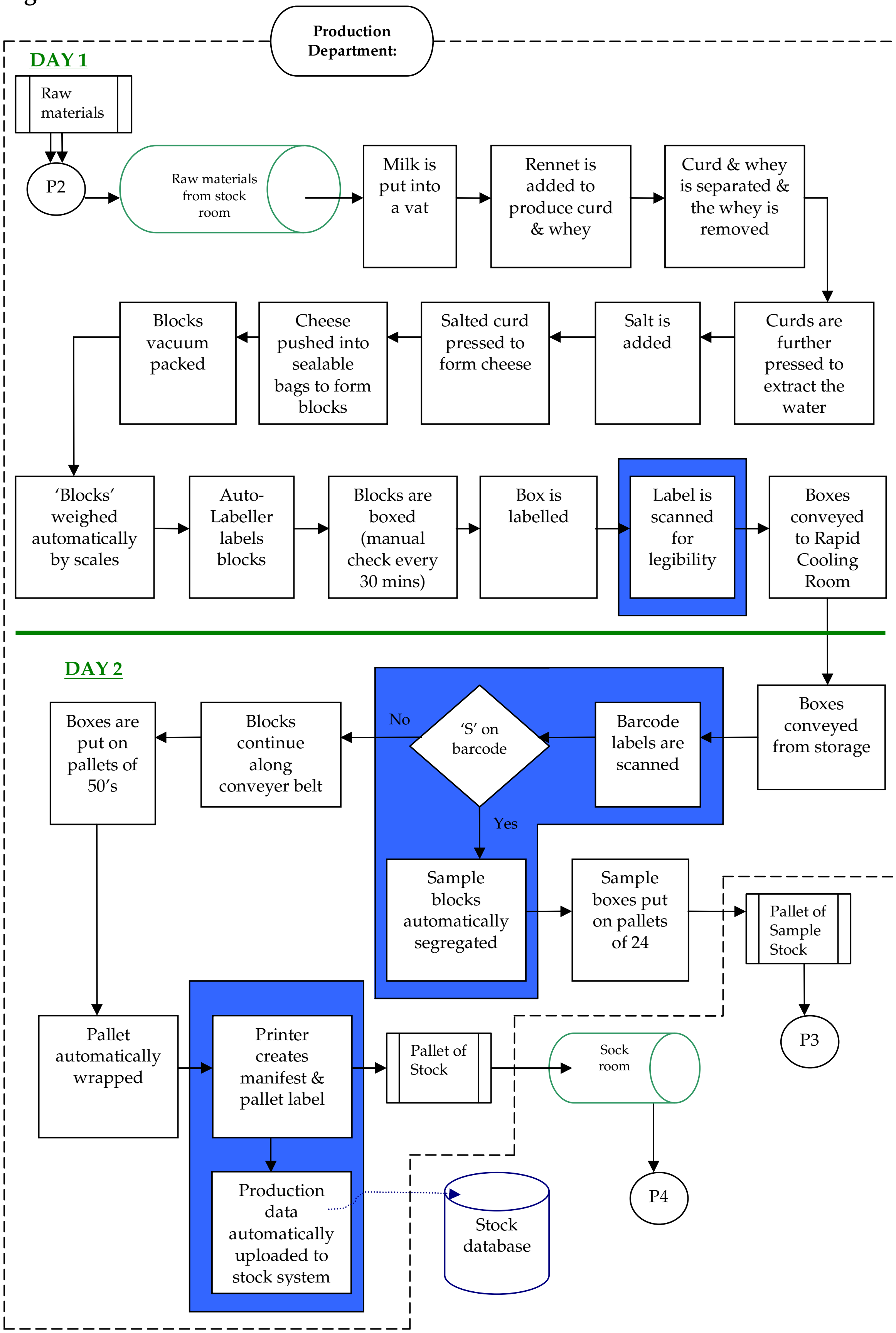


Figure 6.4: Continued

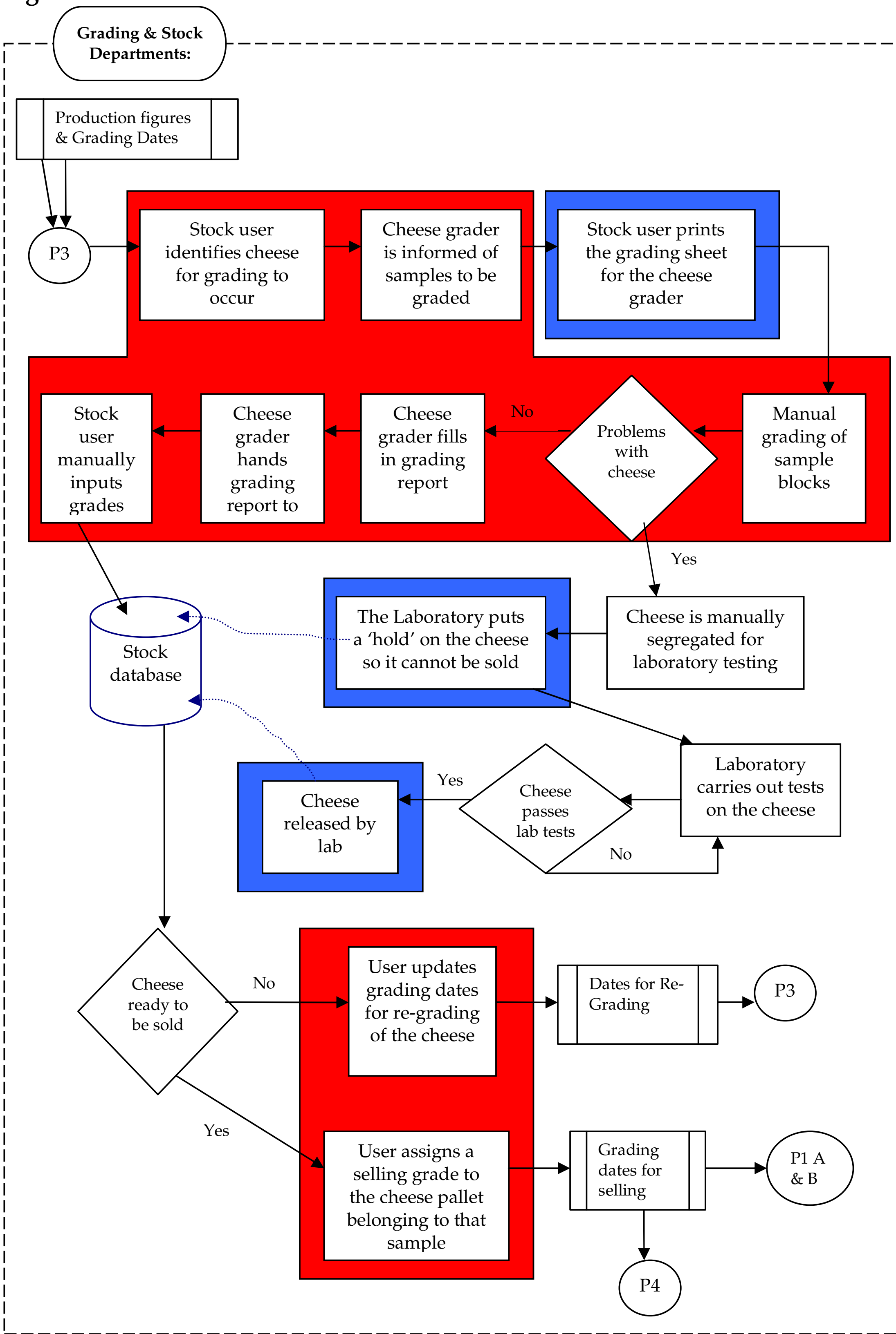
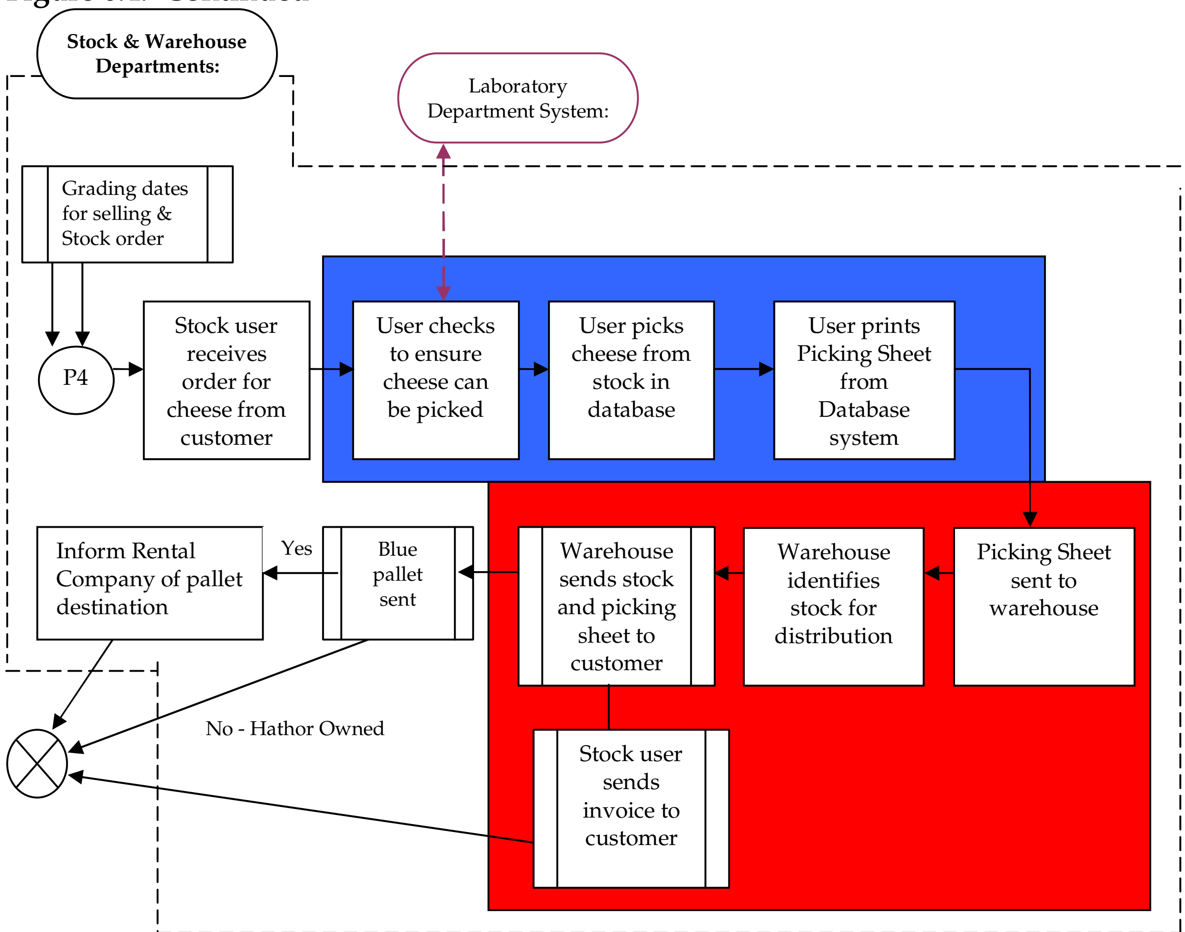


Figure 6.4: Continued



6.2.4 Synopsis of Findings

In this section, synopses of the key findings inherent within the narrative were made explicit.

- ➔ The development process used by Enki went through various stages with the developers returning to the requirements gathering phase once problems occurred.
- ➔ Enki used a variety of methods such as, participation, storytelling, observations, knowledge brokering etc. when carrying out requirements gathering.
- ➔ Hathor's old system was extensively examined by the developers to understand the working context of the system and its users and as a source of requirements.
- ➔ Documentation of the old system was used as a source of requirements and for Enki to develop a clear understanding of the system's role within the organisation.
- ➔ Storytelling was an important requirements elicitation technique used by Enki. It allowed Enki to uncover the embedded knowledge requirements of the users by comparing what the developer observed the users carrying out with what the users said their work practices were.
- ➔ Knowledge of the clients' industry was important for Enki as it allowed them to have a deeper understanding of the particular industry requirements.
- ➔ The internal project team was important for the identification of Hathor's informal networks and requirements elicitation as the internal project team re-directed who Enki should talk to if it was felt that another user was more of an expert in a certain area.
- ➔ The internal project team was important in terms of identifying user's needs and requirements as they were the experts for their given areas and

knew what was required from the system to ensure that their work practices would be fully supported.

- By identifying the informal networks, Enki were able to determine the users' community of practice that existed within Hathor and how the users' embedded knowledge flowed between these users groups.
- Participation by Enki in the users' working context was important for the identification of the users' needs.
- Observations in real-time of the situated practice of the users ensured that requirements needed by the users were identified.
- The creation and maintenance of close relationships between both companies were important as they helped Enki understand the users' work practices and situated context, which the developed system was to support.
- The relationships between Enki, the lead users and the general users were established and maintained through the use of a knowledge broker.
- The knowledge broker was important to the development process, as he facilitated the transfer of the internal project teams' requirements to Enki. It was he who communicated, explained and provided clarity on the user's requirements for the system to Enki.
- The knowledge broker acted as a two-way communications channel between Enki, the lead users and the general users until all the system requirements were understood and interpreted correctly by Enki.
- Getting the general users to list their working practices while the development team observed them carrying out their daily functions, allowed Enki to identify any inconsistencies between what the users said they did and what they actually do.
- The identification of Hathor's key recording points ensured that all important knowledge areas were given a workstation for the creation, retrieval and updating of Hathor's knowledge.

- Identifying critical instances was an important step in the development process as it allowed the developers to ascertain the work practices that the users carried out to solve problems as they arose.
- Identifying the steps required to overcome systems failure was another important step in the development process. By uncovering these steps, Enki were able to identify what practices the users carried out in order to ensure that the system was fully operational again.
- The mapping of the repetitive processes of the users was important to requirements elicitation as it ensured that the daily working practices of the users were included and supported by the development of the system.
- The management of the general users and their involvement in the development process was a factor in the overall success of the system, as both Enki and Hathor felt that to include them would ensure that the system would meet their needs and that it would be fully accepted by the general users.
- An important step in the involvement of the general users was to explain to them why some of their suggestions for improving the system would not be included in the design and development of the system.
- The development of a prototype early on in the process allowed the project leader and team to carry out unit testing to ensure that requirements had been identified and supported by the new system.
- Systems testing by Enki allowed for further identification of requirements to ensure that the system would actually carry out and support the users' working practices.
- The implementation of the new system and parallel running of both the old and new systems allowed for any problems or missing requirements with the new system to be identified prior to it taking over as Hathor's main system.

6.3 Case Study Two

The two organisations involved in Case Study Two were as follows:

6.3.1 Case Study Profiles

Enki discussed in §6.2.1.

Matuta were a baby foods manufacturing company that specialised in Instant Milk Formula (IMF) and there were 105 employees working in the company. It was a subsidiary of a large European corporate company (holding company) and ranked 2nd or 3rd in the world for baby foods. Matuta had a long established history, which have made it a market leader in baby foods manufacturing. In 2005, it was acknowledged as the European market leader in infant nutrition with over 58% of the Irish market[14].

To support the development of infants and toddlers, Matuta had developed a unique range of nutritional products, which they continued to build upon. The company's core strategy was two fold:

- to ensure that their products were the brand of choice through a child's early years and,
- to ensure that parents were safe in the knowledge that their child's nutritional needs were best served by a trusted brand that consistently delivered nutritional benefits as their child grew.

[14] Available on the Internet from http://www.irishjobs.ie accessed on 20th November 2006.

To meet their strategic objective, Matuta was comprised of two sub-factories. One factory produced a semi-finished product or bulk product, which was then sent onto other packing units for packaging and further distribution. The second factory produced the finished product, which was packed and distributed on-site.

Matuta's organisational structure was a formal hierarchical structure in that it was run locally by a Senior Management Team in conjunction with Matuta's Board of Directors and Managing Director, whom reported directly to the parent company. Each department within the company was controlled by a department manager. In addition, during production, each team was managed by a production team leader, who reported directly to the department manager.

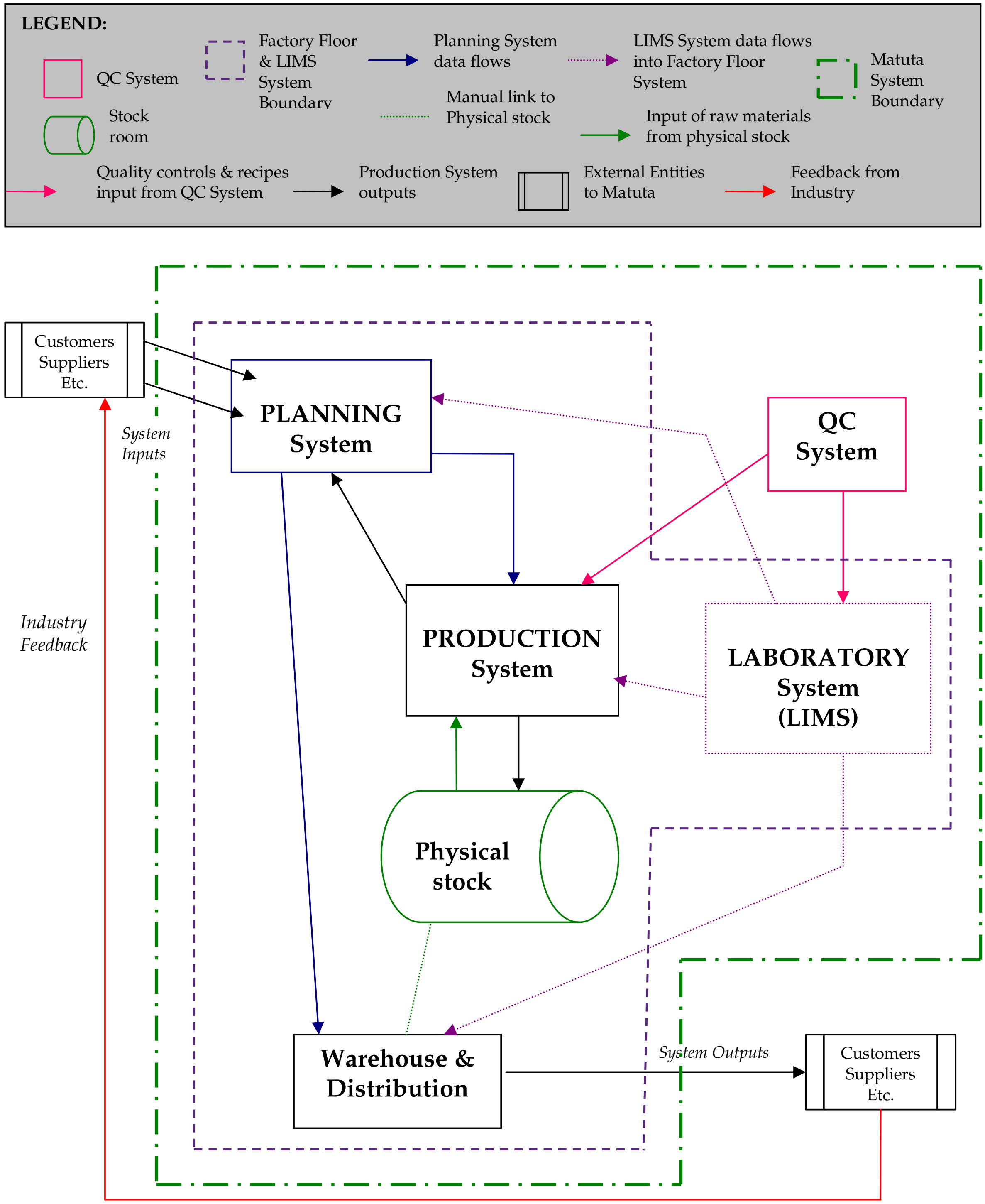
There were several values which were radiated throughout Matuta and the corporation, both internally and externally. These were: Care; Agility; Commitment; and Integrity. Also there was a code of practice that everyone was expected to comply with and which was given to all employees. Formal communication structures were in place within the organisation. These were dictated by the system in place, which in turn was controlled by the parent company.

6.3.2 The Context

This case study focused on the development of the Factory Floor and Laboratory Information Management Systems (LIMS) that occurred between 1987 and 2005. Figure 6.5 illustrated a diagram of the context of Matuta's system. The focal point of the system was the Factory Floor system and it consisted of Planning, Production and Warehouse. It governed the amount produced by the organisation in that it controlled the planning of raw materials for the Production System by determining production's quotas and the amount of physical stock to be distributed based upon preconceived stock and planning levels. The test specifications for Laboratory System were stored in the Quality Control (QC) System and these directly impacted upon Matuta's Factory Floor System. The laboratory carried out tests on random samples of raw materials as they arrived into the organisation to ensure that they met industry specifications. If the raw materials did not meet the required standards, planning had to re-order the stock before production could take place.

The Laboratory System also randomly removed samples from the Production System while products were being produced. If the Laboratory System detected a problem, Warehouse would not distribute the product until it had been successfully passed by the laboratory. Prior to 1982, the problems with this system were that it was a manual off-the-shelf system that was under-developed and did not meet the company's business requirements. Also, the potential for human error with this system was high. As detailed in subsequent sections, Matuta experienced severe problems in terms of cost and time inefficiencies, which the company wanted to overcome in order to retain their competitive advantage in the market place. To rectify the inadequacies in the factory floor and laboratory systems, Matuta approached Enki and asked them to develop an automated version of their manual system.

Figure 6.5: Overview of the Factory Floor and Laboratory System



The flowchart in Figure 6.5 outlined the different systems that comprised the Factory Floor and LIMS systems and how each sub-system integrated with the others. Also depicted were the manual information processes that occurred and the areas where potential problems happened within the system. Similar to Case Study One, this analysis of the system was developed ex post based upon the analysis of documentation, observations and interviews carried out by the researcher in both Enki and Matuta.

6.3.2.1 Factory Floor System

Within the planning component of the Factory Floor System (P1), Matuta's planning users experienced several difficulties. It was a manual system and all stock orders were manually carried out either over the phone or on pieces of paper.

> *The old planning system was essentially pieces of paper and phone calls [Matuta: PM]*

On receipt of the raw materials from their suppliers (P2), Matuta's planning users' experienced further difficulties. If the orders had been misinterpreted by the supplier as a result of illegible handwriting or inaccurate recording of figures, etc., the raw materials received for production would be inaccurate [*Compounded Problem A*]. In addition, the raw materials invoices were manually entered into the stock database and the labels created for those raw materials often were incorrect. For example, a mistake made when ordering stock would result in further errors when the invoice data was being manually inputted into the stock system, which in turn, would lead to incorrect processing and use of that information [*Compounded Problem A*].

Figure 6.6: Analysis of the Planning, Production & Laboratory Systems

Model is based on documentation and interviews with both Enki and Hathor – adapted for illustration.

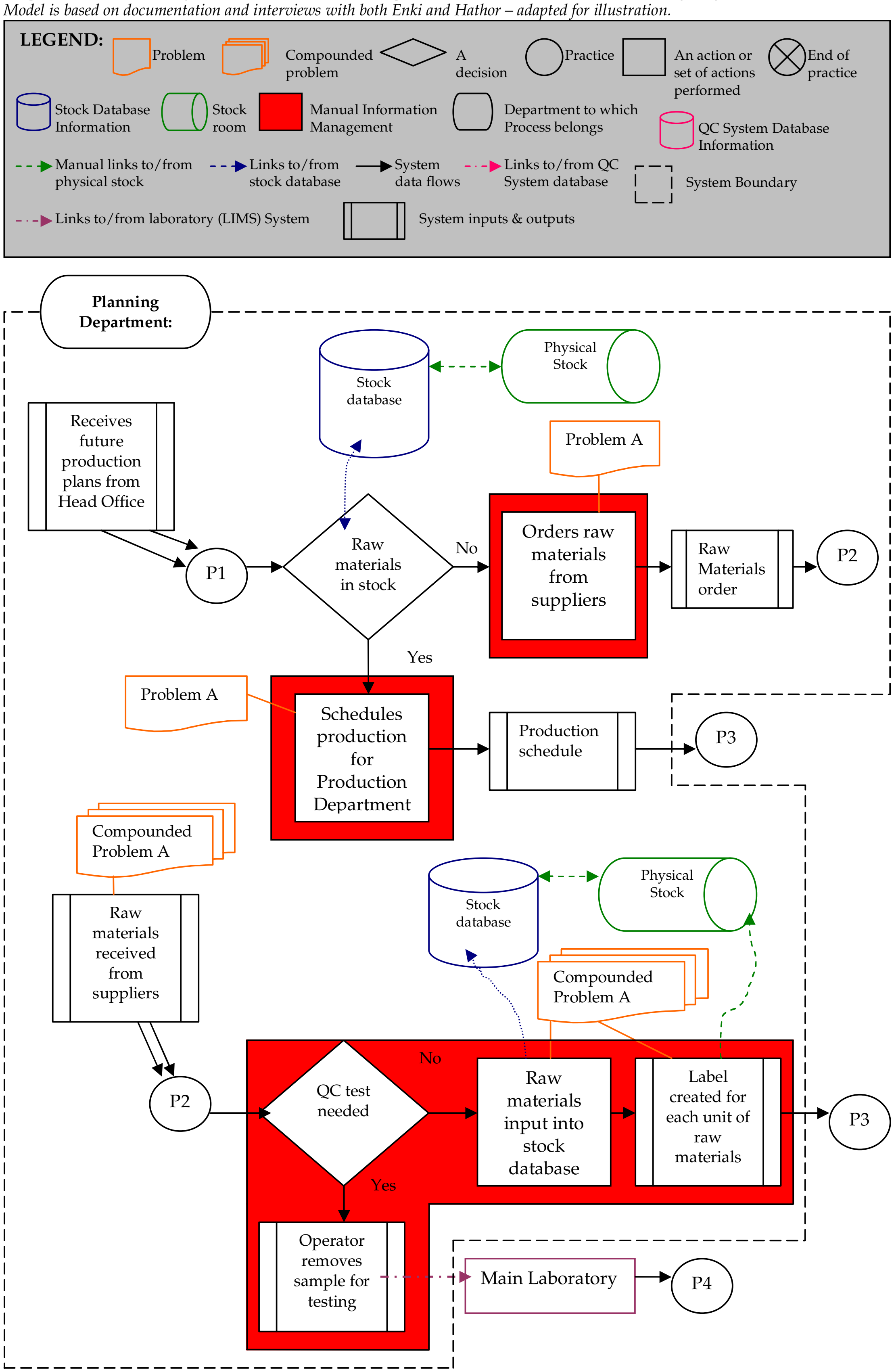


Figure 6.6: Continued

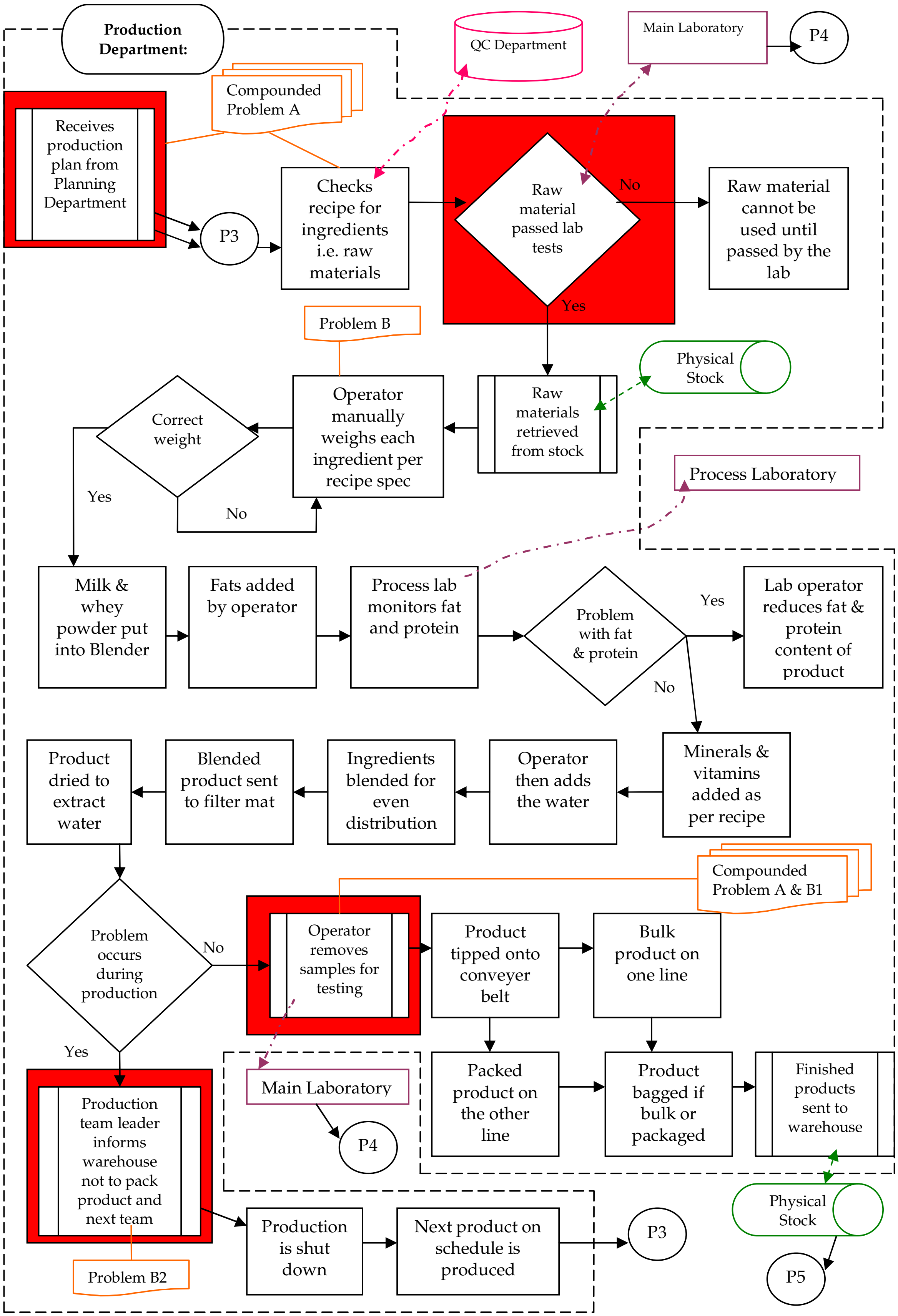


Figure 6.6: Continued

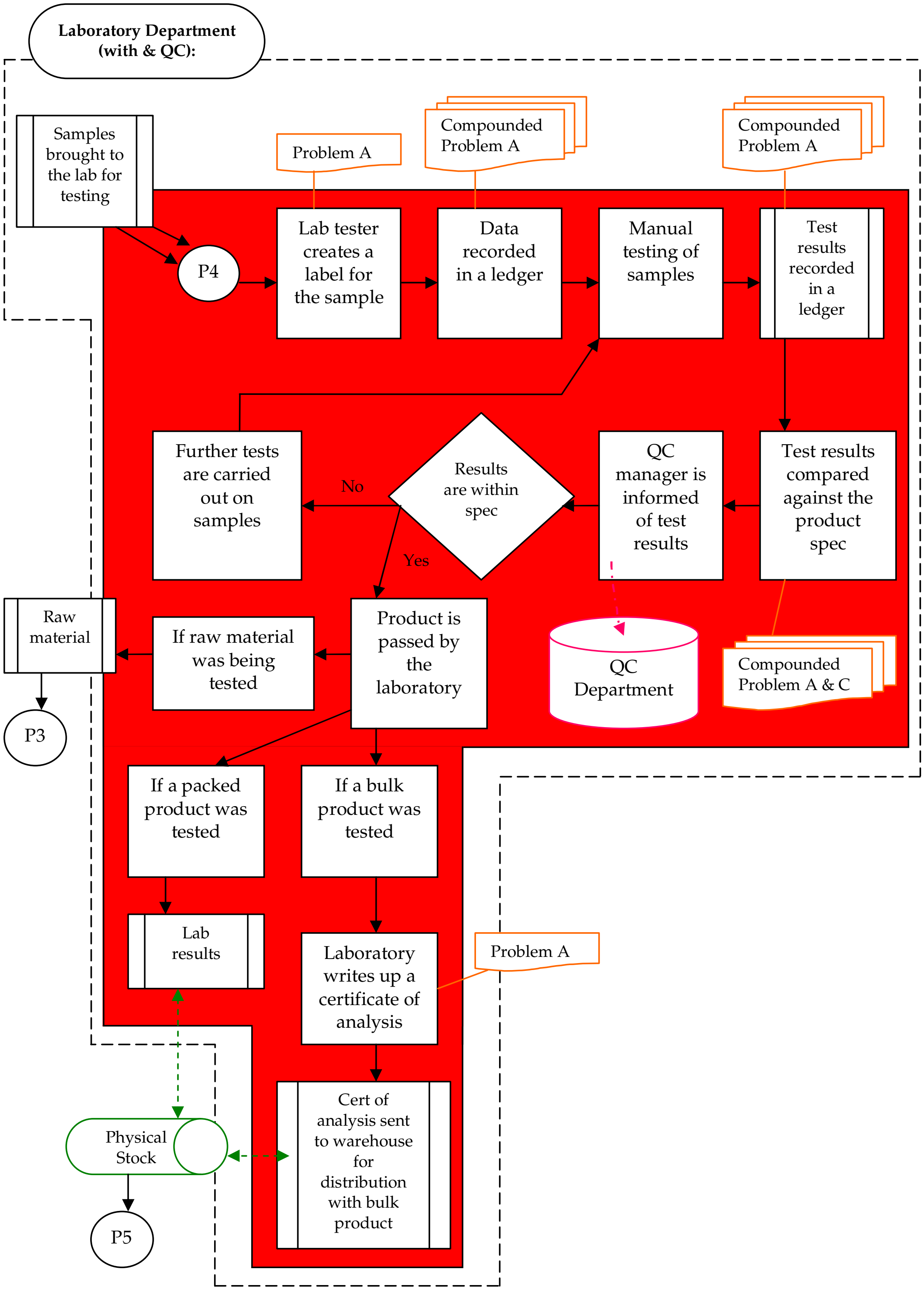
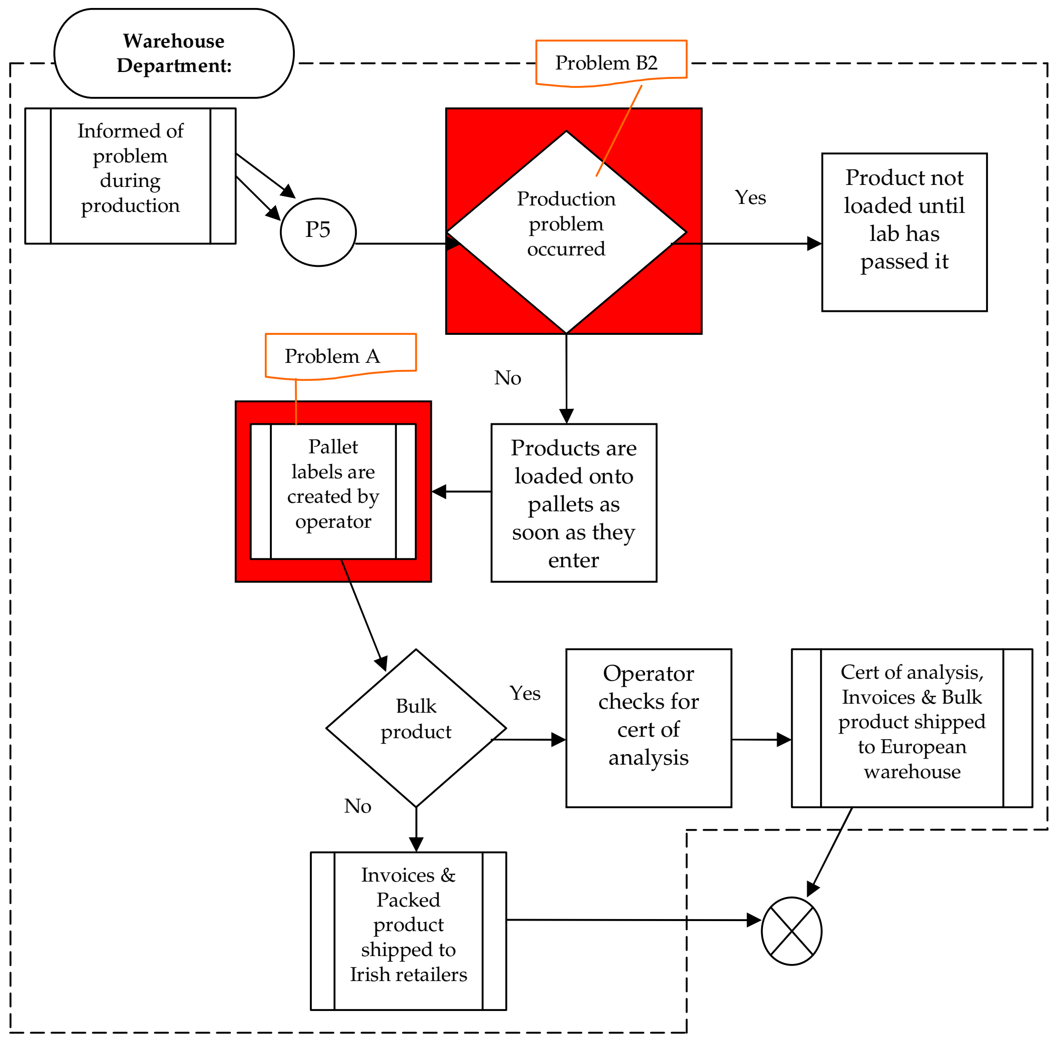


Figure 6.6: Continued



Problem – Potential for error in the system		Compounded Problem – Error in one process is used as a basis for subsequent processes, thus compounding the original error	
Problem A	Manual recording of data; human error; illegibility	Compounded Problem A	Inaccurate manual recording of information - incorrect processing & use of that information
Problem B	Manual weighing of ingredient for product; human error	Compounded Problem A & A1	Incorrect stock delivery – incorrect manual input of stock into database
Problem B2	Production problems manually recorded or verbally passed on; human error in forgetting; illegibility; loss of paper	Compounded Problem A1 & C	Manual checking of test results against the test specs; human error; inaccurate recording of data
		Compounded Problem A1 & B1	Manual removal of samples; human error in forgetting the times

Creating labels to identify the raw materials in stock was also a problem. These were manually created and problems arose concerning bad handwriting, misreading of the data and inaccurate data being recorded [*Compounded Problem A*].

> *With the old system, it was more careless. With the labels, the number/batch number could be wrong; there was bad hand writing; misreading of numbers etc. [Matuta: PM]*

Although the future production plans were received from the parent company's head office through the corporate system, it was still the responsibility of the planning manager to schedule the production plans on a six week basis. The production plans for Matuta's factory were manually created using a whiteboard and paper.

> *Some production planning done on PC, some done on whiteboard… it was a manual paper based system [Matuta: PM]*

Inherent within these processes were several problems, such as loss of paper orders or production plans, and, inaccurate transcription of the order over the phone by the supplier. In addition, there was the potential for human error, the misreading of figures and illegibility of handwriting [*Problem A*].

While most of the factory system for the production department was already automated, several potential problems existed, which Matuta's managers wanted removed. First, all information between the planning department and the factory floor was being transferred on paper by hand, i.e. the production schedule. Thus, if inaccurate recording of the production output occurred on the part of the production planner, or if the information was misinterpreted by the production team leader it would result in an incorrect quantity of products being manufactured [*Compounded Problem A*]. Another problem was the manual weighing and checking of production ingredients against the specifications [*Problem B*]. A production user had to manually weigh the recipe ingredients for production by hand and this could result in incorrect measurements being applied to the product.

If a problem occurred anywhere in production (P3), the production team leader had to manually inform either the next shift's team leader of the problem, or warehouse that the product was not to be sent unless it had been passed by the laboratory as meeting industry specifications [*Problem B2*]. There were many problems with this process such as, the loss of paper, forgetfulness on the part of the team leader and illegibility of handwriting.

> *[There was] warehouse packing problems… With the old system, the production team leader would have to remember and tell warehouse or if his shift was finished would have to tell the next team leader coming on after him what the problems were. There was plenty of room for error as humans can forget and pieces of paper can be lost. [Matuta: PM]*

Once production had been completed, a user had to manually remove production samples for testing in the main laboratory. The problem experienced here was that the user had to remember the correct time for the samples to be removed so that the laboratory could perform its tests on those samples [*Compounded Problem A & B1*]. Forgetfulness and manual recording of the removal and details of the samples resulted in various problems.

> *The samples are being manually recorded…There are time constrictions in place for the different tests being carried out e.g. every hour for fats & proteins or every 4 hours for chemical tests… There is manual lab testing and inputting of results by the lab people. [Matuta: LT]*

Within the warehouse (P5), there was the problem of creating pallet labels for product distribution. The warehouse had to manually record the pallet labels which could lead to illegibility of handwriting and human error in recording the data [*Problem A*].

6.3.2.2 Laboratory Information Management System (LIMS)

Matuta's laboratory system (P4) was a manual system of bookwork and ledgers. As mentioned already, samples were manually removed from the production line at regular intervals. The operator then had to manually create a label for each sample obtained, which led to problems of illegibility, recording of inaccurate data, etc. [*Problem A1*]. If the sample labels created by the user were recorded incorrectly in the first instance, this would lead to incorrect data being manually recorded in the ledgers and in turn, incorrect usage of that information [*Compounded Problem A*].

The corresponding results then had to be manually inputted into the ledgers [*Compounded Problem A*]. Once recorded, the test results had to be manually checked by the laboratory user against the product specifications to ensure that the results were not over or below the ranges that they should be in.

> *There are different parameters for the different products produced i.e. the spec is the different ranges that each test can fall into. They are changes for each recipe and test type [Matuta: QM]*

Several problems were inherent within the manual recording of data and checking of test results: the inaccurate recording of the test results, illegible handwriting, incorrect processing and use of those results, mistakes and human error in checking the results against the specifications particularly if the results were wrong to begin with [*Compounded Problem A & C*].

If there were no problems with the test results, the products were passed by the laboratory. However, for the bulk products produced by Matuta, a certificate of analysis was required by their customers to illustrate that the product had passed its tests[15].

> *The Bulk product is the only product that is certified. It is the only product that is sent to warehouses in Europe for further packing i.e. it is produced by us as a raw material for other Matuta companies. The cert of analysis proves that is has passed all tests and it's within its spec so that the European companies can go ahead and package it [Matuta: LT]*

The certificate of analysis had to be manually created by the laboratory user [*Problem A*], which could lead to inaccurate manual recording of information from the ledgers and incorrect data being sent with the products to the European warehouses by Matuta's warehouse.

Having discussed the problems Matuta were experiencing with their Factory Floor and Laboratory (LIMS) Systems, Matuta's managers approached Enki in 1987 to automate their systems and the following narrative details the development process used.

6.3.3 Project Narrative for Factory Floor & LIMS System

The following project narrative traces Enki's development process of the Factory Floor and LIMS Systems with particular emphasis upon the elicitation of user requirements and the transfer of knowledge between the users and the development team. For Case Study Two, the phases of activity utilised by Enki for the development of Matuta's system were:

Phase 1: Initial Requirements Gathering;

Phase 2: Identify Lead Users & Requirements Gathering;

Phase 3: General User Involvement & Further Requirements

---

[15] A sample of a certificate of analysis is provided in Appendix G.

Gathering;

Phase 4: Systems Design & Requirements Gathering;

Phase 5: Prototype Testing, Implementation & Requirements Gathering.

The data gathered for each of these phases will now be set out in turn.

6.3.3.1 Phase 1: Initial Specification & Requirements Gathering

Matuta's management team developed the initial requirements specification for Enki. However, to gain a clear understanding of these requirements and management's perspective on the system, Enki interviewed Matuta's senior management team to discuss the company's overall objectives for the eventual system.

> *Matuta did the initial spec for the system and gave it Enki who then did a detailed spec based on the initial one we gave them. [Matuta: FC]*

To clearly understand the problems Matuta were experiencing with their manual system, Enki listened to the managers' stories in relation to the system. These stories and analogies provided Enki with deep insights into the problems and working practices inherent within the system and valuable information concerning critical events that Matuta's management wanted corrected. Sometimes these stories were general in nature, or they referred to particular experiences and problems that were encountered by management or sometimes they enlightened Enki to the decisions that were taken. From these stories, Enki were able to understand the values and the code of practice inherent within the organisation that each and every employee must abide by. These values were at the heart of Matuta and every process within the organisation must take them into consideration. Accordingly, it was important for Matuta that Enki understood these values and from their stories how they were incorporated into their work practices.

> *The values at work within Matuta are: (1) Care; (2) Agility; (3) Commitment; and (4) Integrity. These values are driven throughout the company both internally and externally. There is a code of practice that is expected by everyone and everyone receives a copy of it. [Matuta: FC]*

These interactive meetings often evolved into brainstorming sessions, where both Matuta and Enki discussed in detail the problems with the system and potential solutions. The dialogue between the two companies and the level of interaction between them was regular and intense, with both Enki and Matuta's managers openly communicating and sharing their ideas.

> *We design: top – down... You have to start with management…we listened to and tried to understand their needs. [Enki: MD]*

> *Three months were spent analysing the requirements [and] the focus was put on the factory floor and all others were seen as peripheral functions… [We also] do whiteboard sessions. [Enki: MD]*

The initial requirements specification for the factory floor system given to Enki was to automate the current system in use.

> *The manual system was brought up to date as an automated system, as it was only a paper system. [Enki: MD]*

The specification given to Enki by Matuta's management team for their laboratory department was to develop an automated version of their existing laboratory system.

> *The LIMS is a homemade system that was built in house…It is tailored… We decided to get a package built that we would not have to work around. [Matuta: LT]*

The reason for the development of this system was that it could not cope with the quantity of testing that was being carried out. The reason for this was that is was a manual paper-based system.

> *The reason for development of the LIMS was that the laboratory couldn't cope manually with the level of testing they had to do. [Enki: MD]*

In addition, the management team wanted control mechanisms built into the overall new system, to prevent the possibility of mistakes from occurring during production of the baby food.

> *The goal was to prevent mistakes from occurring… The key was prevention rather than cure. [Enki: MD]*

> *We wanted safeguards in the system to alert other people to things or problems [Matuta: PM]*

Directly linked to this was the requirement for incident reporting. If an error or problem happened to occur at any stage during production, Matuta's managers wanted the new system to automatically record the problem, how it was rectified, and by whom.

> *The new system also has incident reporting, which is a method of reporting exceptions. [Matuta: FC]*

> *The system gives you the opportunity to log incident reports. [Matuta: PM]*

> *If something goes wrong during production or manufacturing an incident report is written up on the system. [Matuta: QM]*

They wanted the data recorded once so that it could be used many times, thus eliminating the need for redundant data within the system.

> *The key to our IT was to record data at a point of use. Record it once and use it many times [Matuta: FC]*

Based on this strategy, Matuta's managers wanted the factory floor and LIMS system to be integrated with the other corporate systems used in the company. This was to ensure that automatic feedback and use of information throughout the organisation occurred, particularly if problems were encountered.

> *It is a home-grown system. We are trying to make all the corporate systems compatible. [Matuta: PM]*

> *Also, with the new system more integration allowed for rapid feedback through the use of IT, so the system essentially became an Early Warning System. [Enki: MD]*

When developing the new system, the overall requirement given to Enki by Matuta was to use information technology to ensure that a quality product was produced.

> *The directive by the MD was to use IT for quality assurance and product traceability. [Enki: MD]*

To achieve this objective, Matuta's management requested that traceability be incorporated into the new system. As the baby food industry was highly sensitive and competed on quality this was of paramount importance to Matuta.

> *For systems development, quality assurance was a high priority. The aim was to help the operative to make the best possible product and to improve the quantity. [Enki: MD]*

Traceability is very important with this system. We have to know where everything is, where it has gone, and what was used to make the product etc. [Matuta: PM]

6.3.3.2 Phase 2: Identify Lead Users & Requirements Gathering

Once Matuta's management team had established their initial requirements for the system, Enki then set out to discover who the lead users of the system were. The lead users of the system were the identified as the project managers from each department as they were in a position to understand and predict the requirements of the general system users and so they were involved in the development of the system.

The team leaders were the lead users who carried out the operations. The team leaders included the following departments: Quality Assurance; Production; Consumer packing; Logistics; and Maintenance & Services. There was at least one person from each department involved in the development of the factory floor system. [Matuta: FC]

The project manager came out of line management, so this is bringing in another skill set. The best person is freed up for the duration of the project. [Enki: MD]

To analyse the system, Enki engaged with each lead user and observed them performing their daily work practices. Clarification and rationale for various practices were obtained in the context of the overall system. This provided Enki with a thorough understanding of what actions were performed by the lead users and why they were performed in that manner. The lead users' requirements were gathered in a number of ways such as, interactive storytelling, documentation and multiple on-site, in-depth interviews. The information gathered was made into a logical story by Enki and the analyst's interpretation of Matuta's working practices and their information systems requirements was then presented to lead users for verification. Any gaps in understanding that were apparent in the narratives were subsequently corrected by the lead users in further cycles of data collection. This repetitive process allowed Enki to engross themselves in the lead uses' experiences and to ensure that the identified requirements matched the needs of the system users.

> *Enki carried out interviews person-to-person on-site. [Matuta: FC]*

> *There were 8 modules included in the development of the system and for each module there were approximately 20 to 25 interviews carried out…These were face-to-face meetings [Matuta: FC]*

> *We carried out repetitive interaction with the champion, the leader, the likely and the projective users of the system. [Enki: MD]*

> *There were several face-to-face meetings between us and Enki. [Matuta: LT]*

There were two user communities within Matuta, namely the laboratory technicians and the factory floor and warehouse operators. The factory floor and warehouse operators were managed by the production department in that all production schedules come from there, while the laboratory was governed by the Quality Control department who determined the specification ranges for the tests carried out on all products into and out of Matuta. On the factory floor, the process laboratory technicians controlled the removal of samples for testing and were in direct contact with the factory floor workers. They also interacted with the main laboratory technicians who tested all the raw materials and final products produced by the factory floor workers. Informal communications occurred between both the laboratory and the factory floor and warehouse workers. Any problems that were experienced were communicated directly to those who would be affected and management. For example, if problems occurred on the factory floor when a product was on the line, the laboratory was immediately sent a sample to test and the warehouse operatives were told not to dispatch the product unless the laboratory had released it. In addition, the laboratory technician kept the Quality Control manager informed of all samples tested and the specification ranges the samples reached. These communications were both informal and formal in that they were documented within the system formally, but were discussed openly between all persons involved in overcoming the problem and the solution exchange.

By observing the users within Matuta carrying out these altercations through continuous and frequent interactions, Enki were able to identify these informal communications and information flows that existed between the different communities within the system. Additionally, Enki were able to determine who the users went to when they needed help on solving problems, or when they wanted to get advice on different issues when they arose. Identification of these informal networks allowed Enki to understand how information was transferred and used within the users' community, who acquires what kind of information, when and for what purposes. It also helped Enki to gain an insight into the users' social customs that governed their working environment and practices. This understanding provided Enki with a deep insight into how knowledge embedded within the system was used by its users and how they are connected.

> *We try to observe the people working in the natural environment… the key is the stand back and watch… it was used at the operator level… You get a far a more complete spec and you can identify any idiosyncrasies [Enki: MD]*

System documentation also assisted Enki in gaining a deeper understanding of lead user requirements. Documents were used as a prompt for memory recall and as a mechanism to test lead users' memories and cross-check their ex post data and perceptions. Consequently, the lead users' reflection was more accurate concerning their working practices within the system with Enki being provided with a more realistic understanding of the system and their needs.

> *Old documents are used if they exist. It can point out inconsistencies or opportunities… It ensures that nothing is overlooked and that no opportunities are missed. [Enki: MD]*

In addition, the regularity of interactions between Matuta's lead users and the development company facilitated the formation of close personal relationships between both members of companies. Consequently, Enki and Matuta began to trust one another and so a higher level of communication was achieved. Through these interpersonal relationships, Matuta's lead users and Enki were able to gain a greater understanding of each others' perspectives on critical issues. Nevertheless, communication problems did occur. For instance, the lead users knew what they wanted but were speaking in their own industry language which Enki found difficult to understand. Equally, Enki were communicating their understanding of the system back to the lead users in their technical language which the Matuta's lead users did not comprehend.

> *Communication was a big issue… There was language difficulties involved in the development of the system. It was like two different worlds colliding, IT and Quality Control/Science. [Matuta: LT]*

> *Sometimes it is difficult to interpret what they [the users] want. They say they want something but they actually don't, they wanted something different. [Matuta: FC]*

For most of the development process, Matuta's lead users were directly involved in the design of the new system while Matuta's IT department stayed in the background. However, the expectations of Matuta's lead users in relation to the development process were causing problems for Enki. Matuta's lead users believed that once they had told Enki their requirements that they would receive a fully finished operational system. They did not realise that they had to be involved in the development process of that system in order for it to achieve what they wanted.

> *We were involved in the development directly for a while… the IT department did not get involved initially. [Matuta: LT]*

> *We didn't know that we would be involved in the actual building of the system or that it would take so much time. We expected a finished product. [Matuta: LT]*

To overcome the communication barrier and to free up the time the lead users spent involved in developing the system. Matuta's managers approached their IT department to act as a mediator between the lead users and Enki. The IT department appointed a knowledge broker to act as an intermediary between the lead users and Enki. The role of the knowledge broker was to ensure that all system requirements were understood and interpreted correctly by Enki.

> *To develop it took huge amounts of time and…There was also a resource issue. Enki were not given a big project, only bits of it. Matuta didn't have the resources available… [Matuta: LT]*

> *[Our IT department] only took over the role… in last 2 years or so. [Matuta: LT]*

> *There was a link used… For Matuta the best person was freed up for the duration of the project. [Enki: MD]*

The main role of the knowledge broker was to ensure that communications between both companies were expressed in a manner so that both sides could clearly understand each other. The broker could speak, interpret and explain the languages of both the lead users and the development company and so communication and language difficulties between them were overcome. From then on, if further requirements were identified by the lead users they had to approach the knowledge broker, who in turn contacted Enki with these updated system requirements.

> *We would tell [our Financial team leader] what we wanted. He would ask Enki and they would come back with the software. [Matuta: LT]*

When Matuta's knowledge broker requested these new requirements from Enki the corresponding lead users would also be identified so that Enki could interact with them to clarify their needs.

> *If changes need to be made there is one point of contact, me. The department looking for the change contacts me and I contact Enki. Once the request has been put in, Enki then talks directly with the operatives looking for the change [Matuta: FC]*

> *I identified who Enki should talk to and then they went off and met up with those people in each of the different functions. [Matuta: FC]*

However, the misinterpretation of requirements was a significant problem. Matuta's IT department was controlled by Finance; therefore, they were governed by costs. Thus, once requirements' requests had been made by the lead users to Matuta's IT department, they were re-interpreted and given incorrectly to Enki. Essentially, the IT department were filtering and paraphrasing the users' requirements on the basis of the cost of delivery.

> *Their IT department is part of Finance, which is a difficult aspect to handle. What the factory manager wants is interpreted and changed by their Finance department as they are only interested in costs. [Enki: MD]*

This difficulty further increased development problems when Enki's meetings with lead users were cancelled. When they subsequently did meet with the lead users, their requirements had changed again. In addition, Enki faced the problem of the lack of availability of those lead users throughout the entire process, particularly when requirements needed to be clarified and understood.

> *We had some major problems. There were delays project meetings, and the system would have moved as the requirements had changed. There was a problem with availability of key users and resources for the duration of the project. [Enki: MD]*

Furthermore, at different stages of the development process, Matuta opted for a very short systems lifecycle, which put Enki under pressure to understand and elicit the requirements and needs of the users.

> *Matuta adopt a Big Bang Approach to development. [Enki: MD]*

> *The project lifecycle used by Matuta was very tight. The approval to go ahead to implement is very short. Once they want something, they want it in tomorrow. We have to have a good understanding of the process. It is high speed development and it is very hectic... The problem with this approach is that they don't know themselves what they want. We could be told in 3 lines what the spec for the new system is... It is high pressure to draw up the spec. [Enki: MD]*

6.3.3.3 Phase 3: General User Involvement & Further Requirements Gathering

Once Enki had identified what the lead users' wanted from the system, their next step was to conduct an analysis of the needs of the prospective systems users. Enki believed that there was a significant difference between what management wanted from the system and what the users needed. Therefore, they felt that the needs of the general users on the floor must be investigated and identified. For Enki, neglecting to identify these requirements would result in a failed system.

> *There was at least one person from each department involved in developing the system. However, there are four people in each department, so opinions were taken from each person. [Matuta: FC]*

> *The users had input into what they wanted from the new system [Matuta: LT]*

> *What the manager tells you he wants can be poles apart from what the users want. [Enki: MD]*

> *What the client tells you he wants and what he needs can be poles apart, particularly at the factory level. [Enki: MD]*

As mentioned early, Matuta consisted of two user communities, the factory floor operatives and the laboratory technicians. To identify what the general users from both of these communities needed from the new system, Enki went down to their work environment. Enki developed a relationship with these users and participated in their working context in order to fully understand their situated working practices and systems requirements.

> *You have to start with management, but for requirements gathering you have to go to the factory floor. [Enki: MD]*

> *We regard requirements gathering as a process of living with them i.e. the operators of the system. [Enki: MD]*

The management of the general users was a very important process throughout the development lifecycle as it ensured the users' commitment to the end product. Their involvement created a level of satisfaction amongst the users as the users felt they were being listened to and contributing to the systems development process. In addition, they felt that they had ownership of the system, rather than it being forced upon them.

> *You have to get what the operator requires. Give him something he wants. He is the user so involve him; give him something even if it is only to say to his friends that he had to explain to you what it is he does. You have to have pro-active involvement. This gives the users a level of satisfaction and makes the process easier. [Enki: MD]*

It was through a process of storytelling that Enki identified the working practices and systems requirements of these users. During development, Enki asked the users to explain how they carried out their work practices within the system. The users walked the analyst through their work processes. During the walkthroughs, the users would explain to the analyst in story form what occurred as they performed their job. These stories were often very general or they could refer to specific instances or problems encountered by the user and its community. Additionally, the stories would describe the decision-making process that emerged to solve these problems or how the user reacted in certain instances. Each of the stories referred to the interactions of the users within the community and the processes that they worked in. For example, when the factory floor operator encountered a problem on the production line, he called over his team leader and informed him of the problem. The team leader would then inform the warehouse operative not to pack and distribute the products until the laboratory technicians had cleared the product. The laboratory was also notified about the problem on the production line and tests were carried out to determine whether the product was safe to distribute for sale. Additionally, the team leader reported the problem to the production manager so that the production schedules could be updated to include the problem and if necessary the re-manufacture of the product.

We asked them to list the functionality of what they do with the system. [Enki: MD]

Interviews were carried out on site. The people who carried out the jobs were interviewed by Enki. They would know the functions and how they're carried out. These functions were then replicated onto a software package i.e. the system. [Matuta: FC]

These working practices and requirements were identified by listening to the general users' stories about how they perform their daily working practices within the current system.

We listened to the operators to identify their requirements. [Enki: MD]

Once the general users' working practices were identified, Enki observed them in their situated context. The reason for this was to identify any irregularities between the practices narrated by the users and the practices they actually performed to carry out their job. If inconsistencies arose between what the users said they did in relation to the practices they carried out, Enki conducted personal interviews with the user to get them to reflect on the processes they use to actually perform their daily practice. This was important as it allowed Enki to obtain a more realistic understanding of the general users' requirements and practices. By observing the general users performing their working practices, Enki were able to identify who they went to for advice or when they needed a solution to overcome problems when they arose. Also, through the use of observational techniques, Enki were able to determine what was feasible in relation to the development of the system and the users' requests.

Enki observed the functions that were being carried out and spoke to the individuals involved. [Matuta: FC]

The operators may not realise what's possible to do, so the key is to stand back and watch. [Enki: MD]

Observation was also carried out at the requirements stage as it was felt 'a picture speaks a thousand words'. [Matuta: FC]

While observing the users in their situated context, the key recording points of the system were identified by Enki. Identifying these key processes was critical for this system as most of Matuta's working practices and information is obtained from their Factory Floor System.

The key recording points are where information is received and updated. 80 to 90% of the system is held here. The key recording points are the requirements for the system where information comes in and goes out. Everything stems from the factory floor system. [Enki: MD]

You monitor their operations and identify the key recording points. [Enki: MD]

By carrying out observational techniques of the users performing their working practices, Enki were able to identify any critical cases, repetitive processes and the recovery steps taken by the operators if systems failure occurred. Uncovering the users' repetitive processes was necessary for the development of system as it ensured that the system would meet and support their daily operations. Also, Enki were able to identify recovery steps employed by the users should systems failure occur.

We observed the processes involved, in this case the factory floor system, such as repetitive cases; critical cases and systems recovery. [Enki: MD]

For Enki, this process was iterative until they were sure that they had identified and elicited all user requirements and processes needed for the development of the system. However, Enki knew that since the baby food industry was extremely competitive and evolving and that these requirements may change again at a later stage.

> *The requirements elicitation process is repetitive… It is a constantly changing environment as competition is high, so automation is rapidly evolving. [Enki: MD]*

> *At the end of first season there is ongoing requirements' gathering, if processes changes or demands change then we quote for enhancements. [Enki: MD]*

However, Enki's interactions with the general users were limited once Matuta appointed the knowledge broker to act as an intermediary. All requirements from the general users now had to come to Enki via the knowledge broker who misinterpreted these needs based on cost delivery.

6.3.3.4 Phase 4: Systems Design & Requirements Gathering

Once Enki had discovered the requirements of Matuta's management, lead and general users, they developed a requirements specification of the system based their system needs. These requirements were interactively discussed with Matuta's lead users. The functional specification for the system was presented to Matuta's lead users and a discussion ensued to determine if the requirements identified by Enki met and fulfilled the users' needs and would support their working practices.

> *Once you have identified the functional schema, then you have to bounce if off the supervisor or manager on a whiteboard session. [Enki: MD]*

If the lead users were unsatisfied with the requirements schema and felt that Enki had omitted something, Enki returned to the users' working context to identify and explore the missing requirements using the same elicitation processes as before. The specification was then rewritten and presented to the lead users for their approval.

> *We used observation; interviews and iterative specifications... We kept going back until we got it right. [Enki: MD]*

Enki then presented the functional specification to Matuta's managers to ensure that the system would successfully meet and support the organisation's working practices and requirements. This was an important process for the development team as it facilitated discussions on the development of the system and ensured that Enki fully understood the needs of the users. After several revisions of the functional specification, Matuta's managers signed off on the proposal and prototype development began.

> *They then wrote the detailed spec and Matuta checked it at management level. [Matuta: FC]*

> *Then you come up the rank and get them i.e. the requirements, signed off by the manager. You have to let the top of the pyramid* [Appendix H] *know what's happening… We gave the spec to the client and did a presentation for them. [Enki: MD]*

> *The final spec was presented by Enki and development began once approval of spec by Matuta was given. [Matuta: FC]*

6.3.3.5 Phase 5: Prototype Testing, Implementation & Requirements Gathering

Once the prototype was developed, Enki presented it to the lead users to demonstrate its capabilities to them. For Enki, prototype development was paramount to the success of the development process as it allowed Matuta's lead users to compare their expectations of the system against what it actually could do.

Enki then developed a prototype of the system… Prototyping gives them what they want and then they can see if it is what they need. [Matuta: FC]

We then prototype and demonstrate it to get their reaction. [Enki: MD]

We believe that prototyping is worth ten times more than the spec so the clients can see in the early stages what is possible and look at internal resources in a better light. [Enki: MD]

Enki initially carried out unit testing of the system and once they were happy that the prototype was fully functional, they presented it to Matuta's lead users for testing. User testing was important as it ensured that all their requirements were being met and that Enki had not overlooked anything.

Unit testing was carried out by us, and then systems' testing was done with the users. [Enki: MD]

This [the prototype] was double checked before going live. It was also user tested to ensure that it met all our needs. [Matuta: FC]

If requirements were omitted from consideration, Enki met with the lead users via the knowledge broker to discuss those needs. Then they went back to the operators to further observe their working practices and context. Several interactive meetings were held between the lead users and Enki via Matuta's knowledge broker to identify the source of the problems and possible solutions to rectify the situation. For example, with certain elements of the system, several prototypes had to be developed before the users were completely satisfied with it. This was a recurring process until Enki were satisfied that all Matuta's requirements and solutions were met and clearly understood.

It was installed and tested. Glitches were found, and after many, many months of glitches we have it working reasonable well now. [Matuta: LT]

The prototype of the system was iterative for some modules, and not for others… In some cases Enki were spot on first time round and some they were not. [Matuta: FC]

When no further problems occurred and Matuta's users were happy with it, the system was implemented into the company and parallel running was carried out until the new system mirrored the old system and Enki was certain that the new system was not going to cause major disruptions to Matuta's operations. However, in a few instances Matuta refused to allow parallel running to be carried out and opted to go live immediately.

There was implementation of the system and then parallel running. We had one or two big bangs with Matuta, where they didn't want parallel running. [Enki: MD]

Once no further requirements or problems were identified as missing from the system, Enki integrated the system into the entire company and the system went live.

Once there was approval of the system, it was set live. [Matuta: FC]

Once parallel running was carried out, we 'go live' with the system. [Enki: MD]

6.3.3.5 Epilogue

Figure 6.7 illustrated the Factory Floor and LIMS System that was developed by Enki. For Matuta's production and factory floor users, the developed system had been a success and had met all their working practices and requirements. Nevertheless, they were in the middle of completing some aspects of the development process with Enki, which once completed would enhance the functioning and efficiency of their system.

> *I am very happy with the system… I have a vague plan to do the bulk side but it hasn't been done yet. This will be for future development… The system works for good for us. [Matuta: PM]*

On the other hand, the users of the laboratory system were not happy with their system. They viewed it as underdeveloped and wanted major modifications made to it in the future to ensure that it supported all their requirements.

> *We decided to get a package built that we would not have to work around. In hindsight it was not a good idea… The system is seriously under developed and is only one third functioning. [Matuta: LT]*

Most of the problems with the LIMS system were due to the under-development of the barcoding and scanning technology, which they wanted to use to input their test results. However, this technology had only been recently introduced into Matuta and was still only in the development phases.

> *Barcode scanning is going to be fully installed. At the moment they are at the early stages but it is on-going. [Matuta: FC]*

For Enki, the development of Matuta's Factory Floor and LIMS system had been a success. They had reproduced these systems in several other manufacturing firms owned by Matuta's parent company.

> *The system is a success in that it has been replicated in a number of Matuta factories. [Enki: MD]*

Figure 6.7: Analysis of the Factory Floor & LIMS System Developed by Enki

Model is based on observations of the systems, and interviews with both Matuta and Hathor – adapted for illustration.

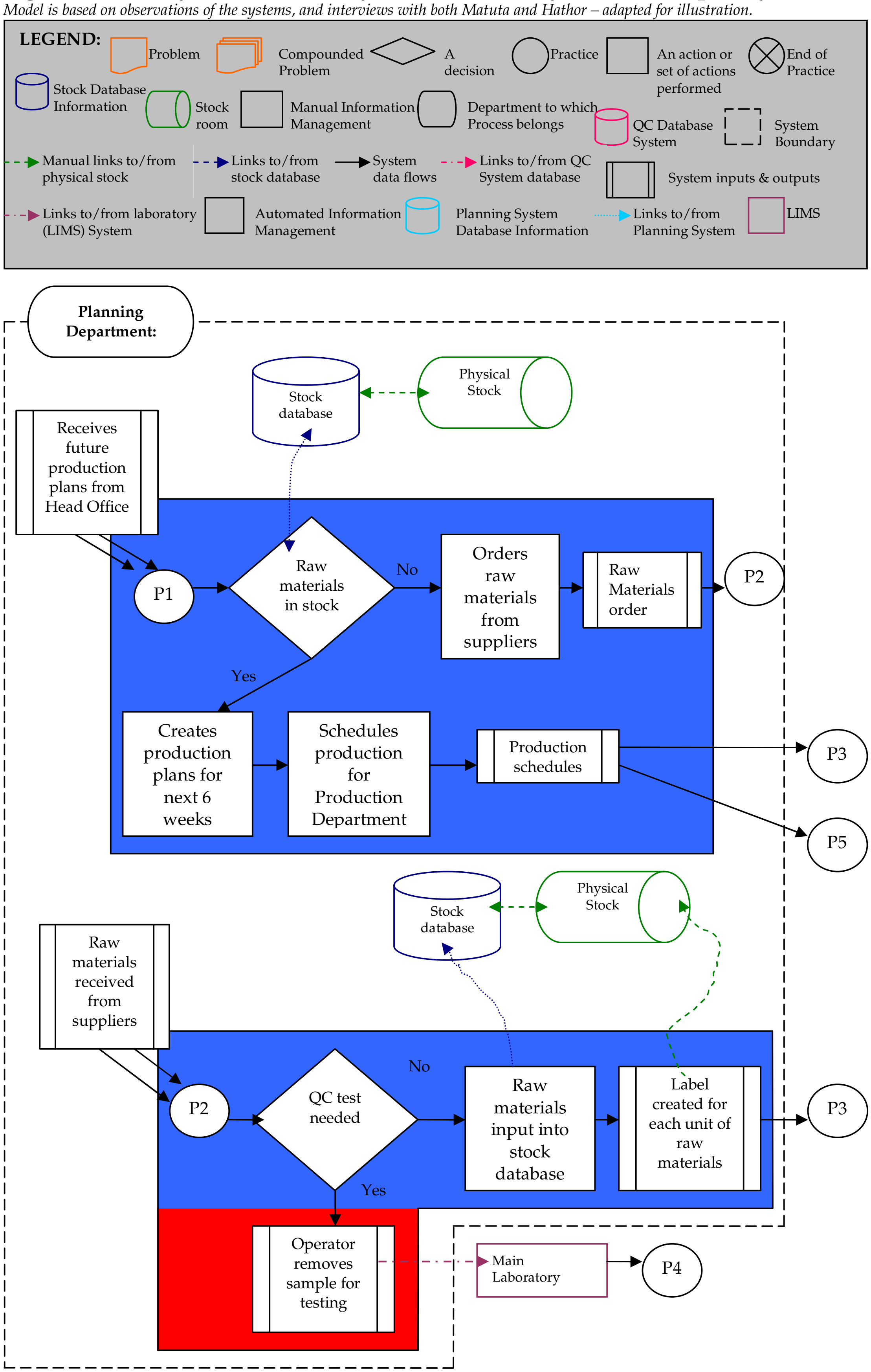


Figure 6.7: Continued

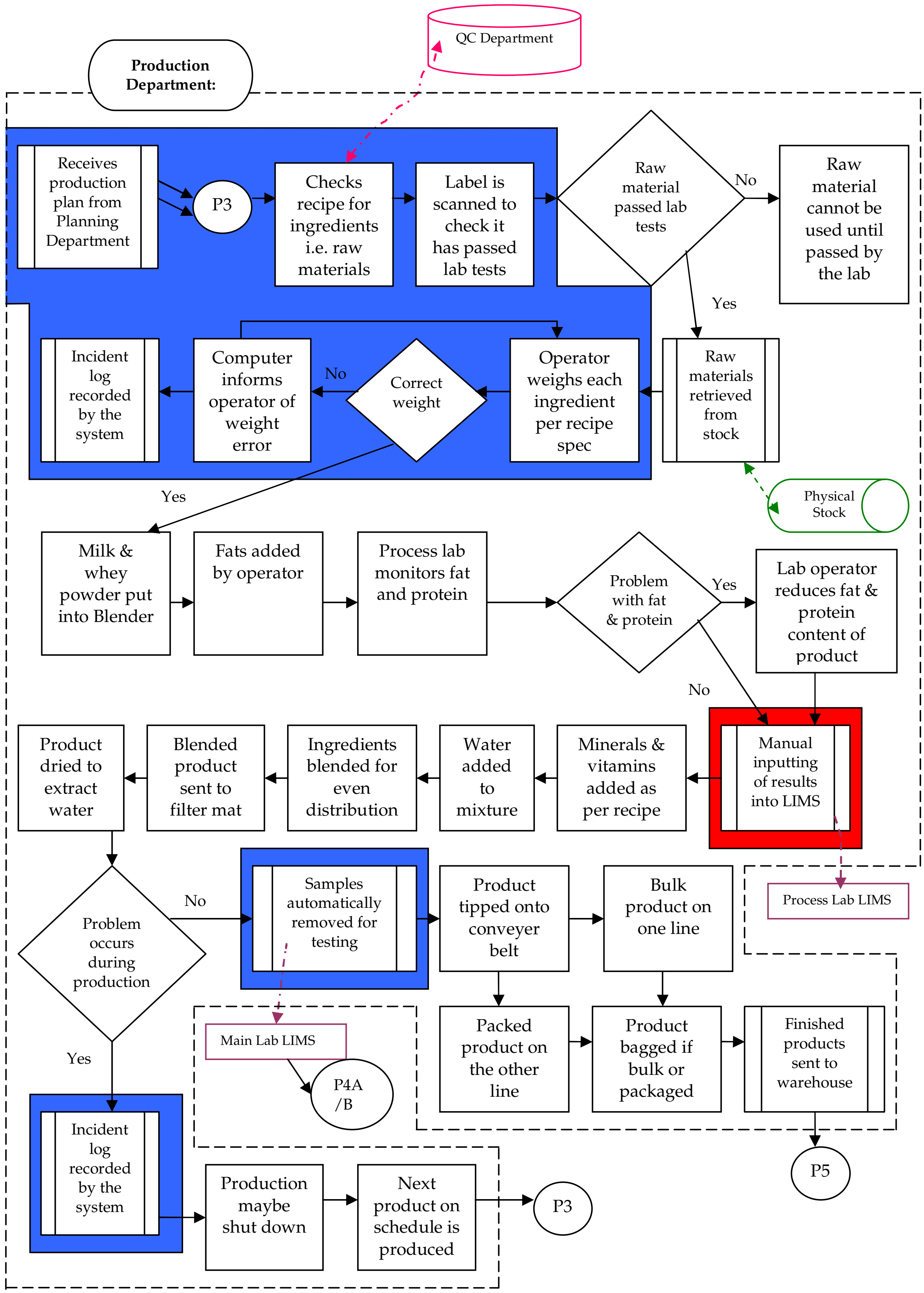


Figure 6.7: Continued

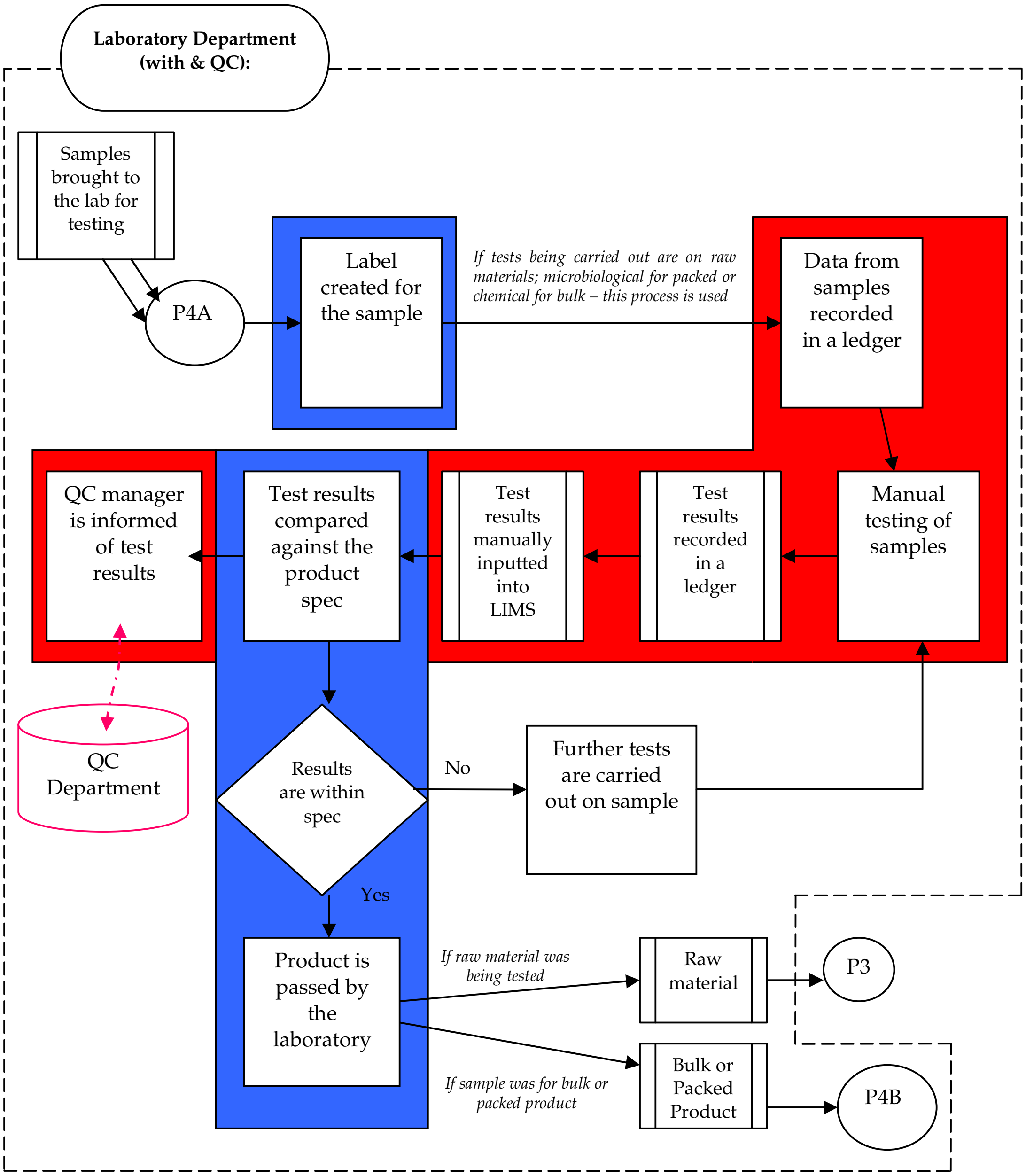


Figure 6.7: Continued

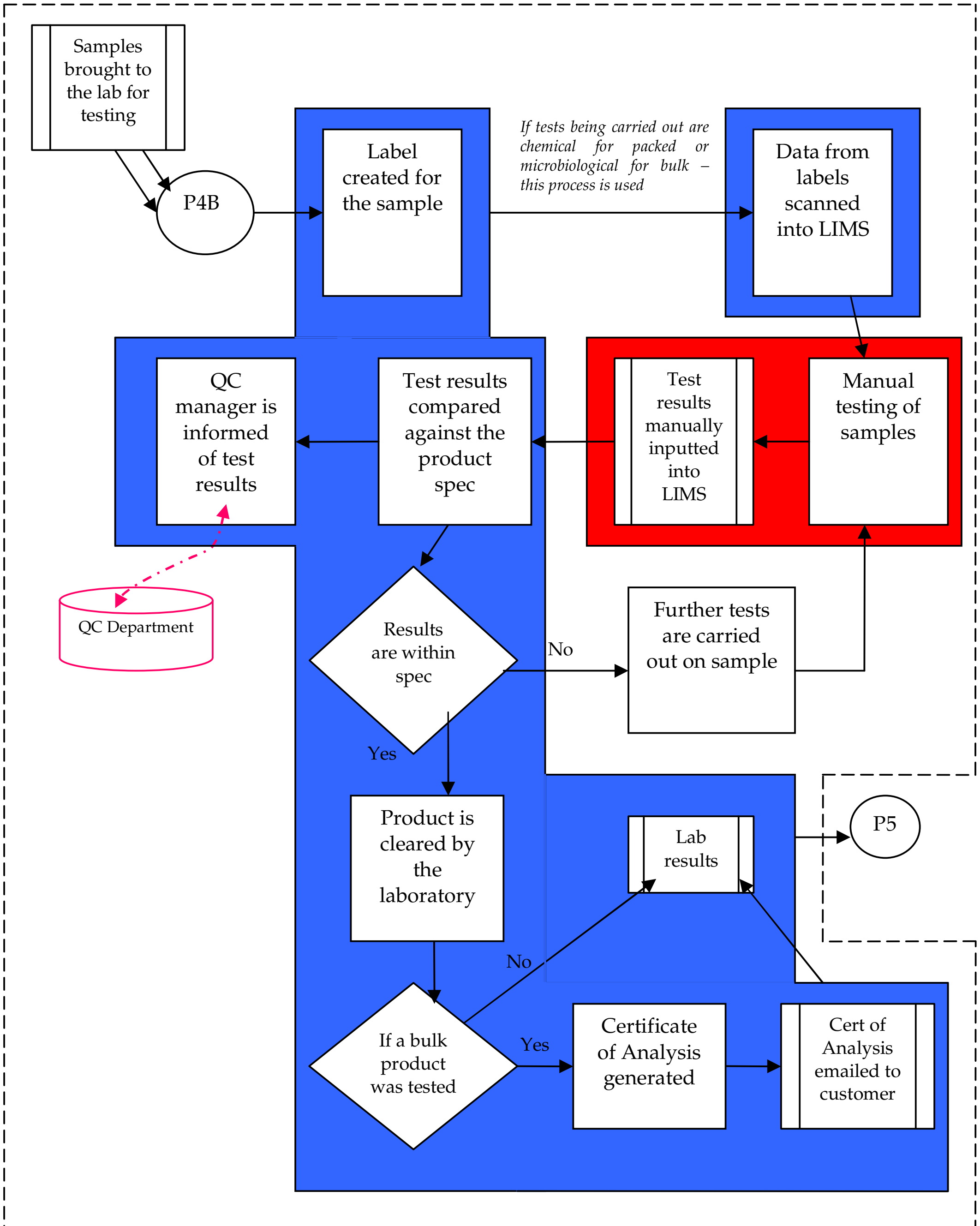
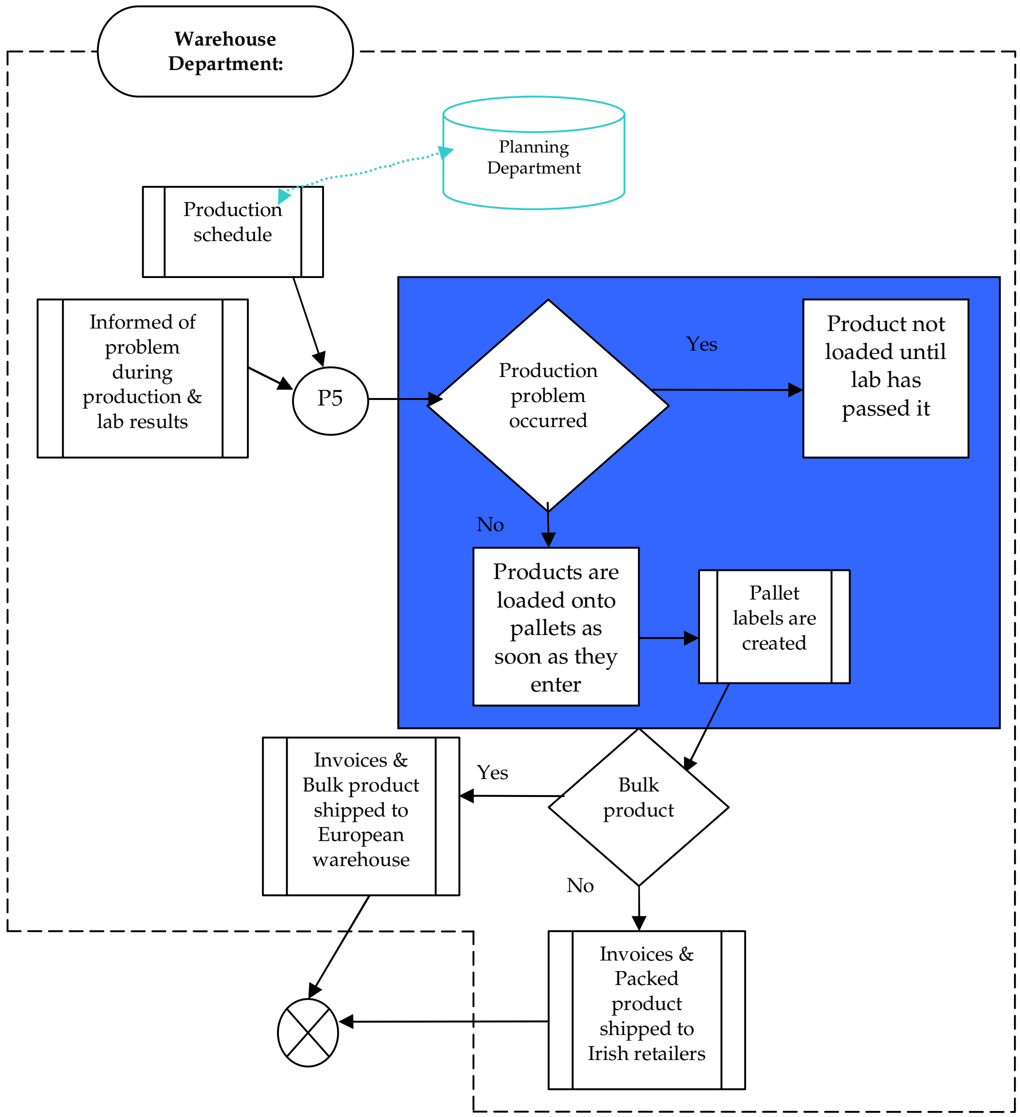


Figure 6.7: Continued



6.3.4 Synopsis of Findings

The key themes of the narrative were summarised as follows.

- Enki used a repetitive requirements elicitation process during development, as Matuta's industry was constantly evolving and so were its requirements.
- Matuta manufactured products for a highly sensitive market that was controlled at every stage by industry standards, thus Enki felt that knowledge of the industry was very important when they were developing Matuta's system.
- Enki used various different elicitation approaches such as, participation, storytelling, observations and knowledge brokering etc. to gather the users' requirements.
- Matuta's old manual system used by Enki to understand the working context of the system and its users and was the initial basis for requirements gathering for their new system.
- Documents of the old system were used by Enki to ensure that they obtained a full understanding of the system currently in use and to develop a clear understanding of the system's role within the organisation.
- Storytelling was used by Enki to uncover the embedded knowledge requirements of the users by comparing the work practices they observed the users carrying out with what the users.
- Lead user involvement was very important for identifying systems requirements as it allowed for the identification of the informal networks in place within the company. They re-directed Enki towards other system users when it was felt that the other user was more of an expert in a certain area.

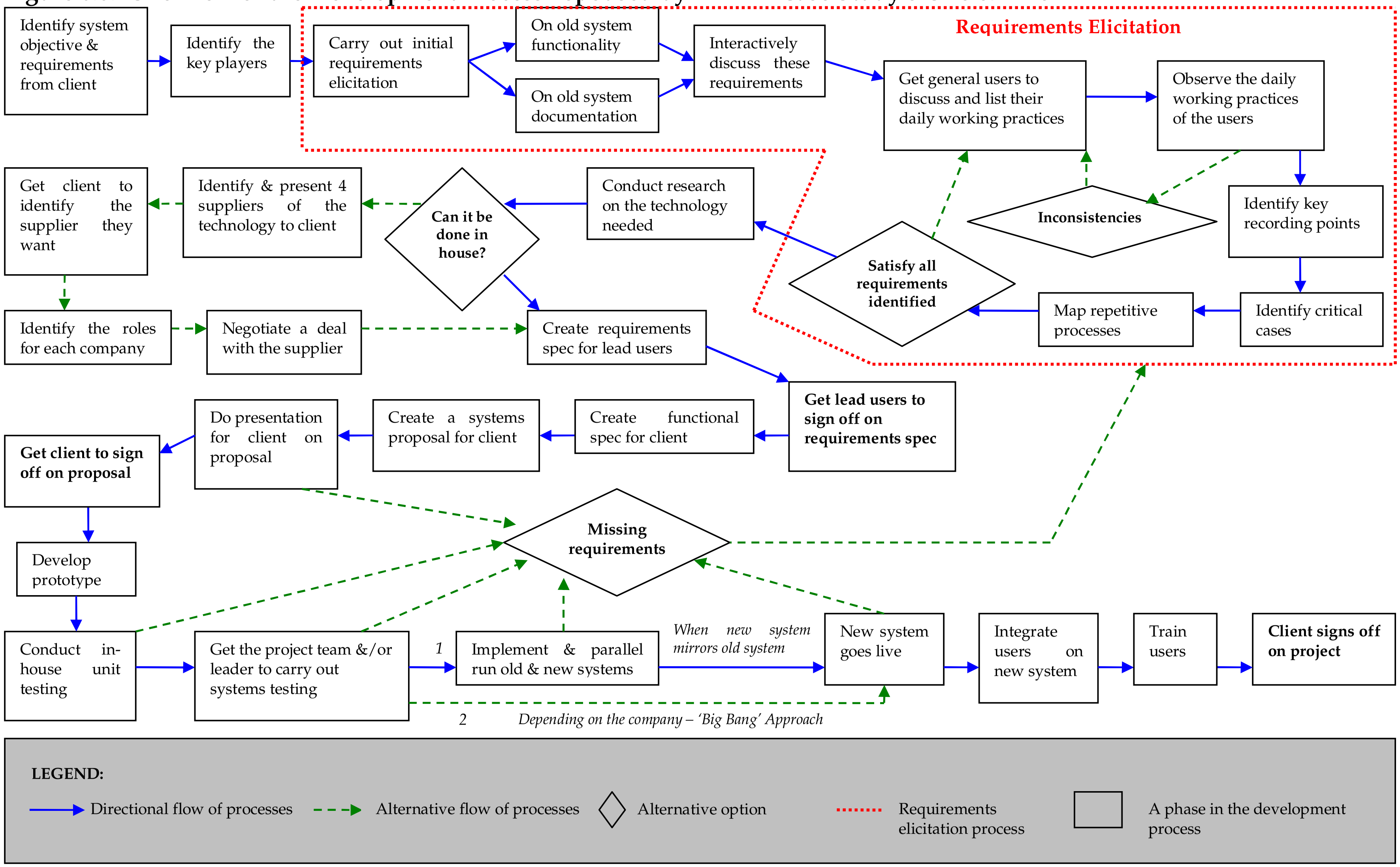
- By identifying the informal networks Enki were able to determine how the users' embedded knowledge flowed between the different communities of practice that existed within Matuta.
- Continuous and frequent interactions and level of lead user involvement in the development process created a strong relationship between Matuta and Enki.
- Participation with the users in their working context was vital for Enki to identify the users' requirements.
- Observations were carried out on the users while they were carrying out their daily work practices.
- The expectations of the lead users were unrealistic. They believed that once they had told Enki what they wanted the system to do and what their requirements where that they would receive a fully functional system.
- Problems occurred between Enki and the lead users as the lead users did not realise they would have to be so heavily involved in the development process. They believed that once they told Enki what they wanted that would be the end of their involvement.
- Matuta's IT department created the role of knowledge broker to act as an interpreter between Enki and the lead users to ensure that the requirements were successfully understood..
- The role of the broker was established to help overcome communications and language difficulties between the development team and Matuta.
- There was a problem with misinterpretation of user requirements by the broker as Matuta's knowledge broker came from the IT department which was controlled by Finance, consequently all user requirements were filtered by the knowledge broker in relation to their costs.
- The knowledge broker caused problems during the development process, namely by limiting Enki's access to Matuta's lead users, causing delays with meetings and cancelling meetings.

- The intensity of the involvement of the general users was very important for the overall success of the system.
- The involvement of the general users was paramount to the development process as it ensured their commitment to and ownership of the system.
- Enki were able to obtain a clear picture of the working practices of the users by getting the users to list their daily functions and, by observing them performing those operations.
- Any inconsistencies between what the general users said and what Enki observed was discussed with them in real-time.
- Observations allowed for the identification of key recording points of the system.
- Identifying Matuta's critical instances was an important step in the development process as it allowed Enki to establish what work practices the users carried out to solve problems as they happened
- Identifying how the users overcame systems failure was another important step in the development process.
- Development of a prototype as early as possible in the development process gave lead users the chance to visualise the new system and to identify any missing functionality.
- During implementation, parallel running was carried out on some elements to ensure that the new system fully supported the working practices of the users. However, Matuta opted not to carry out parallel running on some elements of the new system. Instead, they decided for a 'Big Bang' approach to implementation because Matuta's management wanted a shorter development lifecycle.
- There were problems with this approach to systems development, as it did not give Enki sufficient time to create a thorough understanding of the users' knowledge requirements for the system.

6.4 Conclusion

On the basis of discussions with Enki and the documentation made available, the diagram set out in Figure 6.8 was established as a summary of Enki's view of the development process. This diagram was discussed and modified until Enki's MD agreed that this was their espoused process. However, it was clear from the case studies that Figure 6.8 did not capture nor entirely represent the activities that actually took place during their ISD process. Furthermore, under certain conditions Enki departed from the development process depicted in Figure 6.8 in order to address the users' embedded knowledge needs and employed knowledge transfer processes to capture these requirements. It was evident in both case studies that, the knowledge transfer processes used by Enki focused on the intensity of the developer's participation in the users' working context through their direct involvement of the users in the development process, particularly through personal and constant interaction. This development approach allowed Enki to identify the users' informal networks and knowledge requirements via the knowledge transfer processes of storytelling, observation, reflective practices and brokering in order to develop a strong, personal relationship with the users.

Figure 6.8: Overview of the Development Process Espoused by Enki in Case Study's One & Two



These knowledge transfer processes were successfully utilised by Enki in both cases with two exceptions in Case Study Two. Namely, the process of brokering was not as affective due to the misinterpretation by the knowledge broker of the practice-based requirements of the systems users. Also, the users' organisational environment placed considerable pressure on the development company to shorten its development lifecycle. This affected the elicitation of the users' knowledge requirements for that system.

In conclusion, the findings from both case studies clearly demonstrated that participating in the users' situated practice was an evolutionary process, consisting of iterating knowledge transfer processes in order to ensure the successful elicitation of the users' embedded knowledge requirements for the developed system to incorporate and support.

The next chapter discussed these findings in relation to the existing literature on knowledge transfer and in light of the working propositions presented in Chapter four.

Chapter 7: Discussion

7.1 Introduction

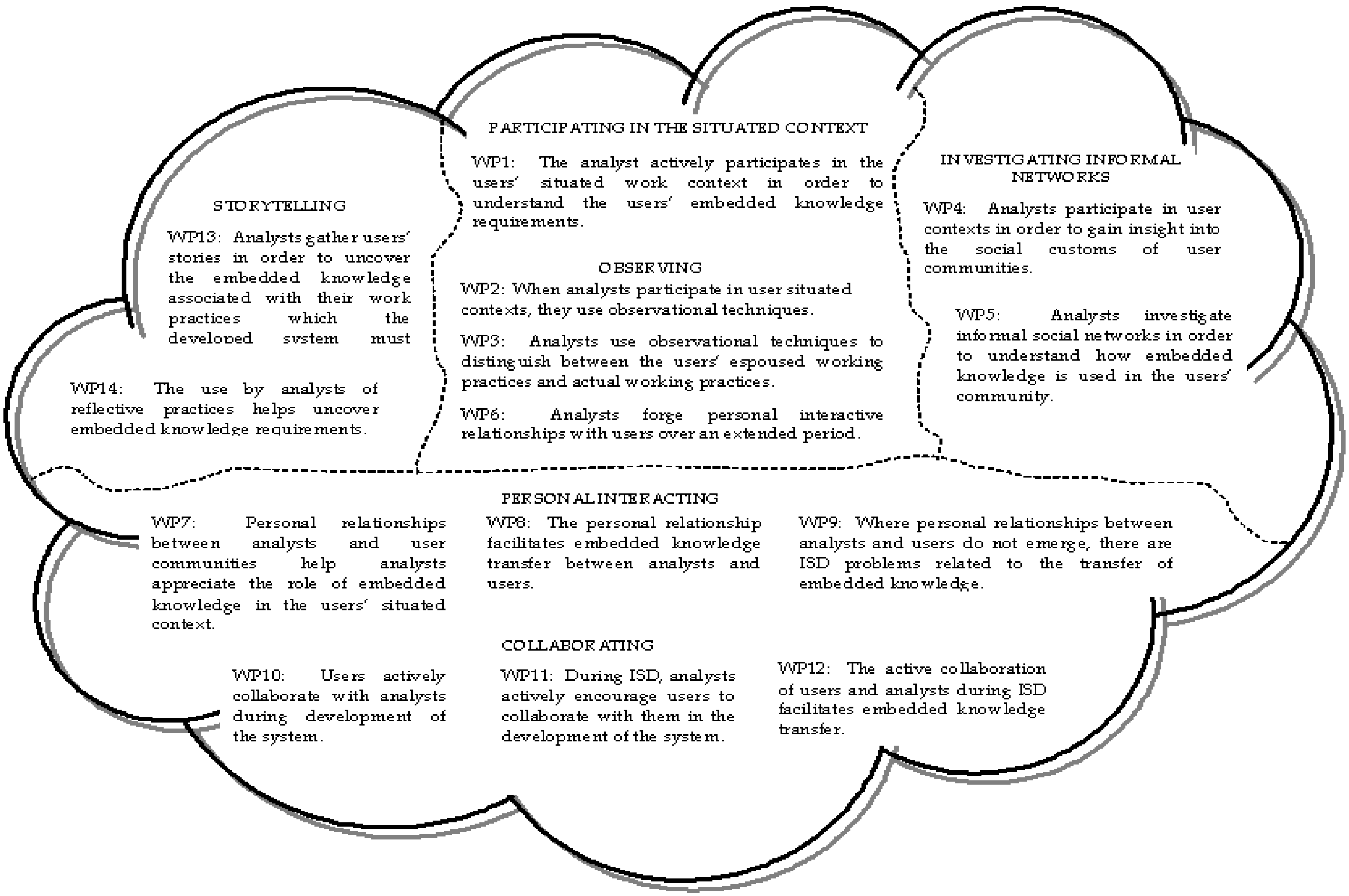
Having presented the research findings with respect to the development process used in the creation of systems for both companies, this chapter endeavoured to explore the implications of these observations within the context of the reviewed literature and the working theory.

This chapter presented a discussion of the findings emanating from Case Study One, followed by a discussion of Case Study Two's findings, based upon the working propositions identified from the literature and presented in Figure 7.1. Next, a comparative discussion of both cases outlining the knowledge transfer processes used by Enki to elicit the users' embedded knowledge requirements within the context of systems development was presented. Finally, the chapter concluded with a model based upon the findings and discussions presented in this study.

7.2 Discussion of Case Study One

The following sections discussed the findings of this study in relation to the literature review presented in Chapter three and the working propositions presented in Chapter four.

Figure 7.1: Conceptual Framework of the Working Propositions identified from the Literature



7.2.1 Participating in the Situated Context

WP1: The analyst actively participates in the users' situated work context in order to understand the users' embedded knowledge requirements.

In §4.2.1 it was argued that, for the analyst to elicit user embedded knowledge requirements they must participate in the users' working context. This was supported by the findings for Case Study One. Enki met with Hathor's management team in their working environment to identify the objectives of the system they were developing and the initial requirements that the company and its industry demanded were met [*§6.2.3.1 Phase 1*]. In §4.2.1 it was theorised that, by engaging with the managers in their working environment Enki would be able to understand the company's strategy and traditions that shaped how their organisational practices were created and carried out by their workers. Through Enki's participation in the manager's working situation, Hathor's organisational strategies were identified. In addition, the opinions and future directions of the company were ascertained, which ensured that the system developed by Enki would be compatible with those views. As §4.2.1 indicated, through Enki's engagement in the situated context of the managers, they were able to identify the manager's belief structures and their attitudes in relation to the system being developed. This was important as it gave Enki the opportunity to ascertain the level of involvement and the role the managers would have in the overall development process. §4.2.1 illustrated that, it was through an understanding of the managers' situated context that Enki would be able to gain an understanding of the managers' embedded knowledge that governed the work practices of the users. Essentially, by participating with Hathor's managers Enki were able to determine what was important to them and the organisation, their general expectations of the system and it gave them the chance to gain an understanding of the professional language that was in place within the organisation.

Following this, Enki met the lead users in order to participate with them in their working context and to determine their system requirements and knowledge needs [*§6.2.3.2 Phase 2*]. For instance, in this case study, Enki began the elicitation of user requirements by examining their system in its working environment. This process was carried out with the development team interacting with the lead users' and observing them while they were performed their working practices. As argued in §4.2.1, by observing the lead users in their context, Enki were better able to understand the functionality of the system. This was an important issue for Enki as they were able to determine what Hathor's managers required from the system. It was through their participation with these users that Enki were able to visualise the practices that the lead users would otherwise not attend to. For Enki this would ensure that all the requirements and knowledge needs of the users would be identified. As discussed in §4.2.1, the analyst could not attend to the world in the same manner as the user and would not know the language of the user. Thus, by participating with the users in their situated context, Enki were able to 'see' on some level how the lead users' created and used their knowledge. Consequently, it allowed Enki to further understand and improve their knowledge of the professional language used by the lead users and Hathor when discussing their working practices, as Enki could associate what the users were talking about with what they were doing. Thus, Enki were able to ascertain the knowledge and practice needs of the lead users within the context of their working environment.

Also, from the findings in Case Study One, it was evident that Enki went down to the general users' place of work and participated in their situated environment in order to identify their requirements for the system [*§6.2.3.3*

Phase 3]. Initially, Hathor's general users walked Enki through their system and explained how they carried out their daily work practices. Enki listened to the users explain their daily operations and what requirements they needed for the system. In addition, they observed the general users performing those working practices while engaging the users in their work environment. As §4.2.1 illustrated, observing the general users performing their functions was necessary for the development team to better understand the knowledge practices of the users in real-time. This was very important for Enki as it allowed them to identify the requirements of the users that they would not generally attend to, thus ensuring that their needs could be successfully supported by the system. In addition, Enki were able to understand the professional language used by these users and associate what they were saying with the practices they were carrying out. §4.2.1 indicated that, by participating in users' situated context, Enki were able to explore the customs, rituals and traditions that enabled the general users to carry out their work practices. This was apparent in the findings of this case study. By participating with the general users in their working environment, Enki were able to identify the work processes that were important to the general users, how these users coped when various different problems arose within the system and any repetitive and critical practices that the users performed.

Enki carried out feasibility tests and created functionality specs to determine what hardware and software were required to develop the system [*§6.2.3.4 Phase 4*]. The reports generated for this stage in the lifecycle was presented to Hathor's management and lead users. As §4.2.1 argued, this would be important for the overall development process as it would ensure that the lead users' and managers' opinions and attitudes concerning the system being developed were listened to and taken into account by the development team when they were designing the system documentation. In Case Study One, if the lead users and managers were unhappy with the functional specifications presented to them, Enki returned to the lead users' and possibly the general users' working environment in order to determine the requirements that they had omitted. Furthermore, any difficulties or errors that arose through a misinterpretation of the company's needs could be highlighted and rectified by the lead users and managers prior to the development of the system.

At the final stages of the development lifecycle if something was deemed missing or inaccurate with the system prototype Enki participated with Hathor's management, the lead users and the general users in order to rectify the problem. For example, Enki implemented the working prototype of the system into the lead users' work environment so that the broker and the lead users could carry out unit testing on it [*§6.2.3.5 Phase 5*]. This process allowed the lead users to examine the potential of the system in their environment and to identify if all their knowledge and practice needs were met. As argued in §4.2.1, through their participation with all parties in their working context, the developers were able to re-phrase and re-question these users over what was missing from the system or what they wanted to change. This was supported in the findings. If requirements were discovered as missing, Enki returned to the context of the users to determine how that need was being fulfilled and how it could be incorporated in the development of the system. Repeating these steps as different problems arose allowed Enki to fully elicit the embedded requirements of the users and ensure that their working practices were fully supported and identified. Moreover, by allowing the lead users to operate the prototype in their working environment Enki were ensuring that the system would support all their working practices and knowledge needs, as the users were given the opportunity to visualise the systems potential and to reflect on their work and knowledge needs.

Finally, once the system was implemented [*§6.2.3.6 Phase 6*], its progress was monitored by Enki while it was operating in Hathor's actual working environment. This was important for the development process as it gave Enki the opportunity to ensure that the system was operating efficiently and meeting the needs of the users. However, with this case study, when the system was implemented into Hathor the lead users identified several requirements as missing from the system. Thus, Enki had to return to the situated context of these users to identify and elicit the omitted requirements. Through a process of participating with users in their situated context – management, lead users and general users – Enki were able to ensure that all the knowledge and practice needs of the users would be supported and incorporated into the development of the system. For this case study, Enki carried out an iterative process of engaging with the system users at every stage of development until they were satisfied that they had identified and elicited all the users' knowledge and practice requirements and that the system supported all those needs.

From the findings of this case study, it was evident that Enki actively participated in the users' situated work context in order to gain an understanding of the users' embedded knowledge requirements. Thus, this working proposition was supported in this Case Study One's findings.

7.2.1.1 Observing

WP2: When analysts participate in user situated contexts, they use observational techniques.

In §4.2.1.1 it was theorised that, the use of observational techniques while participating in the users' situated context would greatly improve the analyst's understanding of the users' working practices and their embedded knowledge. This was supported by the findings for Case Study One. To identify the lead users' system requirements, Enki met with the lead users in their working environment to observe them carrying out their daily practices [*§6.2.3.2 Phase 2*]. Enki felt that this was important as it allowed the lead users to provide them with explanations of what their work practices were and what they required from the developed system.

Additionally, Enki engaged the general users in their situated context to determine what their working practices and system requirements were [*§6.2.3.3 Phase 3*]. The general users physically walked Enki through their work processes, explaining what they did and what would happen while they would carry out their job. Through their use of observational techniques, Enki were also able to identify critical operations and repetitive processes that existed within the system. By observing the general users performing their daily operations and with the users' explanations, Enki were able to gain a better understanding of the working practices that were being performed and the embedded knowledge that was in use.

From the findings of this case study, it was evident that Enki carried out observational techniques while participating in the users' situated context. Thus, this working proposition was supported in Case Study One's findings.

WP3: Analysts use observational techniques to distinguish between the users' espoused working practices and actual working practices.

In §4.2.1.1 it was argued that, through the use of observational techniques, the analyst would be able to differentiate between the users' espoused theories and their theories-in-use. This was supported by the findings for Case Study One. While they participated with Hathor's lead users in their situated context, Enki carried out observational techniques [*§6.2.3.2 Phase 2*].

By listening to the lead users' explanations of these daily operations and by observing them carrying out these functions, Enki were able to visualise the practices that the lead users would otherwise not attend to. Inconsistencies that arose between what the lead users said their work practices were with what Enki observed the users carrying out were explored. As previously discussed in §4.2.1, by refining their questions Enki would then be in a position to ask more direct questions of these users about their knowledge requirements and work practices. For this case, Enki refined their questions to help the lead users reflect on their actual work practices. §4.2.1.1 indicated that, by immersing themselves in the users' situated context supplemented with the use of observational techniques, the analyst would be able to identify the embedded knowledge requirements of the user community. Carrying out observational techniques while participating in the users' context was important, as it allowed Enki to further understand and improve their knowledge of the professional language used by the lead users and the organisation when discussing their working practices, as Enki were able to associate what the users were talking about with what they were doing. Thus, Enki were able to ascertain the knowledge and practice needs of the lead users within the context of their working environment.

Moreover, as Enki engaged the general users in their situated context, the general users walked Enki through their actual practices explaining what they did and why they did [*§6.2.3.3 Phase 3*]. Additionally, Enki observed these users performing their work practices in real time. In §4.2.1.1 it was indicated that, by comparing their observations of the users work practices with what the users said they did Enki would be able to identify the users' embedded knowledge that allowed them to carry out their work practices. By listening and observing the general users performing their daily functions, Enki were able to determine any discrepancies between what the general users said they did in their narratives with the practices they actually carried out. For this case study, Enki refined their questions in order to close any gaps in their understanding of what they had observed with the explanations of the work practices the general users were providing them with. Through their observations and getting the users to reflect on these questions, Enki were able to discover alternative processes used by the general users. §4.2.1.1 argued that by observing these users, the developers would be able to identify the customs, rituals and traditions that these users performed as part of their working practices. By monitoring the general users' operations, Enki were able to discover where the users went to get their information to perform their work practices and what reports were used and filled in with that information. Additionally, through their use of observations, Enki were able to identify the key processes within Hathor's system such as, the key recording points, critical operations and steps for systems recovery. Furthermore, any repetitive processes that occurred within the daily operations of the system were able to be mapped by the developers. Therefore, through their use of observational techniques while they participated with the general users in their situated context, Enki were able to uncover the users' their actual working practices. Hence, Enki were able to ensure that the general users' actual work practices and knowledge needs would be supported by the developed system.

From the findings of Case Study One, it was evident that Enki used observational techniques to distinguish between the users' espoused working practices and their actual work practices. Thus, this working proposition was supported.

7.2.2 Investigation of Informal Networks

WP4: Analysts participate in user contexts in order to gain insight into the social customs of user communities.

From the findings in Case Study One, Enki participated in the users' situated context in order to understand the informal networks at work within Hathor [*§6.2.3.2 Phase 2*]. Through their observations, Enki were able to uncover the frequent and informal interactions between administration staff, production staff and the cheese grader. As §4.2.2 indicated, embedded knowledge was created and used across social networks and by participating with the users at every level, Enki would be able to identify and uncover the social customs that would be utilised by all users within the company and how their embedded knowledge would be utilised to carry out their work practices. This was supported by the findings. By observing these informal interactions, Enki were able to ascertain who the users went to when they required assistance on solving problems or when they needed to obtain advice. Identifying these social customs was important, as it allowed Enki to gain an understanding of how the users' embedded knowledge was transferred within the communities of practice in order for them to carry out their work practices. From the findings it was evident that, these informal networks existed across all user communities within Hathor, from management to lower grade employees. Furthermore, Enki were able to gain an insight into how these informal networks shaped the users' language and their values. As the findings indicated, Hathor's culture and the language they used to discuss problems and solutions was explored by Enki. For instance, Enki's investigation of the users' informal networks was paramount, as the users talked differently and in a diverse language depending on who they were talking to at that particular moment in time. Therefore, by observing who the users interacted with at an informal level gave Enki the opportunity to identify these differences and determine what the users deemed important for their work practices to be successfully carried out. By participating in the users' situated context and carrying out observational techniques, Enki were able to identify and explore the users' social customs.

Therefore, the evidence supported this working proposition.

WP5: Analysts investigate informal social networks in order to understand how embedded knowledge is used in the users' community.

In §4.2.2 it was argued that, investigating and talking to the users would be important as it would show the knowledge transfer flows between the users. This was supported and illustrated in Case Study One's findings. Hathor's informal networks were initially identified by their management team [*§6.2.3.2 Phase 2*]. Hathor's managers named who the lead users of their system were and who Enki needed to talk to first in relation to the users' system requirements. Furthermore, at various stages in the development process, Hathor's lead users singled out other key system users that Enki should talk to and who should be involved in the project. For example, the production manager identified the production supervisor as a lead user for the development of the production system. In addition, Hathor's lead users were ensuring that Enki talked to the user who they informally deemed the expert in that area and who held the knowledge that Enki needed to understand. By allowing Hathor's management team and lead users to identify other key system users to be involved in the development lifecycle, Hathor were distinguishing for Enki the people who have a mastery over certain areas of specialised knowledge that Enki would need the new system to support.

As §4.2.2 indicated, by identifying these internal knowledge transfer flows, Enki would be ensuring that the system would support the informal embedded knowledge transfer processes that were at use within Hathor's user communities. This was illustrated in this case study. Enki investigated the informal networks at place within Hathor and, Hathor's management and lead users identified who they believed was the expert in specific areas that Enki needed to include in the development process. Additionally, through observations, Enki were able to understand how embedded knowledge was utilised and transferred amongst the users in the different communities.

From the case study's findings, this working proposition was supported.

7.2.3 Personal Interacting

WP6: Analysts forge personal interactive relationships with users over an extended period.

In §4.2.3 it was theorised that, continuous personal interaction between Enki and the system users would ensure that a close relationship could be established. This was supported by Case Study One's findings. Initially, Enki interacted with Hathor's management team in face-to-face interactive, interview sessions [*§6.2.3.1 Phase 1*]. By using a process of face-to-face, continuous interaction with Hathor's managers, Enki were able to form an intimate relationship between them and the management team. As Table 6.1 depicted, the development of Hathor's Cheese Production and Management System took 7 years to complete. Thus, by continuously interacting with Hathor's management throughout the entire development process, Enki were able to maintain their personal relationship with Hathor's management team.

In addition, Enki formed personal relationships with the lead users during the development process [*§6.2.3.2 Phase 2*]. Through their participation with the lead users' in their working environment, Enki were able to maintain personal contact with these users as they were actively involved in the development process for the duration of the 7 years. For instance, whenever, problems emerged or requirements were deemed missing, Enki interactively discussed these with the lead users and together they came up with a solution to overcome these difficulties.

Furthermore, Enki interacted with the general users of the system [*§6.2.3.3 Phase 3*]. In order to identify their system requirements, Enki interviewed the general users individually and listened to their needs and suggestions. In addition, interactive group discussions were carried out with the general users to identify any further requirements that the user community as a whole felt were important for the system to meet and support their knowledge and practice needs. By interacting with these users, Enki were able to understand what practices were important to them and the embedded knowledge required by the general users when carrying out their practices. Consequently, through their personal interactions with Hathor's general system users, Enki developed personal relationships with them throughout the 7 years it took to develop the entire system.

From these findings, it was apparent that Enki forged personal relationships with Hathor's system users – the management team, the lead users and the general users – for the duration of the development lifecycle, which for this case study was 7 years (Table 6.1).

Thus, this working proposition was supported by Case Study One's findings.

WP7: Personal relationships between analysts and user communities help analysts appreciate the role of embedded knowledge in the users' situated context.

In §4.2.3 it was argued that, through their participation in the users' situated context and the emergence of personal relationships with the users, Enki would have a greater appreciation of the users' embedded knowledge needs. As the findings for Case Study One illustrated, Enki participated with Hathor's managers and carried out interactive, face-to-face interview sessions with them [*§6.2.3.1 Phase 1*]. During these interacting processes, Enki were able to determine what was important to the Hathor and its managers, their reactions to various problems the company was experiencing with the system, what their working practices were and what was important to them and Hathor. Thus, Enki were able to gain a greater understanding of the embedded knowledge used by Hathor's managers and its role within the organisation.

As argued in §4.2.3, for embedded knowledge to be successfully transferred some form of personal relationship must occur between the user and the developers in order for the developer to identify what requirements the users deemed important. Enki met Hathor's lead users and participated with them in their situated context to determine their system requirements and knowledge needs [*§6.2.3.2 Phase 2*]. To understand the lead users' requirements, Enki examined the system with the lead users providing them with explanations of what was happening and the rationale behind their working practices. It was through their participation with the lead users that Enki were able to visualise the work practices that the lead users would not realise they were carrying out. Enki then discussed these issues with the lead users in interactive whiteboard sessions in order to further understand their system and embedded knowledge requirements. The personal relationship that had emerged from Enki's interactions with the lead users enabled Enki to understand and appreciate what the lead users' knowledge and practices were; what assumptions and beliefs were important to each of them, how they carried out their practices and their reactions to different situations when problems arose.

Furthermore, Enki interacted with the general users of the system [*§6.2.3.3 Phase 3*]. In order to identify their system requirements, Enki went down to the general users' situated context and interviewed each user individually. The general users physically walked the analyst through their work processes explaining as they went what their work practices were. During this walk through Enki were able to visualise their working practices and identify the embedded knowledge at use. Interactive group discussions were also carried out with the general users to ensure that Enki fully understood the general users' needs and the embedded knowledge inherent within their working practices. Thus, through the formation of a personal relationship with the general users, Enki were provided with the opportunity to be walked through the general users' practices step-by-step until they understood the embedded knowledge being utilised by these users.

It was apparent from the findings that, personal relationships between Enki and Hathor's users allowed Enki to appreciate the role embedded knowledge played in the users' situated context. Thus, this working proposition was supported by the findings from Case Study One.

WP8: The personal relationship facilitates embedded knowledge transfer between analysts and users and
WP9: Where personal relationships between analysts and users do not emerge, there are ISD problems related to the transfer of embedded knowledge.

§4.2.3 theorised that, personal relationships would be likely to establish a common knowledge base between Enki and Hathor's users, which in turn would facilitate embedded knowledge transfer between both parties. From the findings in Case Study One, Enki continuously interacted with Hathor's managers for the duration of the entire development process [*§6.2.3.1 Phase 1*]. These interactions with Hathor's managers were carried out via face-to-face interactive, interview sessions. During these interacting processes, Enki were able to determine what values were important to the Hathor and its managers, how they coped when problems arose. Enki were also able to ascertain the problems the company was experiencing with their system, and what their working practices were. As §4.2.3 argued, the creation of shared principles, basic similarities and a common language between the users and Enki would ensure that embedded knowledge would more likely to be transferred successfully. Thus, by participating and interacting with these users, Enki were able to gain an understanding of the professional language that was in place within the organisation, which in turn, allowed them to successfully communicate their understanding of Hathor's needs back to the management team for them to verify that the organisation's requirements would be met.

Additionally, Enki met Hathor's lead users and participated with them in their situated context to determine their system requirements and knowledge needs [*§6.2.3.2 Phase 2*]. To understand the lead users' requirements, Enki examined the system with the lead users who provided them with explanations of what was happening and the rationale behind their working practices. Enki also carried out interactive whiteboard sessions with these users in order to further understand their system and embedded knowledge requirements. Throughout these sessions, diagrams were used to explain the working practices of the users and what they required from the system. These requirements were then discussed between the lead users and Enki in order to determine what requirements Hathor wanted the system to meet and support. By carrying out these interactive discussions, Enki ensured that extensive feedback occurred between these users in order to get them to reflect on their current system problems, needs and future requirements, thus ensuring that Enki had a good understanding of their system and its requirements. By participating in the situated context of the lead users and personally interacting with them, Enki were able to gain an understanding of what their working practices were and the embedded knowledge at use.

However, as §4.2.3 argued, without a common coding scheme, language difficulties, misperceptions and misinterpretations can arise which would result in a less efficient knowledge transfer process occurring between the developer and the users. While Enki continuously interacted with these users, problems did arise in relation to their understanding of the users' requirements. This was caused by Enki not knowing the professional and industry terminology that the lead users employed in their daily life. Thus, to facilitate and ensure good communications between Enki and the lead users, Hathor's managers set up the role of a knowledge broker [*§6.2.3.2 Phase 2*]. The broker's responsibility was to ensure that a solid trustworthy relationship flourished between the lead users and the Enki. In order to develop a personal relationship between both companies, the broker set up various face-to-face meetings, telephone interviews and interactive discussions. In addition, the broker acted as an interpreter for both the lead users and Enki. The lead users knew what they required from the system but were explaining it in their own professional language, which Enki did not comprehend. Accordingly, Enki were communicating their understanding of the systems' requirements back to the lead users in their technical language, which Hathor's lead users could not understand. Thus, the knowledge broker acted as a two-way point of communications between both the lead users and the developers, as the broker could speak, interpret and explain the languages of both the lead users and Enki to the other party.

Actively working with the lead users and the knowledge broker via formal and informal meetings gave Enki and Hathor's lead users the opportunity to further develop a personal relationship with each other. For both companies, listening and communicating were seen as essential ingredients not only for the elicitation of the systems' requirements but also as the foundation of their relationship. As mentioned previously, due to the informal communications structure in place within Hathor, all lead users were actively encouraged by management to contribute to the development of the system, voice concerns and make suggestions on how the system could be improved for the benefit of their working practices and the company itself. The development of their personal relationship ensured that Enki got the cooperation it needed from Hathor's lead users and, the lead users were guaranteed that their ideas and input would be listened to and incorporated, if possible, into the developed system. Therefore, through a personal and continuous interaction process, the requirements and needs of the systems' lead users were explained and successfully interpreted by Enki through the use of Hathor's knowledge broker.

Personal relationships were also formed between Enki and Hathor's general users [*§6.2.3.3 Phase 3*]. As §4.2.3 argued, personal contact would be likely to improve the transfer of knowledge between the analyst and users. This was supported by the findings. In Case Study One, Enki participated with these users in their work environment and they physically walked through the work processes the general users performed. Explanations of what was happening and the rationale behind these actions were provided. By observing the users performing their work practices during the walkthrough, Enki were able to identify the users' needs and requirements. In addition, problems the general users were having with the system and suggestions on how Enki might improve their work practices were also made. Individual interviews and interactive group discussions were also carried out with the general users to identify any further requirements that their community felt the system should meet and support. Thus, by personally interacting with the general users, Enki were able to understand what practices were important to them and the embedded knowledge required by the general users to carry out their practices.

Personal and frequent interactions between Enki and the lead users were reiterated throughout the development lifecycle. For example, Enki interacted with Hathor's managers and lead users by presenting their report of the functional specifications for the system to be developed [*§6.2.3.4 Phase 4*]. All parties actively discussed the requirements presented in Enki's report of the system and unless Enki were confident that Hathor was satisfied that the requirements presented to them and discussed would meet and support all their knowledge needs and practice requirements, Enki would not begin developing the system.

Again, personal interaction was a significant process for Enki once the prototype had developed Hathor's prototype [*§6.2.3.5 Phase 5*]. Enki interacted with Hathor's knowledge broker and lead users while the lead users were carrying out unit testing on the system. Informal interview sessions were used by Enki, which provided the lead users with the opportunity to reflect on the prototype and question Enki about the system. Enki were provided with feedback regarding whether or not the system would meet and support Hathor's working practices. For this case study, Hathor's lead users did identify missing requirements. An interactive meeting was established between Enki's developers, the lead users and Hathor's knowledge broker to identify the source of the problems and possible solutions to rectify the situation. These discussions were on-going until Enki and Hathor's lead users were satisfied that the omitted requirements would be incorporated into the development of the system.

Finally, personal interactions played a significant part in the development lifecycle once Enki had implemented the system, as Hathor's lead users had identified several requirements that were omitted from the system [*§6.2.3.6 Phase 6*]. Thus, Enki had to return to the requirement elicitation phases to determine what was overlooked and how they could be incorporated into the system. Enki met with Hathor's lead users and through interactive meetings, the lead users discussed with Enki the problems they were experiencing with the system and possible solutions that could be implemented to rectify these difficulties. These interactions were on-going until Enki and the lead users were satisfied that no further problems with the system were forthcoming and that all Hathor's embedded knowledge and practice needs had been successfully transferred and were supported by the system.

From the findings of Case Study One, it was evident that personal relationships facilitated embedded knowledge transfer between Enki and Hathor's users. Thus, this working proposition was supported.

From this case's findings, although personal relationships did emerge between Enki and the lead users, ISD problems did exist in the form of language and communications difficulties. To overcome these problems, the findings demonstrated the use of a knowledge broker as an interpreter and a two-way communications channel between Enki and the lead users.

Thus, there was insufficient evidence to support this working proposition.

7.2.3.1 Collaborating

WP10: Users actively collaborate with analysts during development of the system.

§4.2.3.1 argued that, personal interaction coupled with collaboration from both parties would result in strong ties, which in turn, would increase the time and effort the analyst and the user would be likely to ensure a successful transfer of embedded knowledge between them. From the findings in Case Study One, it was apparent that the users' actively collaborated with Enki at every phase of the development lifecycle. For instance, Enki and Hathor's managers collaborated together to identify the initial requirements of the system [*§6.2.3.1 Phase 1*]. As previously illustrated, Enki and the management team had personal interactions in the form of face-to-face interactive, interview sessions where discussions ensued surrounding the problems they were experiencing with their system, how they coped with these problems and, what their working practices and business strategies were. By continuously interacting and collaborating Hathor's management team in the initial stages of the development process, Enki were able to create a strong bond between the managers and the development process. For Enki this was important as it ensured the managers' co-operation and support throughout the entire development lifecycle.

Enki also actively collaborated with the lead users and Hathor's knowledge broker throughout the ISD process. Initially, Enki participated with the lead users in order to understand and identify their work practices [*§6.2.3.2 Phase 2*]. The lead users collaborated in the development process by actively assisting Enki in identify and eliciting their embedded knowledge requirements and in ensuring that Enki understood their work practices. As previously illustrated, Enki examined and observed the lead users carrying out their daily practices. The lead users explained what was occurring within that practice and the rationale behind any decisions that were made. As the findings illustrated, strong ties and personal relationships were created between Enki and the lead users through their intensive interactions and the lead users' involvement in the development process. Therefore, through the lead users' collaboration in the development process and continuous interactions between the lead users and Enki, the requirements and needs of these users were explained and successfully interpreted by Enki through the use of Hathor's knowledge broker.

Moreover, the general users of the system collaborated in the development process [*§6.2.3.3 Phase 3*]. As previously illustrated, the general users walked Enki through their entire work processes, explaining as they went what was occurring within that practice and the reasoning behind any decisions that were made. It was through Enki's collaborations with Hathor's general users that strong ties began to emerge between these users and the development process. As the findings illustrated, Enki felt that if the general users turned against the system, the result would be a failed system that would never be used. Enki ensured that the general users had the opportunity to contribute and feel part of the development process. Thus, these users were actively encouraged by Enki to collaborate to the development process and, both individual and group interviews were carried out with the general users identify what was important to them.

Additionally, Hathor's lead users collaborated with Enki during the final phases of the development lifecycle. For instance, once Enki had developed Hathor's prototype, Enki collaborated with Hathor's broker and lead users so that they could carry out unit testing on it to check that all their practice and knowledge requirements were met and supported by the system [*§6.2.3.5 Phase 5*]. As theorised in §4.2.3, the more committed the users become to the development process, the more time and effort they would be likely to put into ensuring that Enki understood their working practices and embedded knowledge requirements. This was supported by the findings, as Enki's interaction with the lead users at this stage was carried out as informal interview sessions. This gave the lead users the opportunity to question Enki about the system and interactively discuss their feelings about the prototype. It also allowed the lead users to provide Enki with feedback regarding whether or not all their knowledge and practice needs were supported by the prototype. This was important for Enki as the lead users were committed to the successful development of the system and they placed great emphasis on ensuring that the system met all their needs and supported their working practices. Finally, if requirements were deemed missing once the system had been implemented into Hathor [*§6.2.3.6 Phase 6*] then Enki collaborated with the lead users to determine what problems they were experiencing and how they could be overcome.

From the findings of Case Study One, it was apparent that Hathor's users actively collaborated with Enki during the development of their system. Thus, the evidence supports this working proposition.

WP11: During ISD, analysts actively encourage users to collaborate with them in the development of the system, <u>and</u>
WP12: The active collaboration of users and analysts during ISD facilitates embedded knowledge transfer.

§4.2.3.1 theorised that, Enki would be able to ensure that the users' working practices and embedded knowledge requirements would be supported by the developed system, if the users actively collaborated in the development process. This was supported by the findings of Case Study One. For instance, Enki actively encouraged Hathor's management team to collaborate in the development process [*§6.2.3.1 Phase 1*]. The managers were encouraged to openly discuss their requirements and needs with Enki in interactive face-to-face interview sessions until Enki understood their embedded knowledge requirements.

Enki also actively encouraged Hathor's lead users to collaborate in the development process [*§6.2.3.2 Phase 2*]. The lead users explained in detail their working practices of the system while Enki participated with them in their working environment. They performed their work practices under Enki's observations and they candidly discussed any discrepancies that arose between their espoused theories and their theories-in-use concerning their daily practices. Through the use of these methods, Enki were able to ascertain what the lead users required from the system and what their working practices and embedded knowledge needs were. In addition, Hathor's general users were encouraged to collaborate in the process [*§6.2.3.3 Phase 3*]. Enki actively sought suggestions from the general users on improvements that could be made to the system. The general users also physically walked Enki through their work practices while Enki observed them performing their daily operations. Thus, allowing Enki to understand their embedded knowledge requirements and needs for the developed system.

Moreover, Hathor's lead users continued to collaborate with Enki in the final stages of the development process. The lead users collaborated with Enki to carry out unit testing on the developed prototype to ensure that it met all their practice and knowledge requirements [*§6.2.3.5 Phase 5*]. They openly questioned Enki about the system and discussed their feelings about the final system and changes they would like to see to it. This was important to the development process as the lead user were able to visualise whether Enki had understood and correctly interpreted their embedded knowledge needs and work practices. It also provided the lead users with the opportunity to see what the final system would like. Additionally, if the lead users identified requirements as missing once the system had been implemented into Hathor [*§6.2.3.6 Phase 6*], they again collaborated with Enki to discuss what problems they were experiencing with the system and how they could be overcome. Thus, Enki were ensuring that the lead users' embedded knowledge requirements and needs were being successfully met and supported by the system through their active encouragement of the users collaboration in the development process.

From these findings, it was evident that Enki actively encouraged Hathor's users to collaborate in the development of their system. Thus, this working proposition was supported by Case Study One's findings.

Also the active collaboration of the users with Enki in the development process ensured the successful understanding and interpretation of their embedded knowledge needs and requirements. Thus, the evidence supported the second working proposition.

7.2.4 Storytelling

WP13: Analysts gather users' stories in order to uncover the embedded knowledge associated with their work practices which the developed system must support.

For Case Study One, Enki used storytelling at different stages during the development to gather the users' embedded knowledge requirements. For instance, it was first used by Enki to identify the requirements and overall objectives for the system for Hathor's management team. Enki listened to the managers' stories in interactive sessions [*§6.2.3.1 Phase 1*]. Hathor's managers explained to Enki the problems they were experiencing with their system and reflected on the objectives and requirements they wanted for the developed system. In §4.2.4 it was theorised that, storytelling allowed the users to rationally explain their theories-in-action and how they handled relationships within the organisation, both between other users and the system. From the findings of Case Study One, this process was important for the development of the system, as it allowed Hathor's managers to confirm their theories in relation to Hathor's overall strategies and vision, what the system was for, its objectives and their requirements for the new system. Through the use of storytelling Enki were able to determine the relationship structures that were in place within Hathor, particularly through the interconnections between the characters in the story and their relationships with others within the organisation. As §4.2.4 argued, the use of stories would also afford Enki the opportunity to understand how the users' working practices were established and how they overcame past exploits and problems. From the case study, Enki were able to identify these underlying principles and assumptions that were guiding the development of the system and the organisation in general. Consequently, Hathor's managers were transferring to Enki their embedded knowledge about the concepts that were important to them and Hathor and their perspectives of the organisational work practices that their employees performed.

Enki again used the process of storytelling to identify and elicit the requirements of the lead users of the system [*§6.2.3.2 Phase 2*]. As §6.2.3.2 indicated, these stories emerged through the use of diagrams, interactive whiteboard sessions and in-depth interviews. By listening to the lead users' stories, Enki were able to identify problems they were experiencing with the system and how these were overcome. These stories allowed Enki to understand how the practices at use within the user community were formed (see §4.2.4). This in turn, allowed Enki to identify how the users' practices came about through the stories' characters' interactions with the system and each other. Additionally, the knowledge flows that existed between users within the community could also be identified. As §4.2.4 indicated, the lead users were able to transfer their embedded knowledge to Enki through the process of storytelling, thus Enki were able to gather their embedded knowledge requirements for the system.

This process was reiterated by Enki when eliciting the requirements of the Hathor's general system users [*§6.2.3.3 Phase 3*]. As described in §6.2.3.3, the general users walked Enki through their work practices, all the time describing the story of what happened as they carried out their job. As §4.2.4 indicated, storytelling would give Enki the opportunity to explore the general users' logic, assumptions and behaviour that they adopted when problems were encountered and when different situations arose. In Case Study One, Enki listened as explanations were given about how the general users overcame problems and made decisions. It also provided the general users with the opportunity forum to make suggestions on how Enki could improve their working practices. This allowed Enki to identify the embedded knowledge requirements inherent within the stories that enabled the general users to carry their work practices.

From Case Study One's findings, it was evident that Enki gathered Hathor's stories from management, the lead users and the general users to uncover the embedded knowledge associated with their work practices which the developed system must support. Thus, this working proposition was supported in the finding from this case study.

WP14: The use by analysts of reflective practices helps uncover embedded knowledge requirements.

From the findings in Case Study One, Enki used reflective practices when carrying out storytelling to help discover the lead user's embedded knowledge requirements [*§6.2.3.2 Phase 2*]. As §4.2.4 argued, it was through interruptions and clarifications that Enki would be able to challenge the lead users' stories and identify the existence of embedded knowledge. Within Case Study One, Enki provided Hathor's lead users with the opportunity to fill in gaps in their understanding of the users' stories [*§6.2.3.2 Phase 2*]. Thus, questions were put to the lead users in further data collection techniques when Enki failed to comprehend something the lead users had discussed in their stories. In addition, Enki provided the lead users with the opportunity to reflect upon their stories and the system documentation. This reflection provided the lead users with greater insight into what they required from the system as it challenged them to be more accurate concerning their work practices and in turn provided Enki with a more realistic understanding of system requirements and the lead users' requirements. Through reflection, Enki were provided with a more coherent story that in turn allowed the developer to obtain a greater understanding of the users' embedded knowledge needs. As §4.2.4 suggested, Enki then compared different versions of the same story and presented the users were any inconsistencies that arose. These differences were clarified by the lead users through discussions and refined questioning. In addition, based upon the observations carried out during this phase in the development process, Enki were able to compare the stories with the practices they had observed the users performing. By comparing the lead users' stories about their practices, with Enki's observed practices, Enki were able to uncover further existence of embedded knowledge. Through an additional process of reflection, Hathor's lead users were able to clarify for Enki what their working practices were and the embedded knowledge inherent within their stories. As §4.2.4 highlighted, it was through reflection and reconstructing the past to take into account these discrepancies that Enki were able to uncover the a complete set of the lead users' embedded knowledge requirements, which the developed system must support

This process was reiterated by Enki when eliciting the requirements of the Hathor's general system users [*§6.2.3.3 Phase 3*]. By comparing different versions of the general users' stories, Enki were able to determine any differences between the narratives. As previously discussed in §4.2.4, by carrying out reflective practices and comparing the stories with what was observed, Enki would be able to provide the general users with the opportunity to reflect on any inconsistencies that arose between the different versions of the stories and the working practices they observed. This was supported in the findings. Upon presenting these inconsistencies to the general users and allowing them to reflect upon these inaccuracies, Enki were able to uncover embedded knowledge within the stories. In addition, by listening to the general users' stories, Enki compared the stories to the work practices they had observed the users performing. Using these processes enabled Enki to uncover any embedded knowledge that was inherent within the general users' stories pertaining to their work practices and system requirements.

From the findings of Case Study One, Enki used reflective practices when listening to the lead and general users' stories and comparing them to the observed working practices of these users to help uncover their embedded knowledge requirements. Thus, this working proposition was supported by the findings in Case Study One.

7.3 Discussion of Case Study Two

The investigation into what knowledge transfer processes were used by the systems developers when eliciting the users' embedded knowledge requirements into the development of system was the central theme of this case study. The following sections discussed the findings of Case Study Two within the context of the literature review presented in Chapter three and the working propositions presented in Chapter four.

7.3.1 Participating in the Situated Context

WP1: The analyst actively participates in the users' situated work context in order to understand the users' embedded knowledge requirements.

In §4.2.1 it was theorised that, in order for Enki to elicit user embedded knowledge requirements they must participate in the users' working context. This was supported by the findings for Case Study Two. Initially, Enki participated with Matuta's management in order to identify their system requirements and its overall objective [*§6.3.3.1Phase 1*]. As argued in §4.2.1, by participating with the managers, the developers would be able to gain a greater understanding of the users' language and thus, be able to identify the strategies that have been employed in the company and the customs and traditions in use. Matuta's managers developed the initial specifications for the system and gave them to Enki to review. After examining these documents, Enki were able to engage the management team more directly concerning their knowledge and practice needs, as they could compare what Matuta wanted from the system with what the managers had incorporated into their specification documents. Through their participation with the managers, Enki were able to gain an understanding of their business strategies and its traditions that helped shape the creation of the organisation's practices. Hence, by exploring the opinions and future directions of Matuta Enki were able to ensure that the developed system would be compatible with these future organisational needs. In addition, by participating with the managers Enki could observe and identify how

Matuta's managers perceived and assisted in the creation of the organisation's work practices. §4.2.1 argued that, by participating in the users' context, the development team would be able to identify the attitudes and beliefs that impacted upon the organisation and the environment the system was to be developed for. For Case Study Two this was very important. Through Enki's participation with Matuta's managers they were able to identify the underlying values and code of practice that affected all facets of the organisation and how they interacted with each other and with other organisations. By determining and understanding these issues Enki were able to develop the system to ensure that the system would not negatively impact upon these needs but would meet and support them.

Following this, Enki met with Matuta's lead users to identify and elicit their knowledge and practice requirements [*§6.3.3.2Phase 2*]. To determine their system needs Enki participated with these users in their working context. With this case study, Enki began the process by examining the system currently in use by the lead users in its working environment. This allowed Enki to interact and communicate with the lead users about their practices while they were being carried out in real time. As §4.2.1 argued, by observing the lead users performing their working practices, Enki would be able to better understand the functionality of the system. It was through their observations of the system and the lead users working practices that Enki were able to explore in detail the system that was in place within Matuta, its functionality, what the lead users' practices were and what was required from the system. Additionally, by observing the users performing their working functions in their situated context, Enki were able to determine where the problems with the system were and how the lead users overcame these. §4.2.1 indicated that, observations of the users carrying out their working practices in real time would afford Enki a greater understanding of what was required from the system to meet and support those needs.

Participating with the lead users gave Enki the opportunity to identify and explore the knowledge and work requirements that Matuta's lead users could not attend to, that is, the practices that were completely ingrained and embedded in their daily operations. This opportunity also enriched Enki's understanding of Matuta's professional language by associating what the lead users wanted with what they were doing through their participation and observations of the lead users' situated context. Thus, Enki's participation in the lead users' situated context enabled them to identify the working practices and embedded knowledge needs of the lead users that the developed system needed to support.

Next, Enki carried out an analysis of the needs of the general users of the system [*§6.3.3.3Phase 3*]. Enki went down and participated with these users in their working context in order to elicit their practice and knowledge requirements. Matuta's general users began by walking Enki through their system, explaining to them how their work practices are carried out and what they require from the system to fulfil these functions. Then, Enki observed the general users performing their practices. As argued in §4.2.1, opportunities to observe the users carrying out their practices within their situated context would greatly improve the developer's understanding of the working practices place and the embedded knowledge utilised to carry out those practices. This was important as it gave them the opportunity to better understand the knowledge practices of the users while they were carrying them out. It also allowed Enki to visualise the requirements that the general users would not generally attend to. In addition, by engaging the general users in their situated context, Enki were able to gain a thorough understanding of the professional language at work within their context. As §4.2.1 indicated, by participating in users' situated context, Enki were able to explore the customs, rituals and traditions that enabled the general users to carry out their work practices. From the findings of Case Study Two, Enki were able to identify the work processes that were important to the general users, how these users coped when various different problems arose within the system, Matuta's key recording points, critical operations and the users' steps for systems recovery. Furthermore, the repetitive processes within Matuta's system were identified and mapped by Enki. Thus, by participating with the general users in their situated context Enki were ensuring that their work practices and knowledge needs would be fully identified and supported by the developed system.

Once Enki had identified the requirements of the general users, they created feasibility tests and functional specifications for the system [*§6.3.3.4Phase 4*]. These were then presented to Matuta's managers and lead users to determine if all the organisation's needs were met. As §4.2.1 argued, the attitudes and opinions governing the users' rituals, traditions and customs concerning how they carried out their practices could be identified. In this case study, if Matuta's managers or lead users were dissatisfied with these reports or were not sure that the system would fulfil all their requirements, Enki returned to the lead users' and possibly the general users' situated contexts in order to identify the requirements that were missing or any processes that they were told had been overlooked. This was a necessary phase for the development lifecycle as it guaranteed the lead users and managers that the developed system would meet and support all their practices and knowledge requirements. As the findings for this case illustrated, Enki listened to and included these needs into the design documentation in order to ensure that the developed system supported all the general users' needs. Also, any misinterpretations of Matuta's needs and practices could be identified and resolved prior to the development of the system.

As soon as Enki had developed a working prototype of Matuta's system, they participated with the lead users in their working context to carry out user testing on it [*§6.3.3.5Phase 5*]. This process allowed the lead users to examine the system in the environment it would have to operate in. It also allowed them to determine if all their knowledge and working practices were met. If requirements were identified as missing, Enki returned to the users' situated contexts in order to identify those missing needs and to ensure that the developed system would support all working practices of the users. By allowing the lead users to utilise the prototype in their working environment, Enki were ensuring that all their knowledge needs would be supported by the system and that their work practice requirements would be successfully met. Once the lead users had tested the system and were happy that all their practice requirements and knowledge needs were met and supported, Enki implemented the system into the organisation.

From the findings of Case Study Two, it was evident that Enki actively participated in the users' situated work context in order to understand the users' embedded knowledge requirements. Thus, this working proposition was supported from this case's findings.

7.3.1.1 Observing

WP2: When analysts participate in user situated contexts, they use observational techniques.

§4.2.1.1 theorised that, the use of observational techniques by the analyst would greatly their improve understanding of the users' working practices and their embedded knowledge. This was supported by Case Study Two's findings. To identify the lead users' system requirements, Enki met with Matuta's lead users in their working environment to observe them carrying out their daily practices [*§6.3.3.2 Phase 2*]. By participating with the lead users in their situated context, Enki were providing them with the opportunity to explain what their work practices were and what they required from the developed system as they were carrying out their daily tasks.

Enki also engaged Matuta's general users in their situated context to determine what their working practices and requirements were [*§6.2.3.3 Phase 3*]. Enki were physically walked through the general users' work processes, with the general users providing them with explanations on what they did and what would happen while they would carry out their job. Through their use of observational techniques, Enki were also able to identify Matuta's key recording points, repetitive and critical operations and the steps involved for systems recovery. By participating in the general users' working environment and observing them performing their daily operations coupled with the users' explanations, Enki were able to gain a better understanding of the working practices that were being performed and the embedded knowledge that was in use.

From the findings of this case study, it was apparent that Enki carried out observational techniques while participating in the users' situated context. Thus, this working proposition was supported in Case Study Two's findings.

WP3: Analysts use observational techniques to distinguish between the users' espoused working practices and actual working practices.

§4.2.1.1 argued that the use of observational techniques would allow the analyst to differentiate between the users' espoused theories and their theories-in-use. This was supported by the findings for Case Study Two. While Enki participated with Matuta's lead users in their working context, Enki carried out observational techniques [*§6.3.3.2 Phase 2*]. By listening to the lead users' explanations of their work processes and by observing these practices being carried out, Enki were able to identify practices that the lead users would otherwise not attend to. As previously illustrated in §4.2.1, to uncover the existence of embedded knowledge Enki would have to refine the questions they posed to the lead users by confronting them with the differences in the data. For this case, Enki refined their questions, which in turn, allowed Enki to uncover the embedded knowledge and practice requirements of Matuta's lead users through constant re-questioning. Moreover, by pointing out inconsistencies to the lead users between what they said they did with Enki's observations, Enki were providing the lead users with the opportunity to reflect on their actual theories-in-use. §4.2.1.1 indicated that, the analyst would then be able to identify the embedded knowledge requirements of the users by immersing themselves in the users' situated context supplemented with use of observational techniques. The use of observational techniques while engaging the users in their work context was important for Enki, as it allowed them to further understand and improve their knowledge of the professional language used in the organisation when discussing their working practices. Understanding the language in use with the organisation was vital to understanding their requirements and embedded knowledge needs as it allowed Enki to associate what the users were talking about with what Enki observed them doing. Thus, by engaging with the lead users and utilising observational techniques, Enki were able to establish the knowledge and practice needs of Matuta's lead users within the context of their working environment.

Furthermore, Enki observed the working practices of the general users while they performed these practices in real time [*§6.2.3.3 Phase 3*]. For instance, Matuta's general users walked Enki through their work processes, explaining what they did and how they overcame problems that arose. §4.2.1.1 theorised that, Enki would be able to identify the users' embedded knowledge that allowed them to carry out their work practices by comparing their observations of the users' work practices with what the users said they did. Thus, by listening to the users' stories of what practices they performed and observing them actually carrying out their daily tasks, Enki were able to determine any discrepancies between what the general users said they did with the practices Enki observed them performing. This was important for Enki as it enabled them to refine the questions they asked of the general users. By allowing the general users to reflect on these questions and inconsistencies, Enki were able to close any gaps in their understanding of what their actual theories-in-use were. As §4.2.1 discussed, by carrying out observations of the general users work processes, the developers would be able to determine the customs, rituals and traditions that users performed as part of their daily work practices. Through their use of observational techniques, Enki discovered alternative processes that were in use by the general users that they generally would not attend to. For instance, Enki were able to map Matuta's repetitive processes and to identify the key recording points, critical operations and steps for systems recovery at use within the system. The use of observational techniques in the general users' situated context allowed Enki to uncover the users' their actual working practices. Consequently, the general users' actual work practices and knowledge needs would be supported by the developed system.

The findings from this case study showed that observational techniques were utilised by Enki to distinguish between the users' espoused working practices and their actual work practices. Thus, the findings supported this working proposition.

7.3.2 Investigation of Informal Networks

WP4: Analysts participate in user contexts in order to gain insight into the social customs of user communities.

In the findings from Case Study Two, Enki participated with Matuta's users in their situated context to understand the informal networks at work within the organisation that support their work practices and knowledge use [*§6.3.3.2Phase 2*]. §4.2.2 theorised that, embedded knowledge would be created and used across social networks. Thus, by participating with the users, Enki would be able to uncover the social customs that the user would utilise and the embedded knowledge required by these users to carry out their work practices. This was supported by the findings. Through their use of observations, Enki were able to identify the informal interactions that took place between laboratory technicians, the factory floor workers and the warehouse operators. Identifying these informal interactions allowed Enki to discover who the users went to when they required assistance on solving problems or who they went to in order to obtain advice. As illustrated in the findings, identifying the users' social customs was important for Enki as it provided them with the opportunity to understand how the users' knowledge of those problems and the solutions were transferred amongst the user communities in order for them to carry out their work practices. For instance, when problems occurred on the factory floor, the laboratory was immediately sent a sample to test and the warehouse operatives were told not to dispatch the product unless the laboratory had released it. In addition, the laboratory technician informed the Quality Control manager of all samples tested and the specification ranges of the tested sample. From these findings it was evident that informal networks existed within Matuta and knowledge was transferred between those communities and management.

Additionally, Enki were able to gain an insight into how these informal networks shaped the users' language and their values. As §4.2.2 argued, in order for the developers to understand the culture and language of the users, they must be able to comprehend the values that shaped the users' work practice and how they use their embedded knowledge. For Case Study Two, this was very important for Enki. Matuta has a strong code of practice and values that impacted upon the all employees and how they interacted with each other. By understanding how these values and code of practice affected the informal networks and their embedded knowledge usage when performing their working practices, Enki were ensuring that all the knowledge and practice needs of Matuta's users at every level within the organisation would be met and supported by the system. §4.2.2 indicated that users are more likely to talk differently and in a diverse language depending on who they were talking to at that particularly moment in time. Thus, by observing who the users interacted with at a formal and informal level, Enki were able to identify differences in the users' language and determine what the users deemed important for their work practices to be successfully carried out. By participating in the users' situated context and carrying out observational techniques, Enki identified and explored the users' social customs that impacted upon their working practices.

Therefore, the findings from Case Study Two provided the evidence to support this working proposition.

WP5: Analysts investigate informal social networks in order to understand how embedded knowledge is used in the users' community.

§4.2.2 theorised that, by investigating and talking to the users Enki would be able to uncover the knowledge transfer flows between the users' communities. For instance, Enki identified who the lead users of the system were through their discussions with Matuta's managers [*§6.3.3.2Phase 2*]. These were the experts from each department that the management team felt Enki should talk to in order to determine the systems requirements necessary to meet the objectives of the system. By observing these users performing their working practise, Enki were able to uncover who these lead users engaged with when problems arose. As argued in §4.2.2, it is the users' informal social networks that would allow embedded knowledge to be created and shared. Thus, through the involvement of the lead users in the development process, Enki were able to identify the informal knowledge transfer flows between the lead users and the departments. For instance, when problems occurred on the factory floor, the factory floor team leader informed the warehouse operatives were told not to dispatch the product unless the laboratory had released the product for distribution. By identifying these informal networks at use, Enki were able to understand how the knowledge within the company was employed and could ensure that all the lead users' knowledge needs would be supported by the system.

Additionally, through Enki's participation with the general users in their situated work context and via their observations of the general users' daily practices, Enki were able to identify the informal and social networks that were in place within their working environment [*§6.3.3.3Phase 3*]. For example, Enki's observations of the laboratory technician's working practices allowed them to understand how knowledge was transferred between the process laboratory and the main laboratory when tests were being carried out on the sample products. By observing these users in their situated context, Enki were able to identify how the users' informal networks shared their knowledge when carrying out their practices. Through their observations and participation with the users, Enki were able to determine how Matuta's users transferred and shared their embedded knowledge, how this knowledge was used and who they went too for guidance when problems were encountered.

The evidence from this case study's findings supported this working proposition.

7.3.3 Personal Interactions

WP6: Analysts forge personal interactive relationships with users over an extended period.

§4.2.3 argued that through continuous interactions between Enki and the users, personal relationships would be likely to emerge. This was supported by the findings in Case Study Two. Initially, Enki interacted with Matuta's management team in interactive face-to-face meetings and interviews, which often resulted in brainstorming sessions [*§6.3.3.1Phase 1*]. Through their continuous interactions, a personal intimate relationship emerged between Matuta's management team and Enki. As §6.3.2 stated, the development of Matuta's Factory Floor and Laboratory Information Management Systems began in 1987. The findings from this case study only depicted the development of the system until 2005 and there were still elements of the system that Enki was in the process of completing. Thus, an intimate established relationship existed between Matuta's managers and Enki for the duration of the system's development lifecycle.

Enki also formed personal relationships with Matuta's lead users throughout the development process [*§6.3.3.2 Phase 2*]. Enki engaged the lead users in their situated context and personal relationships emerged between both parties through personal contact over the years. For example, requirements were actively discussed until Enki were happy that they had an adequate understanding of what the lead users required from the system. Additionally, whenever problems emerged, Enki discussed these with the lead users and together they came up with a solution to overcome these difficulties.

Furthermore, Enki interacted with Matuta's general users [*§6.3.3.3Phase 3*]. To identify their working practices and knowledge requirements for the system, Enki interviewed each user individually about what they use the system for and what their system needs were. The general users also physically walked Enki through their work processes. Through personal contact and continuous interactions, Enki were able to determine what practices the general users deemed important and what embedded knowledge was required by them to carry out these practices. Consequently, through their personal interaction with Hathor's general system users, Enki developed personal relationships with them.

From these findings, it was evident that Enki forged personal relationships all of Matuta's users – their managers, the lead users and the general users. Thus, this working proposition was supported by the findings from Case Study Two.

WP7: Personal relationships between analysts and user communities help analysts appreciate the role of embedded knowledge in the users' situated context.

§4.2.3 theorised that, by participating in the situated context of the users' and through the creation of personal relationships Enki would be likely to gain a greater appreciation of the users' embedded knowledge needs. As illustrated in Case Study Two, Enki participated with Matuta's management team and carried out interactive, face-to-face meetings with them [*§6.3.3.1Phase 1*]. These interactive meetings often resulted in brainstorming sessions, which allowed Enki to understand the values and the code of practice that was important to Matuta and how it affected the working practices within the organisation. These core values governed all the employees' actions within the organisation and were adhered to by all employee levels within the organisation. Enki also were able to determine the reactions Matuta's managers had to various problems experienced by the company as they arose and how industry standards impacted on their organisation. Thus, Enki were able to gain a greater understanding of the role embedded knowledge had within the organisation and how it affected the requirements of Matuta's managers.

Additionally, Enki participated with Matuta's lead users in their situated context in order to uncover their system requirements and knowledge needs [*§6.3.3.2 Phase 2*]. To understand their requirements and embedded knowledge needs, Enki observed the lead users performing their working practices, with the lead users providing explanations of what they were doing and the rationale behind their actions. Through their participation with these users, Enki were able to visualise the working practices that the lead users would generally not remember carrying out. Clarifications were sought and any gaps in Enki's understanding were corrected by the lead users. The personal relationship that had emerged between Enki and Matuta's lead users from interactions with each other enabled Enki to appreciate what the lead users' knowledge and practices were. Enki were also able to identify the assumptions and beliefs that were important to each of them, how they carried out their actual working practices and their reactions to problems and different situations as they arose.

Furthermore, Enki personally interacted with the general users of the system in order to understand their embedded knowledge needs of the system [*§6.3.3.3 Phase 3*]. During Enki's participation in their work environment, Matuta's general users walked Enki through their work practices, explaining as they went along what was occurring and why. During this walkthrough, Enki were able to observe the general users' working practices and uncover the embedded knowledge used by these users in the daily operations. Enki also carried out discussion sessions with the general users to ensure that they understood the embedded knowledge needs and practice requirements of these users. Through the emergence of personal relationships with Matuta's general users Enki were able to gain a complete understanding of the role embedded knowledge played in daily working practices that the developed system needed to support.

The findings suggested that, the personal relationships that emerged between Enki and Matuta's users allowed Enki to appreciate and understand the role embedded knowledge played in the users' situated context. Thus, this working proposition was supported by Case Study Two's findings

WP8: The personal relationship facilitates embedded knowledge transfer between analysts and users and
WP9: Where personal relationships between analysts and users do not emerge, there are ISD problems related to the transfer of embedded knowledge.

In §4.2.3 it was theorised that, the formation of personal relationships between Enki and the users would be likely to establish a common knowledge base, which would facilitate the transfer of embedded knowledge between both parties. From the findings in Case Study Two, Enki personally interacted with Matuta's managers for the duration of the development process [*§6.3.3.1 Phase 1*]. These continuous interactions were carried out by means of face-to-face meetings, interviews and brainstorming sessions. During these interactions, Enki were able to explore what values were important to the organisation and its managers, the code of practice that they followed and how it impacted upon the organisation. In addition, Enki were able to ascertain the problems they were experiencing with their system, what their working practices and requirements were and, how the managers reacted and coped when problems arose. §4.2.3 argued that, embedded knowledge would more likely be transferred successfully if shared conventions, basic similarities and a common language existed between the users and Enki. Therefore, by participating and interacting with these users, Enki were provided with the opportunity to gain an understanding of the professional language at use within the Matuta. Following this, Enki were able to successfully communicate their understanding of Hathor's needs back to the managers to ensure that their interpretations were correct.

Enki also met with Matuta's lead users and participated with them in their working context to uncover their system requirements and embedded knowledge needs [*§6.3.3.2 Phase 2*]. To do this, Enki set up multiple face-to-face interactive sessions with Matuta's lead users. Through these interactions, Matuta's lead users explained their working practices and what they wanted the system to perform once developed. These requirements were then actively discussed until Enki were happy that they had an adequate understanding of what Matuta required from the system. By carrying out these interactive discussions, Enki ensured that extensive feedback occurred between these users in order to get them to reflect on their current problems with the system, their needs and future requirements. This in turn ensured that Enki had a good understanding of their system and its requirements through their observations of the users' working context. By engaging in the situated context of Matuta's lead users and continuously interacting with them, Enki were able to gain an understanding of what their working practices were and the embedded knowledge they used to perform their tasks.

However, as §4.2.3 theorised, without a common coding scheme, language difficulties, misperceptions and misinterpretations could arise resulting in a less efficient knowledge transfer process occurring between the developer and the users. Although Enki interacted with Matuta' lead users, problems did arise in relation to their understanding of the users' requirements. Enki did not know the professional language and industry terminology the lead users utilised in their working environment and the lead users could not understand the technical language of Enki. In order to facilitate good communications between Enki and the lead users, Matuta's managers asked their IT department to act as a knowledge broker between Enki and their lead users [*§6.3.3.2 Phase 2*]. The responsibility of the broker was to facilitate good communications and to help overcome any misunderstandings and language difficulties that arose between Enki and the lead users, in particular, the laboratory lead users. Essentially, Matuta's broker was to act as the point of contact between Enki and the lead users. For interactions to occur between Enki and lead users, it was up to the broker to arrange face-to-face meetings and interactive discussions between both parties. Moreover, if the lead users needed to discuss their requirements or if their requirements changed they would have to request a meeting with Enki through the broker. In addition, the broker, more often than not, misinterpreted the lead users' requirements and failed to set up meetings between the lead users and Enki on time. Thus, the personal relationships that were forming between Enki and the lead users failed to develop any further. Moreover, without intensive, continuous interactions with the lead users, Enki failed to elicit the necessary working practice and knowledge needs the system needed to meet and support.

Additionally, Enki formed personal relationships with Matuta's general users through their participation in their situated context [*§6.3.3.2 Phase 3*]. Each user was individually interviewed about what their working practices and what their system needs were. The general users walked Enki through the work processes while Enki observed these processes as they were being carried out. Enki were given explanations of what was happening and the rationale behind these actions as they were occurring. By utilising these methods, Enki were able to ascertain what their practices were and the embedded knowledge required by them in order to successfully perform their job. This was important for Enki and the overall development process, as Matuta's lead users felt that they were being listened to and in turn, committed themselves to the development of the system by ensuring that Enki understood their working practices and knowledge needs. However, once Matuta's knowledge broker took over as the main communications link between Matuta and Enki, the level and intensity of these interactions lessened. Thus, the relationship between the general users and Enki diminished. This in turn affected the elicitation of the working practice and knowledge requirements of the general users.

Frequent interactions continued between Enki and the users throughout the development lifecycle. For example, Enki interacted with Matuta's managers and lead users when the functional specifications of the system were presented to them [*§6.2.3.4 Phase 4*]. All parties interacted and discussed those requirements until Matuta were happy that their working practices and requirements were met and would be supported by the system when developed. Until then Enki would not begin developing the system.

As soon as Enki had developed the prototype for the system, Enki presented it to the lead users via the knowledge broker [*§6.3.3.5 Phase 5*]. Enki personally interacted with Matuta's lead users so that unit testing could be carried out on the prototype. This was important as it allowed the lead users to confirm that their working practices and knowledge requirements were met and would be fully supported by the system. Through these interactive sessions, Matuta's lead users were able to provide Enki with feedback concerning their feelings towards the prototype and whether it met all their needs. As the findings illustrated, these interactions were on-going until Matuta's lead users could not identify any further requirements for the system. The system was then implemented into the organisation once the lead users were satisfied that it met all their knowledge requirements and working practices.

From the findings of Case Study One, it was evident that personal relationships facilitated embedded knowledge transfer between Enki and Hathor's users. Thus, this working proposition was supported.

Although personal relationships did emerge, ISD problems existed in the form of language and communications difficulties between Enki and the lead users. To overcome these problems, Matuta created the role of knowledge broker to act as an interpreter and a two-way communications channel between Enki and the lead users. However, Matuta's knowledge broker misinterpreted the lead users' requirements correctly and communicated these erroneous requirements to Enki. Moreover, the broker failed to set up meetings between Enki and the lead users to discuss the requirements. Thus, Enki delivered system components that did not meet the needs of the users. These difficulties resulted in the cessation of the personal relationships between Enki and Matuta's users and hindered the transfer of embedded knowledge between both parties.

Thus, the evidence did support this working proposition.

7.3.3.1 Collaborating

WP10: Users actively collaborate with analysts during development of the system.

In §4.2.3.1 it was theorised that, strong ties would emerge from personal interaction coupled with collaboration from the developer and the users, this in turn would be likely to increase the time and effort both parties would put into ensuring that the transfer of embedded knowledge between them would be a success. From Case Study Two's findings, it was evident that Matuta's users actively collaborated with Enki. For example, Enki and Matuta's managers collaborated together at the beginning of the development process to identify the overall objectives of the system and its initial requirements [*§6.3.3.1 Phase 1*]. Personal interactions between Enki and the managers were carried out via face-to-face interactive, interviews, meetings and brainstorming sessions. Enki also openly discussed with the management team the problems they were experiencing with their system, how they coped with these problems and what their working practices and business strategies were. Through continuous interactions and collaborations, Matuta's managers and Enki were able to develop a strong bond. This was important for Enki as it ensured the management team's cooperation and commitment to the development process.

In addition, Enki actively collaborated with the lead users. Initially, Enki participated with the lead users in their working environment in order to understand and identify their working practices and knowledge needs [*§6.3.3.2 Phase 2*]. Matuta's lead users collaborated with Enki to walking them through their work practices. As previously highlighted, Enki examined and observed the lead users carrying out these daily practices with the lead users providing explanations of what was occurring within that practice and the rationale behind any decisions that were made. As a result, strong ties and personal relationships were created between Enki and the lead users. Therefore, through the lead users' collaboration in the development process and continuous interactions between the lead users and Enki, the requirements and needs of these users were explained and successfully interpreted by Enki.

However, once Matuta's managers introduced the knowledge broker into the development process to act as an interpreter and communications medium between Enki and the lead users, the lead users' collaboration with the development of their system diminished [*§6.3.3.2 Phase 2*]. As mentioned previously, all interactions and collaborations between Enki and the lead users now had to be arranged via the knowledge broker, who on more than one occasion misinterpreted the users' requirements and failed to set up meetings between Enki and the lead users. Thus, the personal relationships that were forming between Enki and the lead users failed to develop any further and the strong ties the lead users felt towards the development process was reduced considerably. Without intensive, continuous collaboration with the lead users, Enki failed to elicit the necessary working practice and knowledge needs the system had to meet and support.

Furthermore, the general users of the system collaborated in the development process [*§6.3.3.3 Phase 3*]. Walkthroughs were carried out by the general users and explanations were provided to Enki about what was occurring within that practice and the rationale behind decisions that were made. Through Enki's collaborations with Hathor's general users, strong ties began to emerge between the users and the development process. Enki felt that the general users' collaborations in the development process was important as it allowed them to feel that they were being listened to and had a say in the development of their system. Thus, the general users felt committed to ensuring that the system was a success and actively collaborated with Enki. However, once Matuta's knowledge broker took over as the main communications channel between Matuta and Enki, collaborations between the general users and Enki lessened. Thus, the personal relationship and strong ties between the general users and Enki and, the general users' commitment to the success of the system diminished. Without collaboration with the general users, Enki could not uncover the necessary working practices and knowledge needs the system had to meet and support.

Finally, the lead users collaborated with Enki to carry out systems testing on the developed prototype to ensure that their practice and knowledge requirements were met and supported by the system [*§6.3.3.5 Phase 5*]. If requirements were identified as missing, Enki collaborated with the lead users to discuss what the requirements were and how they could be supported by the system. Once these users were satisfied that the system would meet their needs and requirements, Enki implemented the system into Matuta.

From the findings of Case Study Two, it was apparent that Hathor's users actively collaborated with Enki during the development of their system. However, due to the introduction of the knowledge broker into the development process, this collaboration between Enki and Matuta's users was significantly reduced and diminished. This in turn, resulted in the cessation of the personal relationships and strong ties between both parties and Enki failed to identify and understand the embedded knowledge needs of the users.

Although this working proposition was supported by the findings, the role the knowledge broker played in the development process greatly reduced the users' collaboration.

WP11: During ISD, analysts actively encourage users to collaborate with them in the development of the system and
WP12: The active collaboration of users and analysts during ISD facilitates embedded knowledge transfer.

In §4.2.3.1 it was argued that, if the users actively collaborated in the ISD process, the developers would be able to ensure that the users' working practices and embedded knowledge requirements would be supported by the developed system. This was supported by the findings in this case study. Enki actively encouraged Matuta's managers to collaborate in the ISD process. The managers were encouraged to openly communicate and share their requirements and what they needed from the system [*§6.3.3.1 Phase 1*]. Enki facilitated these discussions in interactive face-to-face interviews and brainstorming sessions. Clarifications were sought by Enki and discussions ensued until Enki were satisfied that they understood the managers' embedded knowledge requirements and practice needs that the developed system needed to support.

Matuta's lead users were also actively encouraged by Enki to collaborate in the development process [*§6.3.3.2 Phase 2*]. Enki participated with the lead users in their situated context and were asked to explain in detail their working practices. Additionally, Enki observed these tasks being performed and any inconsistencies that arose between what the users said they did with what Enki observed with openly discussed. From their use of these methods, Enki were able to uncover what the lead users' actual working practices were and the embedded knowledge requirements they needed in order for these tasks to be successfully carried out. However, when Matuta's knowledge broker took over as intermediary between Enki and the lead users, the collaboration between these two parties was greatly reduced. Thus, Enki were not able to encourage the participation of the lead users in the development process. As the findings illustrated, Matuta's knowledge broker misinterpreted the users' requirements and failed to set up meetings between Enki and the lead users, this resulted in reduced collaboration by the lead users in the development process and Enki not fully identifying and understanding the requirements of the system

Moreover, Matuta's general users were encouraged to collaborate in the process [*§6.3.3.3 Phase 3*]. The general users walked Enki through their work processes while Enki observed them performing these practices in real time. By openly discussing their working practices Enki were able to gain an understanding of their embedded knowledge needs and practice requirements that the developed system must support. However, Matuta's management team instated the knowledge broker as a mediator between Enki and the users and the general users' involvement in the development process was significantly diminished.

Collaboration on the part of the lead users also occurred during the systems testing phase [*§6.3.3.5 Phase 5*]. Enki presented a developed prototype to the lead users to allow them to visualise what the final system would look like and to determine if all their practice requirements and knowledge needs would be supported by the system. If requirements were omitted from consideration, Enki collaborated with the lead users via the knowledge broker to discuss the requirements that were missing. When no further problems occurred and Matuta's lead users were satisfied with the prototype, Enki implemented it into the company.

From Case Study Two's findings, it was apparent that Enki actively encouraged Matuta's users to collaborate in the development of their system. However, when the role of the knowledge broker was established by Matuta's management team, collaboration between the lead users and Enki diminished. All communications between both parties were now channelled through the knowledge broker who misinterpreted the lead users' requirements and communicated these incorrectly to Enki. In addition, meetings between the lead users and Enki failed to materialise or were set up too late.

Although this working proposition was supported by the findings at the beginning of Enki's development process with Matuta, the role the knowledge broker had in the development process limited Enki's encouragement for the users to collaborate.

Thus, there was not enough evidence to support this working proposition from the findings in Case Study Two.

Enki's active collaborations with the lead users in the beginning of development process were ensuring the successful understanding and elicitation of the embedded knowledge needs and requirements of these users. However, the knowledge broker severely limited these collaborations and thus affected the facilitation of the users' embedded knowledge needs to Enki.

From this case study, there was insufficient evidence to support the second working proposition.

7.3.4 Storytelling

WP13: Analysts gather users' stories in order to uncover the embedded knowledge associated with their work practices which the developed system must support.

For this case study, storytelling was used by Enki to determine the requirements and objectives of the system for Matuta's managers [*§6.3.3.1Phase 1*]. Since Matuta's management team developed the initial specifications for the system and presented these to Enki, the stories concerning their specification needs could be discussed more in-depth. Enki could ask more direct questions concerning their requirements and needs based upon Matuta's specification documents. In these discussion sessions, Enki listened to the manager's stories on the problems the organisation was encountering with their system and they provided Matuta's management team with the opportunity to reflect on what the overall system objectives and requirements should be. In §4.2.4 it was theorised that, storytelling would allow the users to rationally explain their theories-in-action and how they handled relationships within the organisation, both between other users and the system. From the findings of Case Study Two, by discussing these stories with Matuta's managers, Enki were able to successfully confirm the company's strategies and vision for the system, what the system would be used for, its objectives and their overall requirements for the system. Additionally, these stories reaffirmed the users' theories of how their practices came about and how relationships were handled within the company. As argued in §4.2.4, stories could be used to transfer knowledge concerning past exploits, problems and how they were overcome within a situated context. The findings suggested that, storytelling was used by Enki as it gave them the opportunity to identify the underlining principles, values and assumptions that governed the organisation's daily practices. For example, by talking to Matuta's managers Enki were able to uncover the code of practice and values that the organisation espoused and that affected their work practices throughout the organisation. Consequently, through a process of storytelling, Matuta's managers were able to transfer to Enki their embedded knowledge and perspectives of the system, what was important to them and Matuta, the future directions of the organisation in general, the industry values that impacted upon the organisation and in turn its system, all of which were important for Enki when developing Matuta's system.

Moreover, Enki used storytelling to uncover and elicit the requirements of Matuta's lead users [*§6.3.3.2 Phase 2*]. Enki listened to the lead users' stories in order to understand the problems they were experiencing with the system, what they wanted from the system and the requirements they needed in order to carry out their working practices successfully. Through the use of storytelling, Enki were able to identify how the users' practices came about through the interactions between the characters in the stories and the system. Additionally, the knowledge flows that existed between users within the community were explored. Essentially, these stories allowed Enki to understand the working practices at use within the user community and how they were formed (see §4.2.4). Discussions were carried out between Enki and Matuta's lead users until Enki were satisfied that they understood what the lead users wanted from the system and their knowledge needs. Consequently, through the use of stories in the development process, Matuta's lead users were able to identify for Enki what their actual working practices were, which allowed Enki to uncover their embedded knowledge needs and working practice requirements.

Enki repeated this process in order to elicit the knowledge and practice requirements of Matuta's general users [*§6.3.3.3Phase 3*]. §6.3.3.3 illustrated that, the general users carried out walkthroughs with Enki to describe the story of what happened as they carried out their work practices. §4.2.4 argued that, storytelling would allow Enki to explore logic, assumptions and behaviour that the general users adopted when problems and different situations arose. From Case Study Two, Enki listened to the general users' explanations about how they overcame problems and the decisions that were made as different situations arose. Thus, storytelling allowed Enki to identify the embedded knowledge requirements inherent within the stories and the requirements they needed to carry out their working practices.

From the findings, it was evident that Enki gathered stories from Matuta's managers, the lead users and the general users to help uncover the embedded knowledge associated with their work practices. Thus, this working proposition was supported.

WP14: The use by analysts of reflective practices helps uncover embedded knowledge requirements.

While carrying out storytelling during the development lifecycle, Enki used reflective practices to help uncover the embedded knowledge requirements of Matuta's managers [*§6.3.3.1Phase 1*]. Initially, Enki were able to discuss with Matuta's managers their requirements based upon the initial specifications that the managers had created for the system [*§6.3.3.1Phase 1*]. As §4.2.4 argued, embedded knowledge would be likely to be identified through differences between texts. From the managers' explanations of what they required from the system and the specification documents provided, Enki were able to ask direct questions of Matuta's managers. By providing the managers with the opportunity to reflect on any discrepancies between their initial specifications document and their explanations, Enki were able to obtain an accurate description of their embedded knowledge needs.

This process of reflective practices was also used by Enki when eliciting the lead user's embedded knowledge requirements [*§6.3.3.2 Phase 2*]. Furthermore, it was reiterated when eliciting the requirements of Matuta's general users [*§6.3.3.3Phase 3*]. Any inconsistencies that arose between the users' stories were identified. These differences were then clarified by the users through further discussions and refined questioning. As §4.2.4 argued, through reflection and reconstructing the past on the part of the users, Enki were able to uncover a complete set of the lead users' embedded knowledge requirements. In addition, based upon the observations Enki carried out of the users performing their working practices and the stories they obtained from these users, Enki were able to uncover further existence of their embedded knowledge through the identification of inconsistencies between the two of them. By questioning the users and by allowing them to reflect on these inconsistencies, Matuta's users were able to clarify for Enki what their actual working practices were and the embedded knowledge inherent within their stories.

From the findings of Case Study Two, Enki used reflective practices to compare the users' stories with their observed working practices of these users to help uncover their embedded knowledge requirements. Thus, the evidence supports this working proposition.

7.4 Comparative Case Study Discussion

The following sections compared the findings from Case Study One and Case Study Two in relation to the working propositions presented in Chapter four.

7.4.1 Participating in the Situated Context

WP1: The analyst actively participates in the users' situated work context in order to understand the users' embedded knowledge requirements.

From the discussions in §'s 7.2.1 and 7.3.1 it was apparent that, Enki actively participated in the user' situated work context in both companies, so that they could gain an understanding of the embedded knowledge requirements of the users. As illustrated in both case studies, Enki engaged the managers, the lead users and the general users in their working environments. Face-to-face interviews, brainstorming sessions, system walkthroughs and interactive discussions with both companies allowed Enki to understand the professional language of the users, what values were important to the organisation, what the actual working practices of the users' were and what knowledge needs the developed system had to support. As the findings of both case studies indicated, active participation on Enki's part was essential in order to understand the embedded knowledge requirements of the users.

Thus, this working proposition was supported by both case studies' findings.

7.4.1.1 Observing

WP2: When analysts participate in user situated contexts, they use observational techniques.

As the discussions in §'s 7.2.1.1 and 7.3.1.1 indicated, observational techniques were used by Enki while they participated in the users' situated contexts. In both case studies, Enki observed the lead users and the general users carrying out their working practices. These users explained to Enki what they were doing and the rationale behind any decisions that were made. Also, through the use of observational techniques, Enki were able to uncover and map repetitive processes that existed within the system and, the critical operations and the steps for systems recovery that the users did not attend to.

Consequently, this working proposition was supported by the evidence presented in findings of the Case Studies One and Two.

WP3: Analysts use observational techniques to distinguish between the users' espoused working practices and actual working practices.

Based upon the previous discussions (§'s 7.2.1.1 & 7.3.1.1), it was apparent that through the use of observational techniques, Enki were able to determine the user's actual working practices from their espoused practices. By observing the users carrying out their working practices and listening to the explanations about these operations, Enki were able to identify any inconsistencies between the two. Confronting these users with these discrepancies and asking more direct questions of them concerning their actual working practices, Enki were able to obtain a clearer understanding of the embedded knowledge needs required for the users' working practices to be carried out. As illustrated in the findings, this process was used by Enki in both case studies with the lead and general users of the system to identify their actual working practices.

Hence, the evidence from Case Study One and Two supported this working proposition.

7.4.2 Investigation of Informal Networks

WP4: Analysts participate in user contexts in order to gain insight into the social customs of user communities.

The discussions in §'s 7.2.2 and 7.3.2 suggested that, in order to gain an understanding of the social customs at use within the users communities, Enki had to participate in the users' situated contexts. To identify the social customs the users, Enki observed the informal and frequent interactions that occurred between the different communities within Matuta and Hathor. In addition, Enki were able to identify the informal knowledge flows that occurred between the systems users. For instance, who the users went to in order to get assistance with a problem, who did they go to when they needed to discuss ideas or get advice. By identifying these social customs, Enki were able to understand how embedded knowledge was used and shared across both companies. They were also able to gain an insight into how the organisation's values shaped the working practices of the users and the professional language used by them.

It was apparent from the findings that this working proposition was supported in both cases studies.

WP5: Analysts investigate informal social networks in order to understand how embedded knowledge is used in the users' community.

§'s 7.2.2 and 7.3.2 showed that, by investigating the informal networks at place in the organisation, Enki were able to understand how embedded knowledge was utilised by the users' communities. By observing the system users performing their working practices, Enki were able to identify who these users interacted with when findings solutions to problems when they arose. Also, by allowing the users identify who Enki should talk to and include in the development process, the users were indicating who they believed was the expert in that particular area and who held knowledge that Enki needed to understand in order for their working practices to be successfully supported by the system. By investigating these informal networks with Matuta and Hathor, Enki were able to uncover the informal knowledge flows between the users and their communities.

Thus, the evidence presented in the findings supported this working proposition.

7.4.3 Personal Interacting

WP6: Analysts forge personal interactive relationships with users over an extended period.

From Case Study One and Two's discussions (§'s 7.2.3 and 7.3.3), it was evident that Enki did forge personal interactive relationships with Hathor and Matuta over an extended period. Enki interacted with management, the lead user and the general users and a personal relationship emerged between Enki and these users. These intimate relationships were formed via continuous interactions for the duration of the development lifecycle. As Case Study One highlighted, Hathor's development process lasted 7 years, while the findings depicted in Case Study Two, ranged from the beginning of the development lifecycle in 1987 to 2005.

Thus, this working proposition was supported by the findings from both case studies.

WP7: Personal relationships between analysts and user communities help analysts appreciate the role of embedded knowledge in the users' situated context.

From §'s 7.2.3 and 7.3.3, it was apparent that the formation of personal relationships between Enki and the users would facilitate Enki's understanding of the embedded knowledge at use within the users' communities. From the findings, it was apparent that the evidence supported this argument. Within both case studies, Enki participated with the users in their situated context via continuous interactions. Through their participation and observations, Enki were able to visualise the working practices that the users would not realise they were carrying out. Enki were also able to identify the values and assumptions that were important to the users and that governed their daily practices. This was particularly important for Case Study Two, as Matuta has several core vales and a code of practice that all employees within the organisation must adhere to when carrying out their working practices. By identifying the values in place within the organisation, Enki were able to gain a greater understanding of the role embedded knowledge played in the users' working context.

From the findings it was evident that this working proposition was supported by both case studies.

WP8: The personal relationship facilitates embedded knowledge transfer between analysts and users

The discussions presented in §'s 7.2.3 and 7.3.3 indicated that, personal relationships between Enki and the users facilitated the transfer of embedded knowledge between both parties. It was apparent from the findings that, through personal contact with the users in the form of interactive discussions, storytelling, brainstorming sessions and by using whiteboards and diagrams, Enki were able to seek clarifications and explanations from the users about their embedded knowledge and practice requirements. The users also provided Enki with extensive feedback concerning their problems with the system, their reactions to these situations and decisions that they made to overcome these problems. Additionally, by participating with the users in their situated context and observing them performing their working practices, Enki were able to uncover the actual working practices of the users and how their embedded knowledge was used within the system.

Thus, this working proposition was supported by the findings from both case studies.

WP9: Where personal relationships between analysts and users do not emerge, there are ISD problems related to the transfer of embedded knowledge.

From the discussions in §'s 7.2.3 and 7.3.3 it was apparent that, there was little evidence to support this working proposition. From the findings in Case Study One, it was illustrated that, although personal relationships existed between Enki and Hathor's lead users, ISD problems did emerge.

Language difficulties and misinterpretations of the lead users' requirements arose. Enki could not fully understand the lead users' industry terminology and they on the other hand could not understand Enki's technical language. To overcome these issues, the role of a knowledge broker was established by Hathor's management team to act as a mediator and interpreter between Enki and the lead users. In this case study, the knowledge broker interpreted and explained what the lead users required of the system. Actively working with both the lead users and the knowledge broker allowed Enki to further develop their relationship with the lead users as they could now understand what their working practices were and their system requirements.

For Case Study Two, similar communications problems existed in relation to Enki's understanding and interpretation of the lead users' requirements. As with Case Study One, Matuta also set up a knowledge broker to act as an interpreter and two-way communications channel in order to facilitate good communications between Enki and their lead users. However, unlike Case Study One, the knowledge broker failed to establish meetings between Enki and the lead users and misinterpreted the lead users' requirements, resulting in incorrect requirements being given to Enki. Thus, the personal relationships that were developed between Enki and the lead users failed to develop any further, as all communications between both parties were now controlled by Matuta's knowledge broker. This in turn, affected the transfer of embedded knowledge between Enki and the lead users. Consequently, Enki's understanding of the lead users' working practices and knowledge need were greatly reduced.

Additionally, as the findings suggested, the culture within the organisation would play an active role in the success of the personal interactions that are likely to occur between the development company and the users. In Case Study One, due to the informal communications structure in place, all users were actively encouraged by Hathor's management team to contribute to the development of the system. In addition, they were provided with the opportunity to voice concerns they had with the system and make suggestions on how the system could be improved not only for the benefit of their working practices but for the company itself. Conversely, for Case Study Two this was not the case. Matuta had a more formal communications structure. Therefore, all communications between the users and Enki during the development of their system was controlled by the knowledge broker. This in turn, impacted heavily on the development of personal interactions between the users and the systems developers.

From these findings, there was inconclusive evidence to support this working proposition, as the role of the knowledge broker in Case Study One greatly improved the level of understanding and communications between Enki and their lead users. However, the knowledge broker in Case Study Two controlled and limited the level of interactions between Enki and the lead users, which caused their personal relationships to perish. This in turn, greatly reduced the transfer of embedded knowledge between Enki and Matuta's lead users. Moreover, in order for personal interactions to be important for the transfer of knowledge between the users and the systems developers during the development of the system, the communications structure in place within the organisation and whether the organisation actively encouraged its users to engage in the development of the system by making suggestions and voicing their concerns would play an important part in ensuring whether the system that was developed would successfully meet and support the users' working practices. As the findings suggested, this occurred for Case Study One but not for Case Study Two. Therefore, the relationship between the concepts of close user-analyst relationships and effective embedded knowledge transfer was complicated by the knowledge brokering process. This indicated weak theory.

7.4.3.1 Collaborating

WP10: Users actively collaborate with analysts during development of the system.

Based upon the previous discussions (§'s 7.2.3.1 & 7.3.3.1) it was evident that, the users for both companies collaborated with Enki in the development of their system. From the findings of both case studies, Enki collaborated with many users of the system, from management to the lead system users to the general users within the company. By continuously interacting and collaborating with the users in the development process, Enki were able to create a strong bond between the users and the development process. This was important as it ensured the users' co-operation and support throughout the entire development lifecycle.

However, for Case Study Two, the knowledge broker limited the collaboration of Matuta's users in the development process. All interactions between Enki and the users now had to be arranged by the broker who neglected to set up meetings between Enki and the lead users. As the findings for Case Study Two illustrated, the knowledge broker and Matuta's IT department were a part of the Finance department. Therefore, the knowledge broker was only interested in the costs associated with the development of the system rather than the system meeting the users' requirements. Thus, the knowledge broker re-interpreted the lead users requirements based on cost of delivery and communicated the lead users' requirements incorrectly to Enki. The personal relationships that had emerged between Enki and the lead users failed to develop any further and the strong ties the lead users felt towards the development process considerably weakened. Thus, the collaborations of the lead users in the development process ended once Matuta set up the knowledge broker to act as a mediator between Enki and the lead users.

Although the findings could be seen to have supported this working proposition, the role the knowledge broker played in the development process may or may not reduce the users' collaboration. The user-analyst collaboration was a more complex concept than envisaged in the theory. The findings were therefore inconclusive, as the theoretical proposition failed to account for knowledge brokering in this context.

WP11: During ISD, analysts actively encourage users to collaborate with them in the development of the system.

§'s 7.2.3.1 & 7.3.3.1 illustrated that, Enki actively encouraged the system users to collaborate with them in the development process. Enki collaborated with the users through face-to-face meetings, storytelling, observations and brainstorming sessions where the users candidly discussed their requirements for the system. In addition, when the lead users were carrying out testing on the prototype [*Phase 5*], the lead users openly discussed their feeling towards the new system and provided extensive feedback to Enki concerning whether or not their knowledge needs and working practices would be supported by the developed system. Enki felt that by actively encouraging the users to be a part of the development process, the users would ensure that the developed system would be a success as they were contributing their time and effort to the process.

However, Enki could not encourage Matuta's lead users to participate in the development process once Matuta set up the knowledge broker as an intermediary between Enki and the users. The findings illustrated that, one of the reasons why the role of the knowledge broker was established was to reduce the time the users were involved in the development process. This proved to be counter-productive and did not support the knowledge transfer process. Thus, all communications and collaborations between Enki and the users now had to go through the knowledge broker and Enki were not able to encourage the users to be involved in the development lifecycle of their system.

Thus, there was insufficient evidence between both case studies to support this working proposition, as the role of the knowledge broker for Case Study Two significantly impacted on Enki actively encouraging Matuta's users to become part of the development process. The extent to which analysts actively encourage user collaboration was complicated by the knowledge brokering process, suggesting that the working proposition was insufficiently framed.

WP12: The active collaboration of users and analysts during ISD facilitates embedded knowledge transfer.

From the discussions in §'s 7.2.3.1 & 7.3.3.1 it was evident that, when the users collaborated successfully with Enki their embedded knowledge needs were successfully transferred to Enki. As the findings from both case studies suggested, Enki actively collaborated with the users in order to determine their requirements for the system, their working practices and the knowledge needs that the system needed to support. This collaboration could take the form of storytelling, system walkthroughs, observations and interactive face-to-face discussions amongst other methods. Through these forms of collaborations and continuous interactions, Enki were able to gain an understanding of the users' professional language via the knowledge broker. This was important for Case Study One, as the knowledge broker was able to interpret the users' requirements into the technical language used by Enki.

Thus, the lead users embedded knowledge needs were successfully understood by Enki and incorporated into the development system.

However, for Case Study Two, collaboration with Matuta's users diminished once the knowledge broker became part of the development process (§6.3.3.2). Communications and requirements requests from the lead users had to be made via Matuta's knowledge broker. These requirements were paraphrased and incorrectly communicated to Enki. Discussions and meetings about the users' requirements failed to be set up between Enki and the lead users and when they did materialise they were too late for the requirements to be discussed. Through the introduction of the knowledge broker into Matuta's development lifecycle, collaborations with the lead users were significantly reduced.

There was insufficient evidence from both case studies to support this working proposition. The relationship between collaboration and embedded knowledge transfer was more complex than envisaged in the working proposition. While Case Study One clearly demonstrated that active collaboration on the part of the users with the analysts during ISD facilitated embedded knowledge transfer, the role of the knowledge broker in Case Study Two not only reduced the users' collaboration but significantly impacted on the transfer of embedded knowledge between the lead users and Enki. The transfer of embedded knowledge between both parties failed to be a success as personal interactions between Enki and Matuta's users were not continued, due to the control position of Matuta's knowledge broker. This suggested that collaboration could be established but that it could also be diminished as a by-product with the knowledge brokering processes. This further suggested that, successful embedded knowledge transfer that resulted from collaborations between the users and the developers also utilised effective knowledge brokering processes.

7.4.4 Storytelling

WP13: Analysts gather users' stories in order to uncover the embedded knowledge associated with their work practices which the developed system must support.

§'s 7.2.4 and 7.3.4 illustrated that, Enki gathered the users' stories to indentify the embedded knowledge associated with their working practices. Enki listened to the users' stories in interactive discussions sessions. Through the use of storytelling Enki were provided with deep insights into the problems and working practices inherent within the system, interactions between different users within the organisation, information concerning critical events and the decisions that were taken by the user to overcome problems. From these stories, Enki were able to understand the values, principles and assumptions that were important to the company and that each user complied with. Thus, the users were able to transfer their embedded knowledge needs to Enki through storytelling, which Enki were able to associate with the working practices they observed the users carrying out.

Thus, this working proposition was supported by both case studies' findings.

WP14: The use by analysts of reflective practices helps uncover embedded knowledge requirements.

Based upon the previous discussions (§'s 7.2.4 and 7.3.4) it was evident that, through the use of reflective practices Enki were able to determine the users' embedded knowledge requirements. From the findings of both case studies, Enki carried out a comparison of the stories they were told and presented the users with the inconsistencies that arose between those stories. Discussions between Enki and the users ensued where these differences were clarified by the users and gaps in Enki's understanding were filled in. This was important to Enki as it allowed the users to fill in gaps in their understanding of the users' stories. By providing the users with the opportunity to reflect on these questions in relation to what they said in their stories, Enki were able to challenge them to provide a more realistic picture of what their working practices were and what they required from the system. This in turn, enabled Enki to gain a greater understanding of their requirements and knowledge needs, as Enki were provided with a more coherent story. It was through reflection and reconstruction of the past on the part of the system users that Enki were able to identify the requirements and knowledge needs of the system users.

In addition, while participating in the working context of the users, Enki used observational techniques to determine the working practices of the users. By comparing these observations with the stories Enki received from the lead users about their working practices, Enki were able to uncover further use of embedded knowledge by the users. Re-questioning the users and providing them with an additional process of reflection Enki were able to identify the actual working practices of the users and the embedded knowledge inherent within those practices. Through the use of reflective practices and allowing the users to reconstruct their processes to take into account any inconsistencies, Enki were able to uncover a complete set of embedded knowledge requirements and the actual working practices of the users that the developed system must support.

From the findings it was evident that this working proposition was supported by both case studies.

7.5 The Embedded Knowledge Transfer Process Model for ISD

Based upon the conceptualisations identified in §4.3, a number of important insights emerged from the preceding case discussions about the knowledge transfer processes used to elicit embedded knowledge requirements between the developer and the users in the development of information systems. From the findings for both case studies, the knowledge transfer processes utilised by Enki proved very complex. A tentative model was first presented here to illustrate the dynamic nature of these knowledge transfer processes that were inherent in Enki's systems development process, explicitly in the elicitation of the users' embedded knowledge requirements that the developed system must support (Figure 7.2). As illustrated by Figure 7.2, the development process that emerged from both of these cases can be described as evolving through six general phases. From the findings these were identified as: (1) initial requirements gathering, (2) identify lead users and requirements gathering, (3) general user involvement and further requirements gathering, (4) systems design and requirements gathering, (5) prototype testing and requirements gathering and (6) systems implementation and requirements gathering, with each phase having its own unique phase characteristics.

7.5.1 The Development Phases

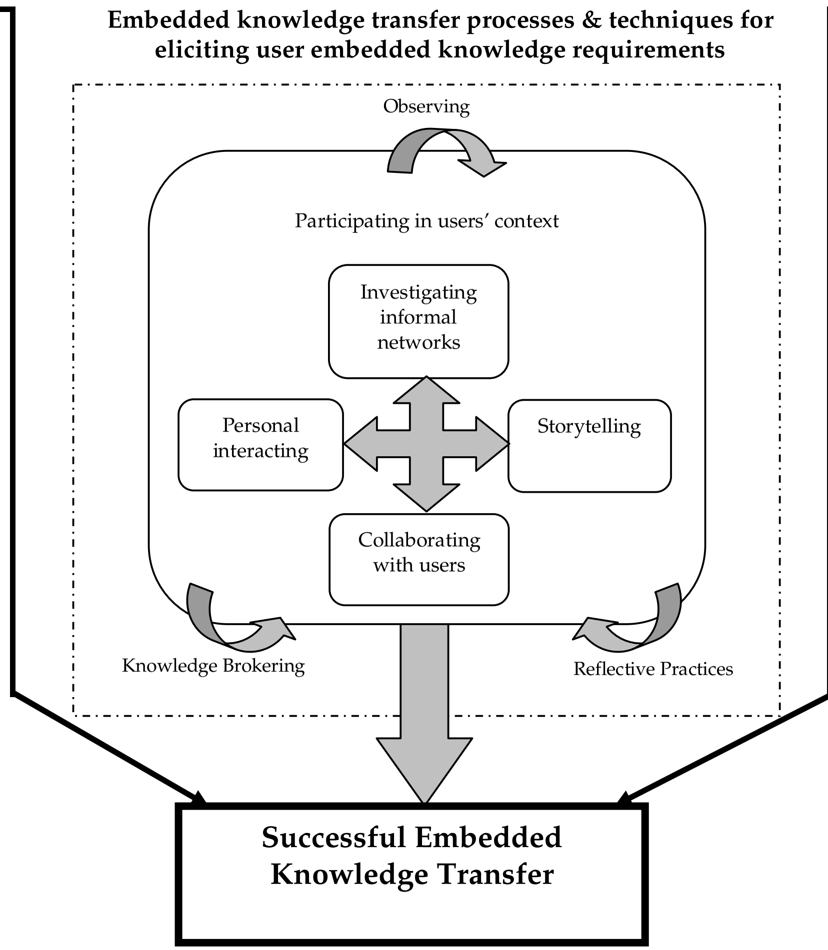
For both cases, Enki's development process began with the initial requirements gathering phase (§'s 6.2.3.1 & 6.3.3.1). The developer met with the management of the client company in order to identify and elicit the management team's objectives for the proposed system and its initial requirements, which as depicted in Figure 7.2, referred to the characteristics of the phase. However, as distinguished by Case Study Two, the management team themselves create the initial specifications document for the developers, stating their overall requirements and purpose of the system.

The next phase in the development process, identifying key players and requirements gathering, was carried out by Enki to distinguish who the lead users of the system were (§'s 6.2.3.2 & 6.3.3.2). For case one, Hathor identified who Enki needed to initially talk too and who the company deemed the experts for a particular area. For case two, Enki went to the department managers to discuss their system needs. By interacting with these lead users the development team could elicit their embedded knowledge requirements, and examine the current system further in conjunction with any system documentation. This was necessary as it allowed them to gain a preliminary understanding of the users' practices.

However, to fully understand the users' practices, the general users of the system were involved in the development of the system (§'s 6.2.3.3 & 6.3.3.3). Thus, the third phase as highlighted in Figure 7.2 was carried out, namely, the general user involvement and further requirements gathering phase. It was through the users' involvement and the developer's interaction with them that their working practices and key knowledge requirements for the system were identified. For both case studies, the management and inclusion of the general users into the development of the system was a very important process. This was paramount to the overall success of the development process, as it created a level of ownership and commitment between the general system users and the development process. This in turn, would result in a successful system being developed, as the general users felt that they were being listened to and that they were playing an important part in the development of the system. Enki actively encouraged them to contribute towards the development of the system by listening to their needs and suggestions.

Figure 7.2: The Embedded Knowledge Transfer Process

Development Phases	Phase Characteristics
1. Initial Requirements Gathering	Elicitation of management's objectives and requirements for proposed system.
2. Identify Lead Users & Requirements Gathering	Identification of lead system users. Interaction between them and development team in order to elicit their embedded knowledge requirements. Examination of current system and documentation.
3. General User Involvement & Further Requirements Gathering	Involvement of general system users in development process to elicit their embedded knowledge requirements. Identification of key recording points, critical cases, systems recovery and repetitive processes.
4. Systems Design & Requirements Gathering	Design documents created for new system including the hardware and software to be used in development. Negotiation with 3rd party developers if necessary. Presentation of documents to management and lead users, further requirements elicitation if necessary. Management signs off on proposal.
5. Prototype Testing & Requirements Gathering	Development of prototype. Users carry out systems testing on prototype. Further requirements elicitation if requirements are missing – iterative process.
6. Systems Implementation & Requirements Gathering	System implemented once no requirements are identified as missing. Parallel running is carried out until users are happy that system meets and supports their embedded knowledge requirements.



Through their interaction with the current system and its users, Enki were able to identify the key recording points of the system, the critical cases that the system currently supports the users' practices during systems recovery and the mapping of repetitive processes that the users may not fully be aware of. As illustrated, this phase was on-going within both cases until Enki were satisfied that they had successfully elicited all the knowledge and practice requirements of these users, that is, when they had reached a level of data redundancy with the knowledge.

As can be seen in figure 7.2, the following phase concerned the development and design of the system documentation (§'s 6.2.3.4 & 6.3.3.4). This documentation incorporated the requirements elicited from the managers, lead users and general users of the system, the system hardware and the software required to development the system. For both cases, as soon as the documents for the new system were created, Enki presented them to the managers and lead users to allow them to discuss if the system would meet all their needs and support the organisation's working practices. If they were not satisfied, Enki returned to the users to carry out further elicitation of their requirements, explicitly phases two and three in the development process. This process was iterative until the management team and lead users were satisfied that the system would meet and support all their working and knowledge needs. The proposal was then signed off by management and Enki commenced with the development of the system. However, as illustrated by case one, this phase can also include the negotiation and interaction between the development company who is designing the system, the users requiring the system and any 3rd party developers who are to participate in the development of the overall system. For case one, these relationships and each company's responsibilities were worked out prior to the creation and presentation of the proposal by Enki.

The prototype testing and requirements gathering phase was the next step in the development lifecycle (§'s 6.2.3.5 & 6.3.3.5). For case one, Enki returned to Hathor's lead users and knowledge broker and got them to carry out systems testing on the prototype. If they felt that requirements were missing or that the system did not meet and support their working practices or knowledge needs, then Enki returned to the elicitation phases to identify these requirements, that is, development phases two and three. This process was also repeated for Case Study Two. With case two, once the lead users were satisfied with the system, then parallel running was carried out by Enki until the system was a replica of their existing system. As soon as this had been achieved, Enki implemented the system into Matuta. However, in a few instances, Matuta's management team refused to allow Enki to carry out parallel running and wanted the system to go live immediately, thus ending the development lifecycle for that aspect of the system.

For Case Study One, the development process continued until Enki installed the system into the company (§6.2.3.6). The system prototype was first set up to allow Hathor's lead users to operate it and verify that all their knowledge and working needs have been supported. If requirements were identified as missing, Enki again returned to the elicitation phases two and three in order to identify and elicit the omitted user needs. This process was continuous until the lead users were satisfied that the prototype of the system had met and supported all their practice and embedded knowledge requirements that they needed in order to fulfil their operations. For the final phase of the development process, Enki implemented the system into the Hathor and carried out parallel running to ensure that the final system met and supported all the users working practices and embedded knowledge needs. If not, Enki returned again to phases two and three in order to elicit those missing requirements.

7.5.2 The Knowledge Transfer Processes & Techniques used by Enki to Elicit the Users' Embedded Knowledge Requirement

From the findings of both case studies, this research identified five knowledge transfer processes that were paramount to the elicitation of the users' embedded knowledge requirements, as depicted in Figure 7.2. The processes that enabled knowledge to be successfully transferred between the users and developers were (1) participating in users' context, (2) investigation of informal networks, (3) personal interactions (4) collaborating with the users and (5) storytelling. Several techniques were also identified from the case studies as facilitators for the transfer of knowledge between the developers and the users. These were used in addition to the transfer processes and were identified as: observations, knowledge brokering and reflective practices. Although the development process took a stages approach to the development of a system, the knowledge transfer processes used to elicit the users' embedded knowledge and practice requirements occurred simultaneously and overlapped until understanding had been achieved by the developers.

7.5.2.1 Participating in the Situated Context

The discussion started with the process of participating in the users' context. As §3.3.1 stated, the reason for the significance of this process was that most of the embedded knowledge of the users was bound up in their working context. As illustrated by Figure 7.2, participating in the situated context of the users was the main knowledge transfer process utilised Enki for these cases. For both case studies, this process was utilised at every stage in the development lifecycle and it allowed Enki to employ other knowledge transfer processes and techniques to ensure that all the users' embedded knowledge requirements and working practices were identified. This process allowed Enki to determine the strategies that the company employed and the facts they regarded as relevant to their daily practices. §3.3.1 suggested that, the users' context would provide the analyst with clues as to how the users construct and interpret events within their organisation and through their participation in the users' environment the analyst would be able to identify what the users' attitudes and opinions, the customs and traditions they have and the rituals they employ. As illustrated in the findings for both cases, by engaging with the management team, the lead users and the general users in their working environment, Enki were able to discover how the users conceptualised and interpreted events within the organisation. In turn, Enki was able ascertain how the users' attitudes, values and opinions affected how they performed their daily operations. Without an understanding of these working practices and knowledge needs, the development team could not guarantee that the final system would conform to the users' working practices and support the knowledge needs of the users.

7.5.2.2 Observing

While engaging the users' in their working environment, observational techniques were utilised by Enki in both case studies. As discussed in §3.3.1.1, the knowledge required by the organisation to carry out its working practices was embedded and created in the psyche of the systems users and they themselves may not be aware of performing those practices. Thus, by participating in the context of the users and observing them performing their working practices, Enki were able to gain an understanding into how those practices were carried out and what knowledge the users required to perform those tasks. By getting the users to walk them through their work process and to explain what was occurring and the rational behind their decision-making, Enki were able to uncover the use of embedded knowledge by the users. Comparing what the users' descriptions of their working practices with the observations, Enki were able to uncover any discrepancies between the two. As §3.3.1.1 stated, by getting the users to reflect on what has taken place, a description of the embedded knowledge required to carry out the task can be made. Thus, by presenting these inconsistencies to the users, Enki were able to challenge them to reflect and reconstruct their past to take into account these differences. Consequently, Enki were able to obtain a clear picture of description of the users' actual working practices and the embedded knowledge required for that practice to be carried out successfully. Thus, for both cases, Enki's participation in the users' working context allowed them to use observational techniques. This in turn, afforded them the opportunity to distinguish the actual working practices of the users from their espoused working practices and to uncover their knowledge needs that the developed system would need to support.

7.5.2.3 Investigating Informal Networks

§3.3.2 maintained that, individuals are not isolated and are not an independent source of knowledge and that specific areas of embedded knowledge are informally transferred. While engaging the users in their working context, the development team were able to identify the informal networks that existed between the users and the system and observe the knowledge flows within and between the user communities. Figure 7.2 clearly placed the investigation of informal networks process within the participation in users' context and it was through engaging with the users in their working environment that Enki were able to identify who the users went to when problems arose or when they needed advice on different issues, as discussed in §3.3.2. For Case Study One, Hathor's management team identified the lead users of the system for Enki, while in case two, Enki identified who the lead users were. For Case Study Two, Enki approached the department managers as they were acknowledged as being the experts in that particular area. These lead users in turn identified other key users that were seen as the experts in certain areas and who held knowledge that Enki needed to understand in order for their working practices to be successfully supported by the system. Thus, Enki were encouraged to incorporate these users into the development process. By investigating these informal networks Enki were able to identify vital sources of knowledge requirements that the companies needed for their working practices to be carried out. Thus, the identification and investigation of these informal social networks was paramount to the knowledge transfer process between Enki and the system users.

7.5.2.4 Personal Interacting

For embedded knowledge to be successfully transferred, some form of interaction must occur between the system users and the development team (see §3.3.3), hence the importance and introduction of the personal interactions process (Figure 7.2). Through continuous interactions while engaging the users in their working context, Enki were able to form personal relationships with the users. Personal interactions with the users took the form of interactive discussions, storytelling, brainstorming sessions by using whiteboards and diagrams. As §3.3.3 illustrated, successful interaction, where personal relationships had been formed, allowed the informal embedded knowledge of the community to be successfully transferred. In both case studies, the establishment of personal continuous interactions was an important process for the development lifecycle. It facilitated embedded knowledge transfer between Enki and the system users, in that Enki were able to seek clarifications and explanations from the users about their embedded knowledge and practice requirements during these interactions.

7.5.2.5 Collaborating

§3.3.3.1 maintained that, by collaborating with the users the developers will be provided with a deep understanding of the users' embedded knowledge. From the findings of both case studies, Enki continuously collaborated with the users during the development process in order to fully understand and interpret their embedded knowledge requirements and working practices. Through their continuous interactions and collaborations with the users in their situated context, Enki were able to understand the professional language used by the system users, as they were able to associate what the users said about their practices with what Enki observed them performing. As discussed in §3.3.3.1, through constant collaborations a strong tie could emerge between the developer and the users, which would provide a greater understanding of the users' world and how their embedded knowledge was used. In addition, the creation of this strong tie could result in both parties putting more time and effort into the interaction and collaboration process to ensure that transfer process was a success. By collaborating with the users, Enki allowed for a strong bond to emerge between the users of the system and the development lifecycle. This strong bond resulted in the users' cooperation and commitment to the development process, which in turn ensured their support that their working practices and knowledge requirements would be successfully understood by Enki. For both cases, Enki felt that collaboration between the users and the development process was important as they did not want the users turning against the system and wanted them to feel that they were being listened to.

7.5.2.6 Storytelling

As depicted in Figure 7.2, the process of storytelling was also used by Enki to elicit the users' embedded knowledge requirements. §3.3.4 maintained that, the use of storytelling would be an important and powerful process when transferring, exchanging and sharing embedded knowledge within the users' situated context. It was used by Enki in both case studies to identify the problems the users were experiencing with their system, how their working practices were carried out and any interactions that occurred between the different user communities and the users. Stories also identified how the users' embedded knowledge helped them deal with mistakes and could identify the logic and assumptions that underlined their decision-making processes when overcoming those mistakes (§3.3.4). For Enki, the rationales behind the decisions that were taken to overcome problems that the users encountered when carrying out their practices were also explored. In addition, through storytelling Enki were able to gain an insight into the values, principles and assumptions that underlined the organisation and impacted on how the users' working practices were carried out. For case one, Enki listened to the users' narratives concerning their practices and suggestions for enhancing the system. They also used diagrams to help the users explain their stories and practices. However, for case two, Enki did not use diagrams to aid the elicitation of the users' requirements through stories. In addition, the initial development specification was created by Matuta' management team not Enki, thus the level and depth of using storytelling to identify and elicit the managers' requirements was greater as they could focus in on what the organisation as a whole wanted from the system.

7.5.2.7 Knowledge Brokering

Nevertheless, as maintained in §3.3.3, while collaborating and engaging with the users in their working context, misperceptions and misinterpretations of the users' requirements can arise due to a lack of common coding scheme and language difficulties, resulting in a less efficient knowledge transfer process. From both case studies it was apparent that, Enki did encounter language difficulties with the users. To overcome these communications and language difficulties, both case studies created the role of a knowledge broker. For Case Study One, the role of the knowledge broker was established to act as an interpreter and two-way communications process between Enki and the system users to ensure that all knowledge was effectively transferred and understood by all parties involved in the development process. While for Case Study Two, the knowledge broker was created to overcome communications difficulties coupled with freeing up company resources and minimising the users' involvement in the development process. It was felt that through the use of a broker, the embedded knowledge requirements of their users could be framed in the technical language of the developers, thus ensuring that the users' working practices and knowledge requirement could be successfully transferred and interpreted correctly by Enki.

Although this premise worked effectively for Case Study One, it did not for case two. For the latter case study, Matuta's knowledge broker was part of their IT department which was controlled by Finance, thus the requirements of the users were often paraphrased in relation to cost of delivery or misinterpreted altogether. Thus, Enki were often given incorrect requirements. Additionally, in Case Study Two, the knowledge broker failed to set up meetings between Enki and the users to discuss and clarify these requirements. Through Enki's lack of contact with the users, they were unable to successfully elicit their actual working practices and knowledge needs. Thus, the system failed to meet the users' requirements due to a lack of personal continuous interaction, miscommunications and misunderstandings. Furthermore, the personal relationships that were established with the users failed to develop and ceased to exist, thus affecting the development process.

However, while the use of brokering was an effective process in ensuring the successful transferral of users' embedded knowledge requirements to the developers in Case Study One, it was important to note that the culture of the organisation significantly impacted upon the success of the knowledge broker in transferring that knowledge. The organisation itself must actively encourage the transfer of their embedded knowledge to the developers, to guarantee the success of sharing that knowledge. For Case Study Two, Matuta's management team heavily impacted upon the development process used by Enki. The knowledge broker was set up to limit the time the users' collaborated and interacted with Enki during the development process. Also, in several instances the managers in Matuta forced Enki not to implement parallel running of the system but to go live immediately. By opting to implement the system at this stage, Matuta were not giving Enki the opportunity to carry out a final test of the system to ensure that it supported all the working practices and knowledge needs of its users.

7.5.2.8 Reflective Practices

While using storytelling to elicit user needs, the technique of reflective practices was also utilised by Enki for both cases. §3.3.4 stated that embedded knowledge can present itself in explicit forms through differences between two texts. In both cases, Enki analysed the users' stories and compared them to each other to determine if there were any differences between the narratives. Enki then redefined their line of questioning by presenting these differences to the users in order for them to reflect on and fill in these gaps in Enki's understanding. As maintained in §3.3.4, clarifications must be sought and interruptions made during the process of storytelling. By allowing the users to modify their story to take into account such feedback, Enki were able to gain a greater understanding of the story's content and the embedded knowledge at use. Additionally, Enki compared the users' stories with the working practices they had observed the users' performing while they had engaged the users in their situated context. This process allowed Enki to identify further existence of the use of embedded knowledge on the part of the users. Any inconsistencies that arose between the observations and the stories were also presented to the users. By re-questioning the users and allowing them to reflect on these discrepancies, Enki were able to identify the actual working practices of the users and the use of embedded knowledge inherent within those practices. As suggested in §3.3.4, through the use of reflective practices and allowing the users to reconstruct their work processes to take into account any inconsistencies that arose, Enki were provided with an accurate description and understanding of the users' embedded knowledge and working practices

Finally, it was important to understand that, although the development phases depicted in Figure 7.2 transpired as stages, the knowledge transfer processes and the techniques used by Enki to elicit the users' embedded knowledge requirements did not. These processes were iterative and occurred simultaneously until Enki had obtained a thorough comprehension of the users' working practices and were satisfied that they had successfully elicited the necessary embedded knowledge requirements to ensure that the developed system would meet and support all the practice and knowledge needs of the users.

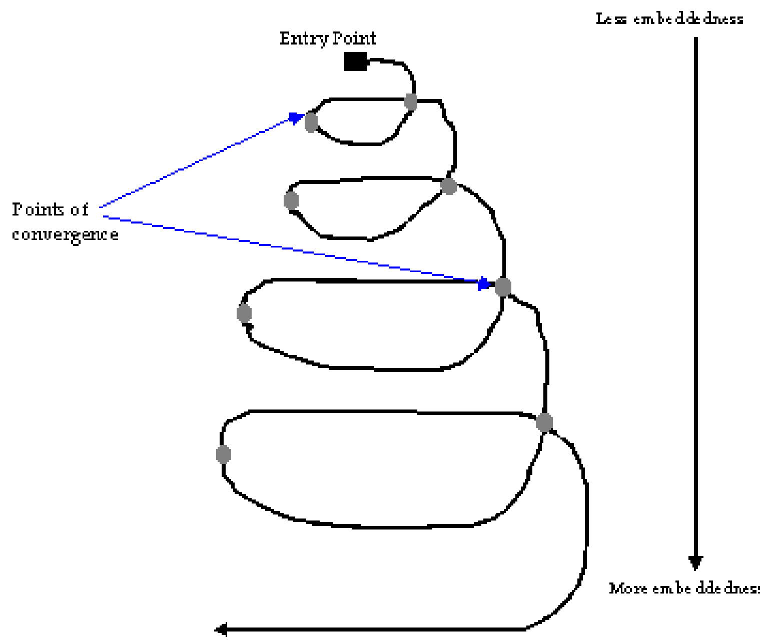
From the model depicted in Figure 7.2, underneath these knowledge transfer processes another layer was at work, which ensured that the developers and users could achieve a successful level of understanding. Once this understanding had been achieved, the users' embedded knowledge could be identified and explored. Figure 7.3 identified the continuous processes that underlined the knowledge transfer process previously discussed.

Embedded knowledge transfer worked from less embeddedness to more embeddedness as understanding grew between the users and the developers. Embedded knowledge transfer began from key entry points, that is, the source of knowledge. For both cases, these knowledge sources could be identified as the managers and lead users. These users in turn identified other key knowledge sources (users) who needed to be involved in the development process. From the entry points, knowledge understanding spiralled outwards further and further across the community. By utilising the knowledge transfer processes illustrated in Figure 7.2, the developers could draw out the users' embedded knowledge until a point of convergence was reached.

At these points of convergence, requirements became apparent and could be recorded and understood, leading to a common intersubjective understanding between the developers and the sources of knowledge. This understanding could be described through shared languages, which itself was created by the spiralling intersubjective processes.

Each direction involved some form of knowledge brokering. This involved the ability to assist the users and the developers in reaching a point of convergence during their interactions. Convergence may result in agreed statements or stories of what has happened, would be likely to happen and may happen in the future. Thus, the developer would be able to understand the future, past and present embedded knowledge requirements once convergence had been reached.

Figure 7.3: Spiral Model Underlining the Embedded Knowledge Transfer Processes



Additionally, knowledge brokering required the ability to move outwards into the wider community of users to find important knowledge sources of stories, events, experiences and problems which need to be identified and organised by Enki into a coherent organisational gestalt. This involved the drawing together of people, the formation of relationships, synergies, etc. within the organisation.

However, if a point of divergence was reached, the spiral process remained stagnant or else stopped altogether, as no common understanding has been reached by both parties. This was what happened in Case Study Two when Matuta's managers set up the role of the knowledge broker. Interactions and collaborations were reduced and the personal relationships between the users diminished. This in turn, impacted on the creation of shared understandings between Enki and the users, which was necessary for embedded knowledge to be successfully transferred.

This ongoing spiral was in fact a continuous process alive in the users' communities but lacking a structured system. The developers would provide a system through which people could learn who they are and who they needed to become in order to operate efficiently within the user community. From this, emerged the concept of the new system, through which the new system with its technology, culture, relationships and identities emerged as a series of phenomena that was organised in a gestalt of values, assumptions, hopes and temporality etc.

7.6 Conclusion

This research project has shown that the knowledge transfer processes used in the elicitation of users' embedded knowledge requirements for systems development was a complicated process. As was illustrated in the comparative discussion and Figure 7.2, the complexity intrinsic to eliciting embedded requirements arose as it involved the systems developers intensely collaborating and involving users throughout the entire development process, not just at one phase, explicitly the requirements elicitation stage. However, as this research illustrated, this was a difficult process because of the multitude of users, their practices and the embedded knowledge that created the working context of the systems users. Indeed, the complexity was clearly evident as it was the users' social and working environment that facilitated the knowledge transfer processes necessary for the development team to identify and elicit the embedded knowledge requirements pertaining to the users' practices, which the system must support.

The major findings emanating from this work was that, the intensity of the developers' participation in the users' situated practices was an evolutionary process that consisted of iterative processes of direct involvement with the users to identify their informal networks via personal interactions, collaboration, storytelling, observations, reflective practices and knowledge brokering. The framework depicted in Figure 7.2 advanced the existing literature on systems development by establishing that without successful knowledge transfer between the systems developers and the users the necessary requirements needed to fulfil all the working practices and knowledge needs of the users would not be met, thus leading to a failed and underdeveloped system. However, as Figure 7.3 indicated, the processes underlining the knowledge transfer processes were just as complicated in order for understanding to be achieved between the users and developers. Without this convergence in understanding, the users embedded knowledge requirements could not be successfully understood and supported by the developed system.

Chapter 8: Conclusion

8.1 Introduction

This final chapter presented a discussion of the outcome of the project in relation to the research objectives and the limitations of this study. Following this, were the key contributions concerning theory and practice, as well as research methodology emanating from this research. The chapter concluded with the implications for the future direction(s) of the research in this area.

8.2 The Outcome of the Project in Relation to the Research Objectives

The overall objective of this study was to investigate how users' embedded knowledge requirements could be successfully transferred and elicited for the development process. To achieve this, the research focused on the knowledge transfer processes that could be used by the developers to elicit users' embedded knowledge requirements. In addition, how those knowledge transfer processes interacted with each other to ensure the successful transfer of embedded knowledge between the users and the developer was also considered. The following sections reflected on the research objective and concluded with the overall aim of the project, namely, to investigate how embedded knowledge requirements of the users could be transferred and elicited into the systems development process.

Research Question 1: *What are the knowledge transfer processes used by systems developers to elicit the embedded knowledge requirements of the systems users during the development process?*

This research concluded that the knowledge transfer processes used by systems developers to elicit the embedded knowledge requirements of the both the lead users and general users in these case studies were evolutionary in nature. These processes consisted of: participation in the users' situated context, personal interactions and collaborations between the development team and the users, investigation of users' informal networks and storytelling to discuss inconsistent practices of the users. In addition, several techniques were used by the systems developers to identify the users' embedded knowledge requirements while using these processes, namely: observations, knowledge brokering and reflective practices.

Research Question 2: *How do these knowledge transfer processes interact with each other to enable the transfer of the users' embedded knowledge requirements to the systems developer during the development process?*

The knowledge transfer processes used by the developers to elicit the users' embedded knowledge requirements did not transpire as stages. These processes – participation in the users' situated context, personal interactions, collaborations with the users, investigation of informal networks and storytelling – occurred simultaneously and were iterative until the development company had obtained a detailed understanding of the users' working practices and embedded knowledge needs. Additionally, the developers continuously utilised these processes until they were satisfied that they had successfully elicited the necessary embedded knowledge requirements to guarantee that the developed system would meet and in turn, support the users' working practices and knowledge needs.

This research illustrated that, the elicitation of the embedded knowledge requirements of users and the knowledge transfer processes used by developers was a complicated process. Initially, the developers had to participate in the working context of the users. By doing this, the developers were able to observe the users carrying out their working functions in real time. This allowed them to 'see' what was actually occurring within the users' environment. Through their participation with the users, the developers were able to observe the informal social networks that existed between the users and the departments, how they interacted with the system and how the system supported their work practices. In addition, the development team formed personal relationships with the users through their continuous interactions with each other. Consequently, by personally interacting with the users on a continuous basis and through the development of strong ties, the developers were able to gain an understanding of the users' embedded knowledge needs and working practices. By listening to the users' stories concerning the creation of those practices and how encountered problems were solved, the developer was able to visualise a clear picture of what the actual theories-in-action were for the users and hence, the users' system requirements.

In order for the developer to successfully elicit the users' embedded knowledge requirements, all these processes – participation in the users' situated context, personal interactions, investigation of informal networks and storytelling – must occur between the users and the systems developers. Without the existence of any one of these knowledge transfer processes, the development company would fail to identify the embedded knowledge and working practice needs of the users. For instance, unless the developers engaged the users in their situated context, they would not have been able to identify the actual working practices of these users via their observations and the users' narratives. Also, they could not have uncovered the informal social networks that existed within the users' community. Strong ties and a personal relationship proved necessary for embedded knowledge to be successfully transferred, as was suggested in §'s 3.3.3 and 4.2.3.1. However, unless the systems developers continuously interacted with the users to understand their needs and develop a relationship with them, they would not be able to uncover these requirements. In addition, as can be seen from these case studies, the users had to collaborate and be involved in the development of the system throughout the entire development process, not just at one phase, explicitly the requirements elicitation stage. Without their involvement, the developers could not have ensured that the system would successfully meet and fulfil all their practice and knowledge needs. Thus, the developers had to clearly establish good relations with the users and engage them in their working context in order for the embedded knowledge requirements to be successfully transferred into the development of the system. Essentially, the developers had to put the users at the centre of the development process and include them in the entire development lifecycle. This was important as the system must meet and support their needs and they were the ones who know what they require from the system.

Underlining these knowledge transfer processes was another layer, which allowed the developers to understand the users and their situated context. This was illustrated in Figure 7.3 as a continuous spiral. The developers started the process at a point of entry, for example a lead user. Interactions occurred using the already described transfer processes until convergence in understanding had been achieved between both parties. This continued into the wider community through the investigation of informal networks, until the developer had explored all embedded knowledge requirements for the users and convergence had been reached by the users and the analyst. If divergence in understanding occurred, the process would break down and comprehension of the users' embedded knowledge requirements would not take place. The process of knowledge brokering facilitated this on-going spiral process and as illustrated by the findings and discussion in both cases, can either assist or impede the understanding and exploring of the users' embedded knowledge requirements.

8.2.1 The Overall Aim of the Study

Research Objective of Project: *To understand how user embedded knowledge requirements can be transferred and elicited for the system development process.*

As illustrated in Table 3.2, existing literature tended to approach knowledge transfer from a stages perspective. What has emanated from this study was that the transfer processes for successfully transferring user embedded knowledge requirements was far more complicated than a sequential process. Indeed, a sequential process would have depicted an incomplete understanding of the phenomenon. This research has shown that, understanding the knowledge transfer processes for the elicitation of user requirements entailed the researcher investigating what those processes were and how they interacted with each other. Participating with the users in their situated context and intensely involving those users in the entire development process, through iterative cycles of personal interaction, informal networking, knowledge brokering, storytelling, observation and reflexivity, the embedded knowledge requirements needed to carry out the users' practices could be elicited by the developers. In turn, these knowledge requirements could then be taken into account when the system was being developed, thus ensuring that it successfully met and supported all the knowledge needs of the users.

8.3 Limitations of the Research

By focusing on the transfer and elicitation of embedded knowledge, this study was limited to studying the transfer processes between the individual user and the analyst. The interaction between the user and the analyst to transfer knowledge was just one relationship between potential transferees that could have been chosen. Others that could have been chosen and explored were: the knowledge transfer processes that occurred between different communities, at departmental, organisational or inter-organisational levels.

The final limitation related to the number of cases employed by this research. As set out in Chapter five, there were no precise guidelines to the number of cases. However, there was a growing tendency to judge the quality of case research by its sample size. For example:

> …analytic conclusions independently arising from two cases…will be more powerful that those coming from a single-case alone. You can also avoid a common criticism about single case designs – that the choice of cases reflected some artifactual condition about the case – rather than any theoretically compelling argument (Yin, 2003, 135).

Unfortunately, there was a predetermined impression that if a researcher utilised a large sample size, the empirical work would become more robust and reliable, while data gathered from one or two sites was considered illustrative and tentative (Yin, 1994). These views were consistent with positivistic notions of *generalisability*, rather than on the principle of deep *understanding* which was associated with interpretivism. Thus, the question that needed to be asked was how many cases were necessary for understanding to be gained? Romano (1989) argued that there was not an answer to this question, “the decision is left to the researcher… [and] should not be influenced by the view that the more cases studies one consults the greater it will increase generalisability and validity” (ibid, 36).

In effect, research originating from single or even two case studies was no less valid than research from multiple cases. What was being suggested here was that, the researcher selected the number of cases that would enable the research questions to be answered. Moreover, the use of two cases for this research ensured that the findings would be corroborated and in turn, provided a greater understanding of the phenomenon being investigated rather than a statistical representation of the population (Mason, 1996)[16].

8.4 Contributions of the Study

The contributions of this study were divided into theoretical, practical and methodological. The following sections discussed each of these in turn.

8.4.1 Theoretical Contributions

This study progressed research on knowledge transfer in systems development in a number of different ways. First, the study used a human centred systems theory as the theoretical approach. In general, the findings emanating from this research provided support for the basic premise of a human centred systems theory, in that, systems developers must take into account and complement the human skills of the user, during their development and that they must be adaptable to the changing needs of those users. As discussed in Chapter two §2.4.2, human centred systems theory challenged the established concepts of user separation from the development process. For proponents of this perspective, system users cannot be separated from their working community and technology should be developed to support the users' social and professional knowledge. As illustrated by the model presented in the previous chapter, the transfer of

[16] The reader is directed to Chapter Four were justification for the rationale behind these choices was argued.

knowledge cannot occur without the developers' participation in the users' working context as this is where most of their embedded knowledge resides. Thus, the main aim of systems developers must be to seek a balance between humans, their skills, their knowledge and their technology. The model sought to create this balance, as the developers must take into account the informal social networks that exist within the users' community and the knowledge they require in order to carry out their working practices. In addition, the model considered how the developer would take into account the users interactions with the system that are needed to support their working practices. In order to consider these interactions, the model highlighted the importance of user involvement in the development process from the beginning of the development lifecycle right through to the implementation and live usage of the system. By involving and collaborating with the users throughout the systems lifecycle, the developers were ensuring that all the working practice and embedded knowledge requirements of the users were incorporated and supported by the system. This in turn, would ensure that the developed system was socially useful and placed the users' needs and skills at its core. Consequently, this discussion illustrated the adequacy of this theoretical perspective for studying the processes required to transfer embedded knowledge during the systems development lifecycle.

Second, the results of this research suggested that current conceptions about the importance of embedded knowledge for the success of the development process do not correspond with the needs of practice. One of the main reasons for this neglect in the ISD research was that there was a tendency amongst systems development studies to focus purely on the phases required to carry out the development lifecycle or on what operations the system was to perform. However, while there were numerous studies investigating the actual development process, few have directed attention towards investigating the critical knowledge required by the users in carrying out their practices. Thus, the theory about the knowledge transfer processes was inadequate and poorly understood in relation to the practices being implemented by systems developers. Indeed, systems development research had become stagnant and as illustrated by this research, a significant gap existed between theory and practice. This study suggested that, systems developers must consider an evolutionary, participative approach with the system users, utilising participation in the users' situated context, personal interactions and collaborations between the development team and the users, investigation of the users' informal networks and storytelling to discuss inconsistent practices of the users, in order to successfully elicit the embedded knowledge needs and working practice requirements of the users.

Third, the importance of the role of a knowledge broker in the development process was highlighted by the findings. The knowledge broker could assist developers in overcoming communication and language difficulties, which may arise due to a lack of understanding of the users' working environment and practices. However, as the previous chapter illustrated in §'s 7.2.3 and 7.3.3, the reasoning behind the user organisation's decision to establish the role of the knowledge broker can affect their role in the development process. If the role was set up to operate as a two-way communications process between the developers and the system users then, as findings for case study one suggested, the knowledge broker would ensure that all knowledge would be effectively transferred and understood by all parties involved in the development process. However, if the knowledge broker was created to overcome company resources and minimise the lead users' involvement in the development process, the impact of the knowledge broker's role on the development process would be negative, as was the case for Case Study Two. Thus, the reasoning behind setting up a knowledge broker to act as a gatekeeper between the users and the development team was important and can have either a positive or negative affect on the overall development process and ultimately on the success of the system.

Fourth, this research contributed to the literature on the philosophy of ISD. Chapter two highlighted that the functionalist perspective had been the focus for most ISD research, with scant attention towards the interpretivist approach. Additionally, most ISD methodologies for systems development have adopted this mechanistic view. They failed to take into account the involvement of the users in the development process, which as argued by this research, was paramount for the ultimate success of the system. Also, these ISD approaches did not address the fundamental human practices that make up organisations. Failure on the part of the developers to support and elicit these issues when developing the system would result in a system that would not meet the practice and organisational needs of the users. By adopting an interpretivist approach towards system development such as the model presented in Chapter seven §7.5, the subjective needs of the users, their performance objectives as well as their technical requirements could be met, thus ensuring the success of the system.

Fifth, this research also contributed to the knowledge transfer literature. As highlighted in §3.2, most researchers focused on the inputs required to transfer knowledge, or the characteristics and management of the process, or on the consequences of transferring embedded knowledge. Scant attention had been given to an in-depth understanding of the actual knowledge transfer processes involved in transferring embedded knowledge between individuals. Those studies that did focus on the process of knowledge transfer, conceptualised it as a sequential orderly progression from one phase to the next, thus neglecting the dynamic and complex nature of the knowledge itself and the emerging context it was embedded in that shaped the knowledge.

Finally, in comparison to the static representations of knowledge transfer, the knowledge transfer process model developed in this research provided researchers with a means for studying dynamic and complex processes within the development process.

8.4.2 Contributions to Practice

From this study a number of important contributions to practice arose. It was argued in this study that, a significant gap existed between what academics described as best practice and the processes that practitioners used to elicit user knowledge requirements. To close this gap, a detailed case description provided systems developers with substantial insights into the knowledge transfer processes that would enable systems developers to successfully elicit the embedded knowledge requirements of the users during the development process.

To effectively develop systems, the evidence suggested that the developer must collaborate with and involve the users throughout the development lifecycle. Heavily involving the users would ensure their cooperation and commitment to the developed system, thus contributing to its overall success. The careful management of user relations would be paramount to achieving this success. As §'s 3.3.3 and 4.2.3.1 suggested, by listening to the users and taking the time to understand their needs, the developers would be ensuring the creating of personal relationships between them, the users and the development process. As the previous chapter illustrated, by the developers taking the time to explain to the users when suggestions could not be implemented, they were giving their assurances to the users that all their comments were being listened to and considered. Hence, the users would be more willing to cooperate and involve themselves in the development of the system. Without the users' involvement and personal interactions within the development process, the embedded knowledge required for the system to conform to the users' needs and practices would be omitted from consideration.

In addition, the development process should be viewed as an iterative, participative practice, whereby the users and developers would co-create and design the system. This would ensure that the system would meet the performance objectives of its users and their organisation. Neglecting to incorporate the user embedded knowledge requirements into the development process would result in a system that did not adequately support the knowledge needs and working practices of the users.

Finally, most ISD research had been overly focused upon the functionalist perspective, with ISD theory centred on the development process as a structure. In essence, students were taught the stages of the systems development lifecycle, what techniques should be used to identify user requirements and what methodologies were available for use. However, as Chapter two stated, current IS development approaches failed to take into account the users' subjective needs. These were requirements that the system must be able to support in order for the users to carry out their working practices. Thus, it can be deduced that, what the students were being taught was a mechanistic approach to development, which failed to consider the embedded knowledge requirements of the users. In order to overcome these issues, the development theory being taught to ISD students should be focused upon the less structured approaches and should concentrate more on the human aspects that impact the ISD process. This in turn, would be more beneficial for practice and would ensure that ISD students learn more flexible approaches to dealing with system users and how their requirements could be gathered.

8.4.3 Methodological Contributions

This research has also made a substantial contribution to methodology, particularly in the areas of information systems development, knowledge transfer and case study research. This study represented an example for other researchers of how a complex phenomenon such as, understanding the process of knowledge transfer for the successful elicitation of users' embedded knowledge requirements could be researched. The methodology adopted for this study proved useful, as it allowed the researcher to follow a systematic approach that guaranteed a coherent design for data collection, analysis and interpretation, resulting in a rich and insightful understanding of the complicated phenomenon under investigation.

In addition, ISD research had been overly dominated by the functionalist perspective with most ISD research taking a positive approach towards carrying out research. While these approaches were very important in identifying the steps and measuring the effects and their impacts, it failed to take into account an understanding of process research for very complex phenomenon. To understand these issues, ISD research must move towards more interpretivist research, particularly if complex issues that impact and underline the development of systems within organisational environments were to be explored in ISD literature. The interpretivist methodological approach would widen the literature on ISD and lessen the gap that existed between ISD theory and practice

8.5 Directions for Future Research

A direction that future research could take concerned the framework developed in this research and whether the findings applied beyond this research project. Further research could be conducted to refine, modify or confirm the framework by replicating it in a different case context. By studying different development cases and their underlining knowledge transfer processes, reassurance could be given that the findings developed in this research were not uncharacteristic and could be generalised to a wider context.

Second, quantitative research could be useful, which could help determine the impact embedded knowledge has on the actual development process, which in turn, would allow systems developers to better manage the elicitation of these knowledge requirements.

Third, the impact organisational culture has on the development process and the relationship between the user and analyst could be further investigated.

Fourth, this study limited its research to the development of manufacturing systems. However, these were just one type of systems that could be developed for users. Researching the development of other systems would contribute significantly to the theory and practice of systems development.

Finally, further research could explore the on-going spiral processes that were identified as underlining the knowledge transfer processes for the successful identification of embedded knowledge. Research in this area would significantly contribute to theory and practice, as it would provide an understanding of how the users and developers understand each other and make sense of what is occurring during their interactions with each other.

Bibliography

Al-Karaghouli, W., Alshawi, S. & Fitzgerald, G. (2005), "Promoting Requirement Identification Quality: Enhancing the Human Interaction Dimension", *Journal of Enterprise Information Management*, Vol. 18, Iss. 2, pp. 256-267.

Alshawi, S. & Al-Karaghouli, W. (2003), "Managing Knowledge in Business Requirements Identification", *Logistics Information Management*, Vol. 16, Iss. 5, pp. 341-349.

Altheide, D.L. & Johnson, J.M. (1994), "Criteria for Assessing Interpretive Validity in Qualitative Research", pp. 485-499. In *Handbook of Qualitative Research*, Denzin, N.K. & Y.S. Lincoln (eds.), Sage Publishers, London.

Alvarez, R. (2002), "Confessions of an Information Worker: A Critical Analysis of Information Requirements Discourse", *Information & Organisation*, Vol. 12, pp. 85-107.

Argote L. & Ingram, P. (2000), "Knowledge Transfer: A Basis for Competitive Advantage in Firms", *Organisational Behaviour & Human Decision Processes*, Vol. 82, Iss. 1, pp. 150-169.

Argyris, C. (1971), "Management Information Systems: The Challenge to Rationality & Emotionality", *Management Science*, Vol. 17, Iss. 6, pp. 275-292.

Argyris, C. & Schön, D.A. (1974), *Theory in Practice: Increasing Professional Effectiveness,* Jossey-Bass Publishers, San Francisco.

Augier, M. & Vendelo, M.T. (1999), "Networks, Cognition & Management of Tacit Knowledge", *Journal of Knowledge Management*, Vol. 3, Iss. 4, pp. 252-261.

Augier, M., Shariq, S.Z. & Vendelo, M.T. (2001), "Understanding Context: Its Emergence, Transformation & Role in Tacit Knowledge Sharing", *Journal of Knowledge Management*, Vo. 5, Iss. 2, pp. 125-137.

Avison, D.E. & Fitzgerald, G. (2003), "Where Now for Development Methodologies?", *Communications of the ACM*, Vol. 46, Iss. 1, pp. 79-82.

Avison, D.E., Lau, F., Myers, M. & Nielsen, P.A. (1999), "Action Research (Technology Information)", *Communications of the ACM*, Vol. 42, Iss. 1, pp. 94-97.

Baumard, P. (1999), *Tacit Knowledge in Organisations,* Sage Publications, London.

Bennett, R.H. (1998), "The Importance of Tacit Knowledge in Strategic Deliberations & Decisions", *Management Decision*, Vol. 36, Iss. 9, pp. 589-597.

Bentley, R., Hughes, J.A., Randall, D., Rodden, T., Sawyer, P., Shapiro, D. & Sommerville, I. (1992), "Ethnographically-Informed Systems Design for Air Traffic Control: Sociologists can be Surprisingly Useful", *Proceedings of the 16th Information Systems Research Seminar in Scandinavia*, Copenhagen, 7-10 August, pp. 1-14.

Blackler, F. & Brown, C. (1985), Evaluation & the Impact of Information Technologies on People in Organisations", *Human Relations*, Vol. 38, Iss. 3, pp. 213-231.

Blackler, F. (1995), "Knowledge, Knowledge Work & Organisations: An Overview & Interpretation", *Organisation Studies*, Vol. 16, Iss. 6, pp. 1021-1046.

Boland Jr., R.J. & Tenkasi, R.V. (1995), "Perspective Making & Perspective Taking in Communities of Knowing", *Organisation Science*, Vol. 6, Iss. 4, pp. 350-372.

Boland Jr., R.J., Tenkasi, R.V. & Te'eni, D. (1994), "Designing Information Technology to Support Distributed Cognition", *Organisation Science*, Vol. 5, Iss. 3, pp. 456-475.

Boland Jr., R.J. (1987), "The In-Formation of Information Systems", In *Critical Issues in Information Systems Research*, Boland Jr., R.J. & Hirschheim, R.A. (eds.), Wiley & Sons, UK.

Boulding, K.E. (1956), "General Systems Theory: The Skeleton of Science", *Management Science*, Vol. 2, Iss. 3, pp. 197-208.

Brachos, D., Kostopoulos, K., Soderquist, K.E. & Prastacos, G. (2007), "Knowledge Effectiveness, Social Context & Innovation", *Journal of Knowledge Management*, Vol. 11, Iss. 5, pp. 31-44.

Brandt, D. (2007), "The Global Technology Laboratory", *Artificial Intelligence & Society*, Vol. 21, pp. 453-470.

Brandt, D. (2003), (Ed.), *Human Centred Systems Design – First: People, Second: Organisation, Third: Technology: 20 Case Reports*, ARMT Aachen, Germany.

Brandt, D. & Cernetic, J. (1998), "Human Centred Approaches to Control & Information Technology: European Experiences", *Artificial Intelligence & Society*, Vol. 12, pp. 2-20.

Bresnen, M., Edelman, L., Newell, S., Scarborough, H. & Swan, J. (2003), "Social Practices & the Management of Knowledge in Project Environments", *International Journal of Project Management*, Vol. 21, pp. 157-166.

Brockmann, E.N. & Anthony, W.P. (1998), "The Influence of Tacit Knowledge & Collective Mind on Strategic Planning", *Journal of Managerial Issues*, Vol. 10, Iss. 2, pp. 204-223.

Brown, J.S. & Duguid, P. (1991), "Organisational Learning & Communities of Practice: Toward a Unified View of Working, Learning & Innovation", *Organisation Science*, Vol. 2, Iss. 1, pp. 40-57.

Brown, J.S. & Duguid, P. (1998), "Organising Knowledge", *California Management Review*, Vol. 40, Iss. 3, pp. 90-111.

Browne, G.J. & Ramesh, V. (2002), "Improving Information Requirements Determination: A Cognitive Perspective", *Information & Management*, Vol. 39, pp. 625-645.

Bryman, A. (2004), *Social Research Methods*, Oxford University Press, Oxford.

Buckley, W. (1967), *Sociology & Modern Systems Theory*, Prentice Hall, New Jersey, USA.

Burrell, G. & Morgan, G. (1979), *Sociological Paradigms & Organisational Analysis*, Hants, Ashgate.

Burstein, F. & Linger, H. (2002), "Supporting Post-Fordist Work Practices: A Knowledge Management Framework for Supporting Knowledge Work", *Information Technology & People*, Vol. 16, Iss. 3, pp. 289-305.

Busch, P. & Richards, D. (2005), "The Implications of Tacit Knowledge Research for Organisations", *Proceedings of Artificial Intelligence & Applications (AIA) Conference*, February 14-16, Innsbruck, Austria.

Cabrera, E.F. & Cabrera, A. (2005), "Fostering Knowledge Sharing through People Management Practices", *International Journal of Human Resource Management*, Vol. 16, Iss. 5, pp. 720-735.

Carson, D., Gilmore, A., Perry, C. & G. Kjell (2001), *Qualitative Market Research*, Sage Publishers, London.

Checkland, P. (2000), *Systems Thinking, Systems Practice: Includes a 30-year Retrospective*, Wiley, England.

Clegg, C., Axtell, C., Damodaran, L., Farbey, B., Hull, R., Lloyd-Jones, R., Nicholls, J., Sell, R. & Tomlinson, C. (1997), "Information Technology: A Study of Performance & the Role of Human & Organisational Factors", *Ergonomics*, Vol. 40, Iss. 9, pp. 851-871.

Cohen, W.M. & Levinthal, D.A. (1990), "Absorptive Capacity: A New Perspective on Learning & Innovation", *Administrative Science Quarterly*, Vol. 35, pp. 128-152.

Connell, N.A.D., Klein, J.H. & & Powell, P.L. (2003),"It's Tacit Knowledge but Not as We Know It: Redirecting the Search for Knowledge", *The Journal of the Operational Research Society*, Vol. 54, Iss. 2, pp. 140-152.

Connell, N.A.D., Klein, J.H. & Meyer, E. (2004), "Narrative Approaches to the Transfer of Organisational Knowledge", *Knowledge Management Research & Practice*, Vol. 2, Iss. 3, pp. 184-193.

Cooley, M. (1996A), "On Human-Machine Symbiosis", In *Human Machine Symbiosis: The Foundations of Human-Centred Systems Design*, Gill, K.S. (Ed.), pp. 69-100, Springer-Verlag, London.

Cooley, M. (1989), "European Competitiveness in the Twenty-First Century", FAST, Brussels. In Brandt, D. (2007), "The Global Technology Laboratory", *Artificial Intelligence & Society*, Vol. 21, pp. 453-470.

Coughlan, J., Lycett, M. & Macredie, R.D. (2003), "Communication Issues in Requirements Elicitation: A Content Analysis of Stakeholder Experience", *Information & Software Technology*, Vol. 45, pp. 525-537.

Creswell, J.W. (1998), *Qualitative Inquiry & Research Design: Choosing Among Five Traditions*, Sage Publishers, London.

Daft, R.L. (1998), *Organisation Theory & Design*, 6th edition, South Western College Publishing, Ohio.

Dahlbom, B. & Mathiassen, L. (1993), *Computers in Context: The Philosophy & Practice of Systems Design*. Blackwell Publishers, UK.

Damodaran, L. (2001), "Human Factors in the Digital World Enhancing Life Style: The Challenge for Emerging Technologies", *Journal of Human Computer Studies*, Vol. 55, pp. 377-403.

Darke, P. & Shanks, G. (1997), "User Viewpoint Modelling: Understanding & Representing User Viewpoints During Requirements Definition", *Information Systems Journal*, Vol. 7, Iss. 7, pp. 213-239.

Davis, J.G., Subrahmaniam, E. & Westerberg, A.W. (2005), "The 'Global' and the 'Local' in Knowledge Management", *Journal of Knowledge Management*, Vol. 9, Iss. 1, pp. 101-112.

de Weer-Nederhof, P. (2001), "Qualitative Case Study Research. The Case of a PhD Research Project on Organising & Managing New Product Development Systems", *Management Decisions*, Vol. 39, Iss. 7, pp. 513-538.

Denzin, N.K. & Lincoln, Y.S. (1994), (eds.), *Handbook of Qualitative Research*, Sage Publishers, London.

Denzin, N.K. & Lincoln, Y.S. (2000), (eds.), *Handbook of Qualitative Research*, 2nd edition, Sage Publishers, London.

Denzin, N.K. (1994), "The Art & Politics of Interpretation". In *Handbook of Qualitative Research,* Denzin, N.K. & Lincoln Y.S. (eds.), Sage Publishers, London, pp. 500-515.

Denzin, N.K. (2001), "The Reflective Interview as a Performative Social Science", *Qualitative Research*, Vol. 1, Iss. 1, pp. 23-46.

Desouza, K.C. (2003), "Facilitating Tacit Knowledge Exchange", *Communications of the ACM*, Vol. 46, No. 6, pp. 85-88.

di Gregorio, S. (2000), "Using NVivo for your Literature Review", *Conference for Strategies in Qualitative Research: Issues and Results from Analysis using QSR NVivo and NUD*IST*, Sept 29-30, Institute of Education, London.

Dougherty, V. (1999), "Knowledge is About People, Not Databases", Industrial *& Commercial Training*, Vol. 31, Iss. 7, pp. 262-266.

Doz, Y. (1996), "The Evolution of Cooperation in Strategic Alliances: Initial Conditions or learning Processes?", *Strategic Management Journal,* Vol. 17, pp. 55-83.

Droege, S.B. & Hoobler, J.M. (2003), "Employee Turnover & Tacit Knowledge Diffusion: A Network Perspective", *Journal of Managerial Issues*, Vol. 15, Iss. 1, pp. 50-64.

Duguid, P. (2005), "The Art of Knowing: Social & Tacit Dimensions of Knowledge & the Limits of the Community of Practice", *Information Society*, Vol. 21, Iss. 2, pp. 109-130.

Easterby-Smith, M., Thorpe, R. & Lowe, A. (1991), *Management Research:: An Introduction*, Sage Publishers, London.

Easterby-Smith, M., Thorpe, R. & Lowe, A. (2001), *Management Research:: An Introduction*, 2nd edition, Sage Publishers, London.

Eisenhardt, K.M. (1989), "Building Theories from Case Study Research", *Academy of Management Review*, Vol. 14, Iss. 4, pp. 532-550.

Emery, F.E. (1959), “Characteristics of Socio-Technical Systems”, *Tavistock Institute*, doc 527, Londn.

Engstrom, T.E.J. (2003), “Sharing Knowledge through Mentoring. International Society for Performance Improvement”, *Performance Improvement Journal*, Vol. 42, Iss. 8, pp. 36-42. Available On-line at www.ispi.org.

Eskerod, P. & Skriver, H.J. (2007), “Organisational Culture Restraining In-House Knowledge Transfer between Project Managers – A Case Study”, *Project Management Journal*, Vol. 38, Iss. 1, pp. 110-122.

Ferran-Urdaneta, C. (1999), “Teams or Communities? Organisational Structures for Knowledge Management”, *Proceedings of the SIGCPR Conference*, New Orleans, USA, pp. 128-134.

Fleck, J. (1997), “Contingent Knowledge & Technology Development”, *Technology Analysis & Strategic Management*, Vol. 9, Iss. 4, pp. 383-397.

Flynn, D.J. & Jazi, M.D. (1998), “Constructing User Requirements: A Social Process for a Social Context”, *Information Systems Journal*, Vol. 8, pp. 53-83.

Foos, T., Schum, G., & Rothenberg, S. (2006), “Tacit Knowledge Transfer and the Knowledge Disconnect”, *Journal of Knowledge Management*, Vol. 10, Iss. 1, pp. 6-18.

Forfás, (2005A), “Making Technological Knowledge Work: A Study of the Absorptive Capacity of Irish SME’s”, pp. 1-125.

Forfás, (2005B), “Forfás Annual Report”, pp. 1-82.

Forfás, (2006), “Annual Competitive Report Volume 1: Benchmarking Ireland’s Performance”, pp. 1-110.

Forfás, (2007), “Annual Competitive Report Volume 1: Benchmarking Ireland’s Performance”, *Journal* pp. 1-124.

Freidus, N. & Hlubinka, M. (2002), “Digital Storytelling for Reflective Practice in Communities of Learning”, *SIGGROUP Bulletin*, Vol. 23, Iss. 2, pp. 24-26.

Gallivan, M.J. (2000), "Examining Workgroup Influence on Technology Usage: A Community of Practice Perspective", *Proceedings of the ACM SIGCPR Conference*, Illinois, USA, pp. 54-66.

Gardner, G. (2001), "Unreliable Memories & Other Contingencies: Problems with Biographical Knowledge", *Qualitative Research*, Vol. 1, Iss. 2, pp. 185-204.

Garrety, K., Robertson, P.L. & Badham, R. (2004), "Integrating Communities of Practice in Technology Development Projects", *International Journal of Project Management*, Vol. 22, pp. 351-358.

Gertler, M.S. (2003), "Tacit Knowledge & the Economic Geography of Context, or the Undefinable Tacitness Being (There)", *Journal of Economic Geography*, Vol. 3, pp. 75-99.

Gilbert, M. & Cordey-Hayes, M. (1996), "Understanding the Process of Knowledge Transfer to Achieve Successful Technological Innovation", *Technovation*, Vol. 16, Iss. 6, pp. 301-312.

Gill, K.S. (1986), "The Knowledge-Based Machine: Issues of Knowledge Transfer", In *Artificial Intelligence for Society*, Gill, K.S. (Ed.), Wiley & Sons, UK, pp. 7-17.

Gill, K.S. (1996A), (Ed.), *Human Machine Symbiosis: The Foundations of Human-Centred Systems Design*, Springer-Verlag, London.

Gill, K.S. (1996A). The Foundations of Human-Centred Systems, In *Human Machine Symbiosis: The Foundations of Human-Centred Systems Design*, Gill, K.S. (Ed.), Springer-Verlag, London, pp. 1-68.

Gill, K.S. (1996B), "The Human-Centred Movement: The British Context", *Artificial Intelligence & Society*, Vol. 10, pp. 109-126.

Gill, K.S. (2002), "Knowledge Networking in Cross-Cultural Settings", *Artificial Intelligence & Society*, Vol. 16, pp. 252-277.

Gill, J. & Johnson, P. (2002), *Research Methods for Managers*, 3rd edition, Sage Publishers, London.

Gill, S.P. (1996A), *Designing for Knowledge Transfer*, In *Human Machine Symbiosis: The Foundations of Human-Centred Systems Design*, Gill, K.S. (Ed.), pp. 313-360, Springer-Verlag, London.

Goguen, J.A. (1993), "Social Issues in Requirements Engineering", *Proceedings of IEEE International Symposium on Requirements Engineering*, 4-6 January, pp. 194-195.

Goguen, J.A. (1996), "Formality & Informality in Requirements Engineering", *Proceedings of International Conference on Requirements Elicitation*, IEEE Computer Society, April 1996, pp. 102-108.

Goguen, J.A. (1997), "Towards a Social, Ethical Theory of Information", *Social Science Research, Technical Systems & Cooperative Work: Beyond the Great Divide*, Bowker, G., Gasser, L., Star, L. & Turner, W. (eds.), pp. 27-56.

Goulielmos, M. (2003), "Outlining Organisational Failure in Information Systems Development", *Disaster Prevention & Management*, Vol. 12, pp. 319-328.

Grant, E.B. & Gregory, M.J. (1997), "Tacit Knowledge, the Life Cycle & International Manufacturing Transfer", *Technology Analysis & Strategic Management*, Vol. 9, Iss. 2, pp. 49-160.

Grant, R.M. (1996A), "Toward a Knowledge-Based Theory of the Firm", *Strategic Management Journal*, Vol. 17, Winter Special Issue, pp. 109-122.

Grant, R.M. (1996B), "Prospering in Dynamically-Competitive Environments: Organisational Capability as Knowledge Integration", *Organisation Science*, Vol. 7, Iss. 4, pp. 375-387.

Gupta, A.K. & Govindarajan, V. (2000), "Knowledge Flows within Multinational Corporations", *Strategic Management Journal*, Vol. 21, Iss. 4, pp. 473-496.

Haldin-Herrgard, T. (2000), "Difficulties in Diffusion of Tacit Knowledge in Organisations", *Journal of Intellectual Capital*, Vol. 1, Iss. 4, pp. 357-365.

Hansen, M.T. (1999), "The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge across Organisational Subunits", *Administrative Science Quarterly*, Vol. 44, Iss. 1, pp. 82-111.

Hansen, M.T. (2002), "Knowledge Networks: Explaining Effective Knowledge Sharing in Multiunit Companies", *Organisation Science*, Vol. 13, Iss. 3, pp. 232-248.

Hayes, N. & Walsham, G. (2001), "Participation in Groupware-Mediated Communities of Practice: A Socio-Political Analysis of Knowledge Working", *Information & Organisation*, Vol. 11, pp. 263-288.

Henning, L. & Marks, S. (1989), "Application of Cybernetic Principles in Organisational Development", 2nd International Symposium on Systems Research, Informatics & Cybernetics, Baden–Baden.

Herstatt, C. & von Hippel, E. (1992), "From Experience: Developing New Product Concepts Via the Lead User Method: A Case Study in a Low Tech Field", *Journal of Product innovation Management,* Vol. 41, pp. 685-718.

Hickey, A.M. & Davis, A.M. (2004), "A Unified Model of Requirements Elicitation", *Journal of Management Information Systems*, Vol. 20, Iss. 4, pp. 65-84.

Hirschheim, R. & Klein, H.K. (1989), "Four Paradigms of Information Systems Development", *Communications of the ACM*, Vol. 32, Iss. 10, pp. 1199-1216.

Hirschheim, R.A. & Newman, M. (1991), "Symbolism and Information System Development: Myth, Metaphor and Magic", *Information System Research*, Vol. 2, Iss. 1, pp. 29-62.

Hirschman, E. (1986), "Humanistic Inquiry in Marketing Research: Philosophy, Method, and Criteria," *Journal of Marketing Research*, Vol. 23, Iss. 3, pp. 237-249.

Howells, J. (1996), "Tacit Knowledge, Innovation & Technology Transfer", *Technology Analysis & Strategic Management*, Vol. 8, Iss. 2, pp. 91-106.

Hsiao, R., Tsai, S.D., & Lee, C. (2006), "The Problems of Embeddedness: Knowledge Transfer, Coordination and Reuse in Information Systems", *Organisation Studies*, Vol. 27, Iss. 9, pp. 1289-1317.

Huysman, M. & Wulf, V. (2006), "IT to Support Knowledge Sharing in Communities, Towards a Social Capital Analysis", *Journal of Information Technology*, Vol. 21, pp. 40-51.

Iivari, J. & Hirschheim, R.A. (1996), "Analysing Information Systems Development: A Comparison & Analysis of Eight IS Development Approaches", *Information Systems*, Vol. 21, Iss. 7, pp. 551-575.

Ives, B. & Olson, M.H. (1984), "User Involvement & MIS Success: A Review of Research", *Management Science*, Vol. 30, Iss. 5, pp. 568-603.

Jarvinen, A. & Poikela, E. (2001), "Modelling Reflective & Contextual Learning at Work", *Journal of Workplace Learning*, Vol. 13, Iss. 7/8, pp. 282-290.

Jarzabkowski, P. & Wilson, D.C. (2002), "Top Teams & Strategy in a UK University", *Journal of Management Studies*, Vol. 39, Iss. 3, pp. 355-381.

Jasimuddin, S.M. (2007), "Exploring Knowledge Transfer Mechanisms: The Case of a UK-Based Group within a High-Technology Global Corporation", *International Journal of Information Management*, Vol. 27, pp. 294-300.

Jasimuddin, S.M., Klein, J.H. & Connell, C. (2005), "The Paradox of using Tacit & Explicit Knowledge Strategies to Face Dilemmas", *Management Decision*, Vol. 43, Iss. 1, pp. 102-113.

Johannessen, J.A., Olaisen, J. & Olsen, B. (2001), "Mismanagement of Tacit Knowledge: Importance of Tacit Knowledge, The Danger of Information Technology & What to do about it", *International Journal of Information Management*, Vol. 21, Iss. 1, pp. 3-20.

Joshi, K.D., Sarker, S. & Sarker, S. (2004), "Knowledge Transfer among Face-to-Face Information Systems Development Team Members: Examining the

Role of Knowledge, Source and Relational Context", *Proceedings of the 37th Hawaii International Conference on System Science*, Hawaii, 5-8 Jan, pp. 1-11.

Joshi, K.D., Sarker, S. & Sarker, S. (2007), "Knowledge Transfer within Information Systems Development Teams: Examining the Role of Knowledge Source Attributes", *Decision Support Systems*, Vol. 43, pp. 322-335.

Kalla, H.K. (2005), "Integrated Internal Communications: A Multidisciplinary Perspective", *Corporate Communications*, Vol. 10, Iss. 4, pp. 302-314.

Kalling, T. (2003), "Organisation-Internal Transfer of Knowledge & the Role of Motivation: A Qualitative Case Study", *Knowledge & Process Management*, Vol. 10, Iss. 2, pp. 115-126.

Karlsen, J.T. & Gottschalk, P. (2004), "Factors Affecting Knowledge Transfer in IT Projects", *Engineering Management Journal*, Vol. 16, Iss. 1, pp. 3-10.

Katz, D & Kahn, R.L. (1966), *The Social Psychology of Organisations,* 2nd edition, Wiley & Sons, UK.

Katz, R. & Tushman, M. (1981), "An Investigation into the Managerial Roles & Career Paths of Gatekeepers & Project Supervisors in a major R&D Facility", *R&D Management*, Vol. 11, Iss. 3, pp. 103-110.

Kerlinger, F.N. (1973), *Foundations of Behavioural Research*, 2nd edition, Holt, Rinehart & Winston, New York.

Kimble, C. & Hildreth, P. (2005), "Dualities, Distributed Communities of Practice & Knowledge Management", *Journal of Knowledge Management*, Vol. 9, Iss. 4, pp. 102-113.

Klein, H.K. & Hirschheim, R. (1996), "The Rationality of Value Choices in Information System Development", *Foundations of Information Systems,* Peer-Reviewed On-Line Electronic Journal. Available on: http://www.bauer.uh.edu/parks/fis/kantpap.htm.

Klein, H.K. & Lyytinen, K. (1985), "The Poverty of Scientism in Information Systems", pp. 131-161. In *Research Methods in Information Systems*, Mumford E., Hirschheim, R., Fitzgerald, G. & Wood-Harper, T. (eds.), Elsevier Science, North-Holland.

Klein, H.K. & Myers, M.D. (1999), "A Set of Principles for Conducting & Evaluating Interpretive Field Studies in Information Systems", *MIS Quarterly*, Vol. 23, Iss. 1, pp. 67-89.

Kogut, B. & Zander, U. (1992), "Knowledge of the Firm, Combinative Capabilities, & the Replication of Technology", *Organisation Science*, Vol. 3, Iss. 3, pp. 383-397.

Kogut, B. & Zander, U. (1996), "What Firms Do? Coordination, Identity, & Learning", *Organisation Science*, Vol. 7, Iss. 5, pp. 502-518.

Koskinen, K.U. (2003), "Evaluation of Tacit Knowledge Utilisation in Work Units", *Journal of Knowledge Management*, Vol. 7, Iss. 5, pp. 67-82.

Kwan, M.M. & Cheung, P. (2006), "The Knowledge Transfer Process: From Field Studies to Technology Development", *Journal of Database Management*, Vol. 17, Iss. 1, pp. 16-33.

Lam, A. (1997), "Embedded Firms, Embedded Knowledge: Problems of Collaboration & Knowledge Transfer in Global Cooperative Ventures", *Organisation Studies*, Vol. 18, Iss. 6, pp. 973-996.

Lam, A. (2000), "Tacit Knowledge, Organisational Learning & Societal Institutions: An Integrated Framework", *Organisation Studies*, Vol. 21, Iss. 3, pp. 487-513.

Lave, J. & Wenger, E. (1991), *Situated Learning: Legitimate Peripheral Participation*, Cambridge University Press, UK.

Leonard, D. & Sensiper, S. (1998), "The Role of Tacit Knowledge in Group Innovation", *California Management Review*, Vol. 40, Iss. 3, pp. 112-132.

Lesser, E.L. & Storck, J. (2001), "Communities of Practice & Organisational Performance", *IBM Systems Journal*, Vol. 40, pp. 831-842.

Lincoln, Y.S. & Guba, E.G. (1985), *Naturalistic Inquiry*, Sage Publishers, London.

Linde, C. (2001), "Narrative & Tacit Knowledge", *Journal of Knowledge Management*, Vol. 5, Iss. 2, pp. 160-171.

Lubit, R. (2001), "Tacit Knowledge & Knowledge Management: The Keys to Sustainable Competitive Advantage", *Organisational Dynamics*, Vol. 29, Iss. 4, pp. 164-178.

Madhavan, R. & Grover, R. (1998), "From Embedded Knowledge to Embodied Knowledge: New Product Development in Knowledge Management", *Journal of Marketing*, Vol. 62, Iss. 4, pp. 1-13.

Malhorta, N. (2002), *Basic Marketing Research*, Prentice Hall, New Jersey.

Malik, K. (2004), "Intra-firm Technological Knowledge Transfer: A Capabilities Perspective", *International Journal of Technology Transfer & Commercialisation*, Vol. 3, Iss. 4, pp. 470-480.

Malone, D. (2002), "Knowledge Management: A Model for Organisational Learning", *International Journal of Accounting Information Systems*, Vol. 3, pp. 111-123.

March, J.G. (1987), "Ambiguity & Accounting: The Elusive Link between Information & Decision-Making", *Organisations & Society*, Vol. 12, Iss. 2, pp. 153-168.

Marshall, C. & Rossman, G.B. (1999), *Designing Qualitative Research*, 3rd edition, Sage Publishers, London.

Mascitelli, R. (2000), "From Experience: Harnessing Tacit Knowledge To Achieve Breakthrough Innovation", *Journal of Product Innovation Management*, Vol. 17, pp. 179-193.

Mason, J. (1996), *Qualitative Researching*, Sage Publishers, London.

Mason, J. (2002), *Qualitative Researching*, 2nd edition, Sage Publishers, London.

McDermott, R. (1999), "Why Information Technology Inspired but Cannot Deliver Knowledge Management", *California Management Review*, Vol. 41, Iss. 4, pp. 103-118.

McInerney, C. (2002), "Knowledge Management & the Dynamic Nature of Knowledge", *Journal of the American Society for Information Science & Technology*, Vol. 53, Iss. 12, pp. 1009-1018.

McLellan, H. (2006), "Corporate Storytelling Perspectives", *The Journal for Quality & Participation*, Vol. 29, Iss. 1, pp. 17-20.

Miles, M.B. & Huberman, A.M. (1994), *An Expanded Sourcebook: Qualitative Data Analysis,* 2nd edition, Sage Publishers, London.

Miller, J.G. (1955),"Toward a General Theory for the Behavioural Sciences", *American Psychologist*, Vol. 10, pp. 513-531.

Miller, J.G. (1965A), "Living Systems: Basic Concepts", *Behavioural Science*, Vol. 10, Iss. 3, pp. 193-237.

Miller, J.G. (1965B), "Living Systems: Structure & Process", *American Psychologist*, Vol. 10, Iss. 4, pp. 337-379.

Mingers, J. & Willcocks, L. (2004), (eds.), *Social Theory & Philosophy for Information Systems*, Wiley & Sons, West Sussex, England.

Morgan, G. & Smircich, L. (1980), "The Case of Qualitative Research", *Academy of Management Review*, Vol. 5, Iss. 4, pp. 491-500.

Morgan, G. (1983), (ed.), *Beyond Methods: Strategies for Social Research*, Sage Publishers, London.

Mumford, E. (1994), "Technology, Communication & Freedom: Is There a Relationship?" In *Transforming Organisations with Information Technology*, Baskerville, R., Smithson, S., Ngwenyama, O. & DeGross, J.I. (eds.), Elsevier Science, pp. 303-323.

Mumford, E. & Beekman, G.J. (1994), *Tools for Change & Progress: A Socio-Technical Aproach to Business Process Re-Engineering*, CSG Publications, UK.

Murphy, F.M. & Stapleton, L. (2005), "Addressing Tacit Knowledge in ISD Methodologies". In *Information Systems Development: Advances in Theory, Practice and Education,* Vaselicas, O., Wojtowski, W. & Wojtowski, G. (eds.), Kluwer Academic/Plenum Publishers, New York, USA.

Orlikowski, W.J. & Yates, J. (1994), "Genre Repertoire: The Structuring of Communicative Practices in Organisations", *Administrative Science Quarterly*, Vol. 39, Iss. 4, pp. 541-574.

Orlikowski, W.J. (2002), "Knowing in Practice: Enacting a Collective Capability in Distributed Organising", *Organisation Science*, Vol. 13, Iss. 3, pp. 249-273.

Østerlund, C. & Carlile, P. (2005), "Relations in Practice: Sorting through Practice Theories on Knowledge Sharing in Complex Organisations", *The Information Society*, Vol. 21, pp. 91-107.

Palys, T. (1997), *Research Decisions: Quantitative & Qualitative Perspectives*, 2nd edition, Harcourt Brace, Canada.

Parent, R., Roy, M. & St-Jacques, D. (2007), "A Systems-Based Dynamic Knowledge Transfer Capacity Model", *Journal of Knowledge Management*, Vol. 11, Iss. 5, pp. 81-93.

Patton, M.Q. (1980), *Qualitative Evaluation & Research Methods,* 2nd edition, Sage Publishers, London.

Pawlowski, S.D. & Robey, D. (2004), "Bridging User Organisations: Knowledge Brokering & the Work off Information Technology Professionals", *MIS Quarterly*, Vol. 28, Iss. 4, pp. 645-673.

Perry, C. (1998), "Processes of a Case Study Methodology for Postgraduate Research in Marketing", *European Journal of Marketing*, Vol. 32, Iss. 9/10, pp. 785-802.

Perry, C., Riege, A. & Brown L. (1999), "Realism's Role among Scientific Paradigms in Marketing Research", *Irish Marketing Review*, Vol. 12, Iss. 2, pp. 16-24.

Pfeffer, J. & Salancik, G.R. (1978), The External Control of Organisations, Harper & Row, London.

Platts, M.J. & Yeung, M.B. (2000), "Managing Learning & Tacit Knowledge", *Strategic Change*, Vol. 9, Iss. 6, pp. 347-355.

Polanyi, M. (1961), "Knowing & Being", *Mind*, Oxford University Press, Vol. 70, pp. 458-470.

Polanyi, M. (1962), "Tacit Knowing", *Review of Modern Physics*, Vol. 34, pp. 601-616.

Polanyi, M. (1966A), "The Logic of Tacit Inference", *Philosophy*, Vol. 41, pp. 1-18.

Polanyi, M. (1966B), *The Tacit Knowing*, Routledge & Kegan Paul, London.

Polanyi, M. (1967), *The Tacit Dimension*, Routledge & Kegan Paul, London.

Rasmussen, L.B. (2005), "Identity Building in Organisations: Proactive Capability Development", *Artificial Intelligence & Society*, Vol. 16, pp. 377-394.

Reagans, R. & McEvily, B. (2003), "Network Structure & Knowledge Transfer: The Effects of Cohesion & Range", *Administrative Science Quarterly*, Vol. 48, pp. 240-267.

Remenyi, D., Williams, B., Money, A. & Swartz, E. (1998). *Doing Research in Business & Management. An Introduction to Process & Method*, Sage, London.

Richards, L. (1999), *Using NVivo in Qualitative Research*, Sage Publishers, London.

Ritchie, J. & Lewis, J. (2003), (eds.), *Qualitative Research Practice: A Guide for Social Science Students & Researchers*, Sage Publishers, London.

Roberts, J. (2000), "From Know-how to Show-How? Questioning the Role of Information & Communication Technology in Knowledge Transfer", *Technology Analysis & Strategic Management*, Vol. 12, Iss. 4, pp. 429-443.

Rosenbrock, H. (1992), "Science, Technology & Purpose", *Artificial Intelligence & Society*, Vol. 6, pp. 3-17.

Ruuska, I. & Vartiainen, M. (2005), "Characteristics of Knowledge Sharing Communities in Project Organisations", *International Journal of Project Management*, Vol. 23, pp. 374-379.

Salancik, G.R. & Pfeffer, J. (1978), "A Social Information Processing Approach to Job Attitudes & Task Design", *Administrative Science Quarterly*, Vol. 23, pp. 224-253.

Scarbrough, H. (1999), "Knowledge as Work: Conflicts in the Management of Knowledge Workers", *Technology Analysis & Strategic Management*, Vol. 11, Iss. 1, pp. 5-17.

Schein, E.H. (1992), *Organisational Culture & Leadership*, 2nd edition, Jossey-Bass, California.

Schein, E.H. (2001), "Uncovering the Levels of Culture". In *The Organisational Behaviour Reader*, Osland, J.S., Kolb, D.A. & Rubin I.M. (eds.), Prentice Hall, New Jersey, pp. 398-405.

Schön, D.A. (1983), *The Reflective Practitioner*, Basic Books, New York.

Schön, D.A. (1987), *Educating the Reflective Practitioner*, Jossey-Bass, California.

Scott W.R. (1987), *Organisations: Rational, Natural, & Open Systems*, 2nd edition, Prentice Hall, London.

Searle, J.R. (1995), *The Construction of Social Reality*, The Penguin Press, UK.

Selamat, M.H. & Choudrie, J. (2004), "The Diffusion of Tacit Knowledge & its Implications on Information Systems: The Role of Meta-Abilities", *Journal of Knowledge Management*, Vol. 8, Iss. 2, pp. 128-139.

Sherif, K., Hoffman, J. & Thomas, B. (2006), "Can Technology Build Organisational Social Capital? The Case of a Global IT Consulting Firm", *Information & Management*, Vol. 43, pp. 795-804.

Shore, B. (2005), "Failure Rates in Global IS Projects & the Leadership Challenge". *Journal of Global Information Technology Management*, Vol. 8, pp. 1-6.

Smith, K.G. & Hitt, M.A. (2005), (Eds.), *Great Minds in Management: The Process of Theory Development*, Oxford University Press, UK.

Stake, R.E. (1994), "Case Studies". In *Handbook of Qualitative Research*, Denzin, N.K. & Lincoln, Y.S. (eds.), Sage Publishers, London, pp. 236-247.

Stake, R.E. (2000), "Case Studies". In *Handbook of Qualitative Research*, 2nd edition, Denzin, N.K. & Lincoln, Y.S. (eds.), Sage Publishers, London, pp. 435-454.

Stapleton, L. (2000), "From Information Systems in Social Settings to Information Systems as Social Settings: A Study of Large Information Systems in Manufacturing Firms". In *Proceedings of the 7th IFAC Symposium on Automation Based on Human Skill*, Brandt, D. & Cernetic, J. (eds.), Elsevier.

Stapleton, L. (2001), *Information Systems Development: An Empirical Study in Irish Manufacturing Companies,* Ph.D. Thesis, Cork.

Subramaniam, M. & Venkatraman, N. (2001), "Determinants of Transnational New Product Development Capability: Testing the Influence of Transferring & Deploying Tacit Overseas Knowledge", *Strategic Management Journal*, Vol. 22, Iss. 4, pp. 359-378.

Swan, J., Scarborough, H. & Robertson, M. (2002), "The Construction of 'Communities of Practice' in the Management of Innovation", *Management Learning*, Vol. 33, pp. 477-497.

Swap, W., Leonard, D., Shields, M. & Abrams, L. (2001), "Using Mentoring & Storytelling to Transfer Knowledge in the Workplace", *Journal of Management Information Systems*, Vol. 18, Iss. 1, pp. 95-115.

Szulanski, G. (1996), "Exploring Internal Stickiness: Impediments to the Transfer of Best Practice Within the Firm", *Strategic Management Journal*, Vol. 17, Winter Special Issue, pp. 27-43.

Teigland, R. & McLure Wasko, M. (2000), "Creative Ties & Ties that Bind: Examining the Impact of Weak Ties on Individual Performance", *Proceedings of the 21st International Conference of Information Systems*, ACM, Queensland, Australia, pp. 313-328.

Tenkasi, R.V. & Boland Jr., R.J. (1996), "Exploring Knowledge Diversity in Knowledge Intensive Firms: A New Role for Information Systems", *Journal of Organisational Change Management*, Vol. 9, Iss. 1, pp. 79-91.

Trist, E. (1958), "Human Relations in Industry", *Proceedings of Vienna Seminar: Congress for Cultural Freedom*.

Tschiersch, I. & Schael, T. (2003), "III-2 – Concepts of Human-Centred Systems", In Brandt, D. (Ed.), *Human Centred Systems Design – First: People, Second: Organisation, Third: Technology: 20 Case Reports*, ARMT Aachen, Germany.

Tuggle, F.D. & Goldfinger, W.E. (2004), "A Methodology for Mining Embedded Knowledge from Process Maps", *Human Systems Management*, Vol. 23, pp. 1-13.

Turner, S. (1994), *The Social Theory of Practices*, Cambridge University Press, UK.

Urban, G.L. & von Hippel, E. (1986), "Lead User Analyses for the Development of New Industrial Products", *Management Science*, Vol. 34, Iss. 5, pp. 569-582.

Valdelin, J. (1974), "Produktutveckling och Marknadsföring" (Translated as "Production Development & Marketing"), Stockholm, EFI. In Gummesson, E. (1991), *Qualitative Methods in Management Research: A Revised Edition*. Sage Publishers, UK.

Vickers, G. Sir, (1983), *Human Systems are Different*, Harper & Row Publishers, London.

von Bertalanffy, L. (1968), *General System Theory: Foundations, Development, Applications*, George Braziller, New York.

von Hippel, E. & Katz, R. (2002), "Shifting Innovation to Users via Toolkits", *Management Science*, Vol. 48, Iss. 7, pp. 821-833.

von Hippel, E. (1986), "Lead Users: A Source of Novel Product Concepts", *Management Science,* Vol. 32, pp. 791-805.

von Hippel, E. (1989), "New Product Ideas from 'Lead Users'", *Research Management*, Vol. 32, Iss. 3, pp. 24-27.

von Hippel, E. (1994), "Sticky Information & the Locus of Problem Solving: Implications for Innovation", *Management Science*, Vol. 40, Iss. 4, pp. 429-439.

von Hippel, E. (1998), "Economics of Product Development by Users: The Impact of 'Sticky' Local Information", *Management Science*, Vol. 44, Iss. 5, pp. 629-644.

Walsham, G. (1995), "Interpretive Case Studies in IS Research: Nature & Method", *European Journal of Information Systems*, Vol. 4, pp. 74-81.

Wang, E.T.G., Lin, C.C., Jiang, J.J. & Klein, G. (2007), "Improving Enterprise Resource Planning (ERP) Fit to Organisational Processes Through Knowledge Transfer", *International Journal of Information Management*, Vol. 27, pp. 200-212.

Warne, L., Ali, I. & Linger, H. (2002), "Representing Social Learning in the Context of Knowledge Management: An Architectural Perspective", In *Knowledge Management in Context*, Melbourne, Burstein, F. & Linger, H. (eds.), Australian Scholarly Press, Australia, pp. 115-132.

Weick K.E. (1992), "Management of Change among Loosely Coupled Elements", pp. 375-408. In *Change in Organisations*, Goodman, P. & Associates (eds.), Jossey-Bass, USA.

Weick, K. (1995), *Sense-Making in Organisations*, Sage Publications, Thousand Oaks, USA.

Weick, K.E. (2005), "The Experience of Theorising: Sensemaking as Topic & Resource", pp. 394-413. In *Great Minds in Management: The Process of Theory Development*, Smith, K.G. & Hitt, M.A. (Eds.), Oxford University Press, UK.

Wenger, E. (1998), *Communities of Practice: Learning, Meaning, & Identity*, Cambridge University Press, UK.

Wenger, E. (2000A), ,"Communities of Practice: Stewarding Knowledge", In *Knowledge Horizons: The Present & the Promise of Knowledge Management*, Despres, C. & Chauvel, D. (eds.), Butterworth-Heinemann, Boston, pp. 205-255.

Wenger, E. (2000B), "Communities of Practice & Learning Systems", *Organisations*, Vol. 7, Iss. 2, pp. 225-246.

Wenger, E. (2000C), "Communities of Practice: The Organisational Frontier", *Harvard Business Review*, pp. 139-145.

Wenger, E. (2004), "Knowledge Management as a Donut: Shaping your Knowledge Strategy through Communities of Practice", *Ivey Business Journal Online*. Available On-line at http://www.iveybusinessjournal.com.

Wong, W.L.P. & Radcliffe, D.F. (2000), "The Tacit Nature of Design Knowledge", *Technology Analysis & Strategic Management*, Vol. 12, Iss. 4, pp. 493-512.

Wood, J.R.G. & Wood-Harper, A.T. (1993), "Information Technology in Support of Individual Decision-Making", *Journal of Information Systems*, Vol. 3, pp. 85-101.

Yakhlef, A. (2007), "Knowledge Transfer as the Transformation of Context", *Journal of High Technology Management Research*, Vol. 18, pp. 43-57.

Yin, R.K. (1994), *Case Study Research: Design and Methods, 2nd* edition, Sage Publishers, London.

Yin, R.K. (2003), *Case Study Research: Design and Methods,* 3rd edition, Sage Publishers, Thousand Oaks, California.

Yu, E. (1997), "Towards Modelling & Reasoning Support for Early Phase Requirements Engineering", *In Proceedings for the 3rd IEEE International Symposium on Requirements Engineering (RE '97)*. Jan 6-8, Washington DC, USA. pp 226-235.

Appendix A: Research Protocol Document for Enki

RESEARCH PROTOCOL

INTRODUCTION:
My name is Fiona Murphy and I am a final year doctoral student at Waterford Institute of Technology. To complete my PhD I am looking for a Case Company that involves users in the information systems development process.

Research Objectives:
The general objective of this study is to investigate how user embedded knowledge requirements can be incorporated into the development process. User embedded knowledge requirements refer to knowledge needs of the users concerning their practice that need to be incorporated and supported by the system being developed. It is this knowledge that governs users' practices in the working environment and is critical to the successful completion of their working performance. This research has important implications for systems development companies. It aims to reduce the knowledge risks associated with poor systems development and to ensure the successful inclusion of users in the development of the system. However, at present, there is no best practice on how users' embedded knowledge requirements should be incorporated into the development process, hence the practical and academic importance of this research.

CASE STUDY ISSUES:

Why Your Company
I am contacting your Company because, first, it is recognised as an award winning enterprise that aims to meet the high quality requirements of the manufacturing industry, and secondly, the systems your Company develops are tailored to meet the specific needs of each user. In essence, I am looking to your Company for a guide to *'best practice'* as you involve your customers in the systems development process. Essentially, I am looking at how you elicited and determined their knowledge requirements, and how these requirements were in turn supported by the developed system.

Benefits to Your Company
- The findings of the research should prove extremely beneficial to your Company because it will devise a *'best practice'* model to determine how users should be involved in the development process. This should greatly enhance your own development process.
- Furthermore, your Company will gain greater insight into how your customers might feel about being involved in the development process and working with you.
- Ultimately, a new model for eliciting embedded knowledge requirements based on your Company will be developed. This will contribute significantly to the development of new knowledge in the field of information systems development.

Important Issues about Researching in Your Company:

- First, it is important to realise that I am an experienced researcher and I recognise the importance of not interfering with the working environment of a busy office. The method by which the research will be conducted is designed to cause as little disruption to work as possible (see below for details). A research schedule will be designed around what best suits your Company.
- I will respect confidentiality and recognise as private, incidental events that may be observed during the research period.
- In effect, Waterford Institute of Technology places a confidentiality agreement on its research students. Case details or findings will not be discussed outside the academic environment (i.e. student and supervisor) without prior agreement from the participating Company.
- A report of the case to be included in the research thesis will be presented to the Company for confirmation that all information is accurate.
- Finally, the proposed research should take approximately ten to twelve months to complete.

DATA COLLECTION TEMPLATE:

1. **Interviews**
   It would be very helpful, if approximately once a month (if possible), an interview with the research participants was conducted in order to reflect upon how they interacted with the User Companies during that month. The interview would be very informal and unstructured and probably would last about 30-40 minutes. Ten to twelve interviews may be required depending on the nature of the data gathered from each interview. Obviously any visits to your Company will be pre-arranged.

2. **Diaries**
   It is hoped that members of a development project will be provided with a diary, within which they would document the interactions they have had with the users and how they elicited and understood the users' requirements. A diary entry could be something like an expectation, a disappointment, a successful moment, or a reflection, problems encountered etc. from interacting with the users. In essence their thoughts on how the interaction went and what they learned. Diary entries do not have to be detailed (often only a word or a sentence will suffice) nor do they have to be on a regular basis. Essentially the combination of diaries and the interview transcripts will provide an audit trail of their interactions with users during the project and how the knowledge requirements were gathered. It is also important to note that the diary will be coded for confidentiality and no one other than the researcher will ever use or see its contents. Diary entries may be further discussed for clarifications and meanings etc. during the interviews.

3. **Access to User Companies**
   Assessing how the user Companies feel about cooperating and working with you would be extremely valuable information. It would enable me to view the requirements gathering process from a 360 degree view. It would also allow me

to determine the knowledge transfer processes that are in place within the organisation and to see if they influenced how the users transferred their knowledge needs to you during systems development. This, again, will be conducted through diaries and informal interviews.

4. **Other Information or Documentation**
   Any other documentation you wish to provide during the interview sessions or at any other stage during the year will also be appreciated.

FINAL COMMENT:
I know the demands that are placed on individuals in a hectic working environment and that there may be concerns over issues such as whether I would interfere or cause disruption to work. If granted the privilege of researching your Company, I will conduct the research in a diligent and professional manner. The research method is designed to facilitate easy access and cause little or no disruption to the important work being carried out in your Firm. Finally, this research project is truly innovative and has never being conducted before. By allowing me to research your Company and your users, not only will I be able to complete my doctorate, but we will be significantly contributing to the generation of new knowledge.

I look forward to hearing from you.

Yours Sincerely,

____

Fiona M Murphy
Doctoral Research Candidate
Waterford Institute of Technology
ISOL Research Group
Waterford
IRELAND.

Appendix B: Confidentiality Agreement

Instructions: *To be read out by the researcher before the beginning of the interview.*
One copy of the form to be left with the interviewee;
A second copy is to be signed by the interviewee and kept by the researcher.

My name is Fiona M Murphy. I am doing research on a project that is looking at how user embedded knowledge requirements can be successfully elicited for information systems development. I am a member of the ISOL research group within Waterford Institute of Technology, Waterford. This research is being conducted under the supervision of Dr Larry Stapleton, and either of us can be contacted (see below) should you have any questions.

Fiona M Murphy
Waterford Institute of Technology
Waterford
Phone: 087 6972617
Email: fmmurphy@wit.ie

Larry Stapleton
Waterford Institute of Technology
Waterford
Phone: 051 302100
Email: lstapleton@wit.ie

Thank you for agreeing to take part in the project. Before we start I would like to emphasize that:

- ➔ Your participation is entirely voluntary;
- ➔ You are free to refuse to answer any question;
- ➔ You are free to withdraw at any time.

The interview will be kept strictly confidential and will be available only to my supervisor, Dr Stapleton & myself. Excerpts from the interview may be made part of the final research thesis, but these will be anonymous. The name of your company will be included in an appendix; but under no circumstances will your name or any identifying characteristics of you or the organization appear in the thesis.

Please sign & date this form to show that I have read these contents to you.

______________________________________ *(Signed)*

______________________________________ *(Printed)*

_______________ *(Dated)*

Please send a report on the results of the research project:

YES NO *(Circle one)*

Address for those requesting a research report.

____

____

____

____

(*Interviewer is to keep a signed copy and leave an unsigned copy with the interviewee).*

Appendix C: Interview Protocol Document for Enki

INTERVIEW NUMBER	INTERVIEW TOPICS
Interview 1	• Introductory Meeting about Context & Profile of Company [Enki Ltd]
Interview 2	• Questions to clarify some points made in interview 1 • Context & Background to Hathor's Systems
Interview 3	• Development of Hathor's Cheese System
Interview 4	• Overview of the Development of Matuta's Factory Floor System
Interview 5	• Validation of Company Profile. • Questions on the requirements gathering techniques used for both cases • Questions concerning the development of Hathor's system • Questions concerning the development of Matuta's system. *(Question Sheet)*
Interview 6	• Development of Matuta's Factory Floor System. *(Question Sheet)*

Appendix C1: Interview Protocol Document for Hathor

INTERVIEW NUMBER	INTERVIEW TOPICS
Interview 1	• Overview of Development of MSA (Management & Sales Analysis) System
Interview 2	• Overview of Development of Cheese Production System
Interview 3	• Overview of Development of Web SMS System
Interview 4	• Overview of Development of Invoicing System
Interview 5 – Group Interview	• Profile of Hathor & Cheese Systems pre 1990
Interview 6 – Group Interview	• Cheese System developed by Enki
Interview 7 – Group Interview	• The Cheese Grading System
Interview 8 – Group Interview	• Overview of Development of Overall Cheese System
Interview 9 – Telephone Interview (30 Mins)	• Organisational Structure, Culture & Strategy
Interview 10– Telephone Interview (30 Mins)	• Chronological Order of the Development of the Cheese Production & Management System *(Question Sheet)*
Interview 11	• The Cheese Grading Process and the Reason why the Grading System was Developed • Validation of the Context of the Cheese Stock System. • Validation of the Context of the Cheese Grading System.
Interview 12	• Validation of the Context of the Production System
Interview 13	• The Cheese Grading Process and how it is linked to the Cheese Grading System. • Validation of the Context of the Cheese

	Grading System.
Interview 14	• Validation of the Company Profile. • Validation of the Context of the Cheese Stock System.
Interview 15 – Telephone Interview (1 h our)	• Validation & confirmation of Findings for Case Study o on Hathor
Interview 16 – Telephone Interview (15 mins)	• Questions concering the Company Profile.

Appendix C2: Interview Protocol Document for Matuta

INTERVIEW NUMBER	INTERVIEW TOPICS
Interview 1	• Introductory Meeting and Overview of Matuta's Systems
Interview 2	• Overview of Matuta's Factory Floor System
Interview 3	• How the development company gathered the specific information needed to develop the Factory Floor System and meet the needs of the users
Interview 4	• Overview of the Production Planning & Logistics Element of the Factory Floor System
Interview 5	• Overview of the Quality Control Element of the Factory Floor System
Interview 6	• Overview of LIMS (Laboratory Information Management System) for the Factory Floor System
Interview 7	• Overview of the development of LIMS.
Interview 8	• Overview of the development of the Production Planning & Scheduling system.

Appendix D: Consent Release Form

<Company Name>
<Address>

13th July 2007

Dear ***<First_Name>***

Please accept my sincere appreciation for all the information and help you provided me over the last year. I would appreciate it very much if you could read over the findings that I have compiled from all the interviews I have carried out with your company, to ensure that everything is acceptable. If you wish to make any alterations or add anything further please do not hesitate to do so and send me back the changes in the pre-paid envelope provided. I will make the required changes, and will subsequently forward you on the up-dated version of the findings.

If you find that when you have read over the findings and that you do not wish to make any changes, please fill in the Consent Release Form enclosed, giving me permission to use extracts of your information in my thesis and further publications.

Finally, I may wish to conduct a further telephone interview with you to clarify any issues that I may find confusing while I am writing up your changes. However, I will get in contact with you about that at a later date, to arrange a suitable time (s). In the mean time, if you have any queries or questions please do not hesitate to contact me at: **fmmurphy@wit.ie** or **087 6972617**.

Yours sincerely

____

Fiona M Murphy

CONSENT RELEASE FORM

I, ***<FULL_NAME>***, have read the findings chapter sent to me on 13 July 2007, and I am satisfied that what transpired in that chapter has been accurately recorded and can be used in Fiona M. Murphy's PhD thesis and further publications.

_______________________________________ (*Signed*)

_______________________________________ (*Printed*)

________________ (*Dated*)

Waterford Institute *of* Technology WIT

Institiúid Teicneolaíochta Phort Láirge
Waterford, Ireland
TEL: +353-51-302000
WEB: www.wit.ie
EMAIL: enquiries@wit.ie

Foirfe chun fónaimh

Appendix E: Auditor's Report

In performing the role of auditor, I have examined the literature, theoretical perspective, philosophical foundations, research design, findings and discussions. In addition, I have examined the NVivo documentation. I have assessed the triangulation of evidence and confirm that the conclusions arrived at flowed from the data collected. The researcher has been probed on the philosophical, theoretical and methodological matters, meanings and basis of interpretations that she arrived at. I conclude that this research is trustworthy in terms of credibility, dependability and confirmability and, is the researcher's own work.

Felicity Kelliher
Dr Felicity Kelliher
RIKON Research Group
Waterford Institute of Technology
Waterford

Patrick Lynch
Dr Patrick Lynch
RIKON Research Group
Waterford Institute of Technology
Waterford

Appendix F: Cheese Grading Process

The actual cheese grading process was carried out manually by the cheese grader.

> *A 6 inch cheese iron is used to bore a hole in the cheese and a plug is then taken out. A sample of the extracted cheese is smelled, crushed with the thumb and forefinger to reveal the texture, and then tasted by the expert to check the flavour. [Hathor: CG]*

Based upon the smell, taste, and touch of the cheese, and, the grader's experience the cheese was graded to be held or to be sold.

> *I can then tell by the body and aroma whether the cheese is moving quick and needs to be sold. The cheese is then graded to be sold or to be held - a sample block, which refers to 2 pallets i.e. 2 Tonnes of cheese, is graded and a life span for the cheese i.e. a use-by-date is given to the cheese, which is usually for 3 months. When the cheese reaches 3 months old it is re-graded for a mature cheese e.g. 1st grade in April, in July the cheese is re-graded. [Hathor: CG]*

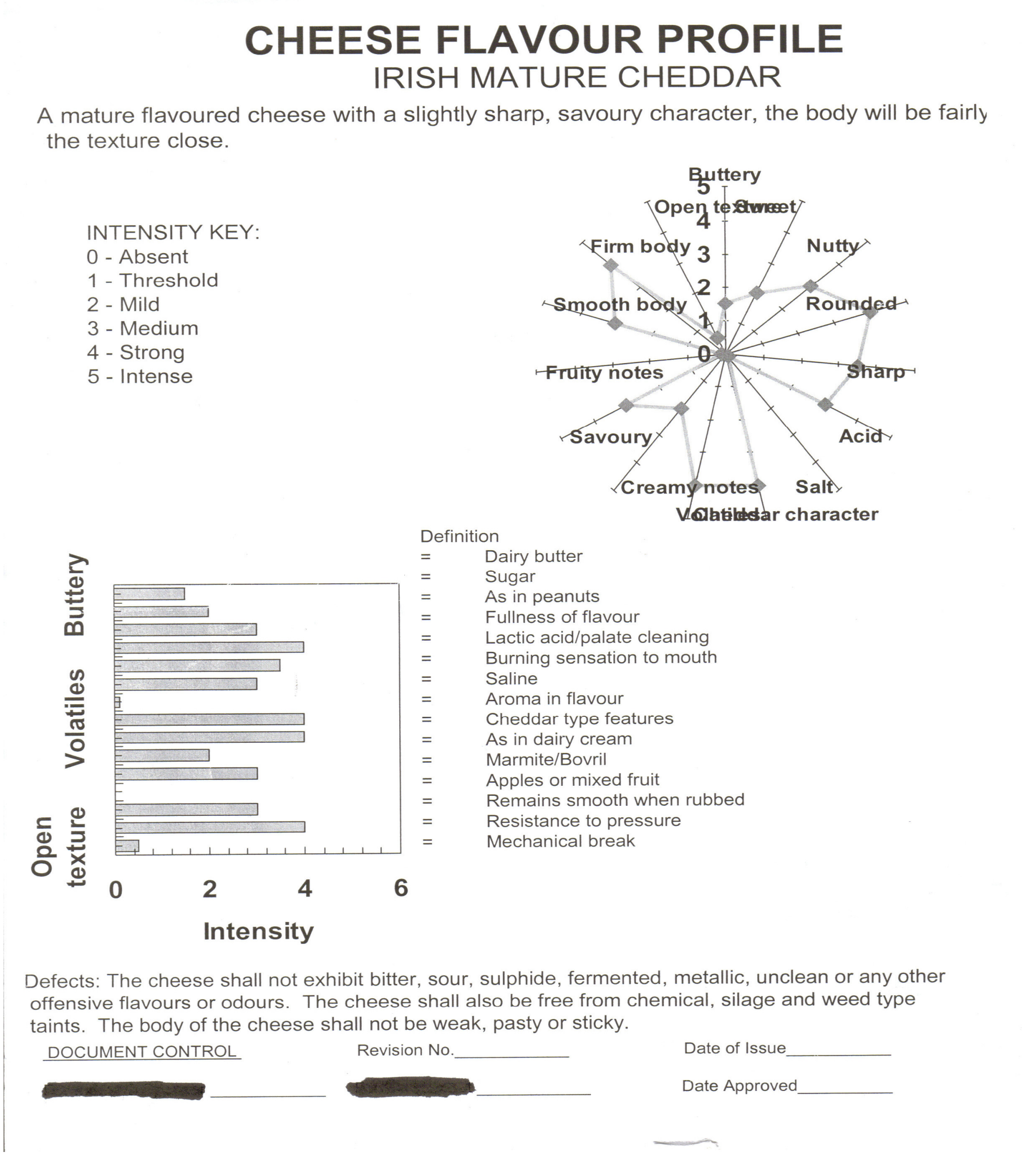
Each customer had their own cheese profile (Figure F1), and grades for that customer relate to that profile. In essence, Hathor tried to reach the requirements of their customers based upon pre-determined flavours, texture as set out in their cheese profile. Therefore the grade placed on the cheese was based upon its recipe and its hit rate per the customer profile.

> *It is known after 3 months by the body and texture if the cheese has reached its required hit rate… When the cheese has reached maturity, it is allocated a customer grade (i.e. a number). These are allocated according to the cheese profiles – this is a cheese spec of the quality and standard of the cheese per customer – each customer prefers different flavours e.g. some like a well rounded cheese, some prefer a mellow flavour while others prefer an acidy cheese etc. The cheeses are given a specific grade that identifies the customer, which has been pre-specified by customer. [Hathor: CG]*

Hathor produced two main categories of cheeses, which could be made from numerous different recipes.

> *We use fast and slow producing starters in production. The cheese is made for short periods of time but it has to last up to 18 months at a time [Hathor: CG].*

Figure F1: Example of a Sample Customer Profile for their Cheese Type


CHEESE FLAVOUR PROFILE
IRISH MATURE CHEDDAR

A mature flavoured cheese with a slightly sharp, savoury character, the body will be fairly the texture close.

INTENSITY KEY:
0 - Absent
1 - Threshold
2 - Mild
3 - Medium
4 - Strong
5 - Intense

Definition
= Dairy butter
= Sugar
= As in peanuts
= Fullness of flavour
= Lactic acid/palate cleaning
= Burning sensation to mouth
= Saline
= Aroma in flavour
= Cheddar type features
= As in dairy cream
= Marmite/Bovril
= Apples or mixed fruit
= Remains smooth when rubbed
= Resistance to pressure
= Mechanical break

Defects: The cheese shall not exhibit bitter, sour, sulphide, fermented, metallic, unclean or any other offensive flavours or odours. The cheese shall also be free from chemical, silage and weed type taints. The body of the cheese shall not be weak, pasty or sticky.

DOCUMENT CONTROL | Revision No.____________ | Date of Issue___________

[redacted] ___________ [redacted] ___________ Date Approved__________

The two categories were: generic cheeses (sold to supermarkets under their name) and branded cheeses (cheese sold using Hathor's name), and each type of cheese required a different storage time if it was to be graded as a mild, medium, mature or vintage cheese.

> *A Mild cheese which is a young, low flavoured cheese needs 3 – 5 months to mature. A Medium cheese which is a slightly higher flavoured cheese requires 7 – 10 months. A Mature cheese which has a stronger flavour needs 12 – 15 months, and a Vintage cheese which is a very strong cheese requires 18 months – 2 years to mature. [Hathor: CG]*

Appendix G: Certificate of Analysis

Pallet Manifest **Batch** 06102006 **Pallet No.** 44 **Date / Time** *07/10/2006*

Seq No	Block No	Production Date/Time	Weight
1	06100612186	06/10/2006 16:29:36	20.36
2	06100612187	06/10/2006 16:29:43	20.15
3	06100612188	06/10/2006 16:29:54	20.03
4	06100612189	06/10/2006 16:30:00	20.37
5	06100612191	06/10/2006 16:34:08	20.25
6	06100612194	06/10/2006 16:34:26	20.06
7	06100612192	06/10/2006 16:34:16	20.42
8	06100612190	06/10/2006 16:33:55	20.38
9	06100612195	06/10/2006 16:34:32	20.20
10	06100612193	06/10/2006 16:34:20	20.31
11	06100612196	06/10/2006 16:34:37	20.32
12	06100612197	06/10/2006 16:34:43	20.21
13	06100612198	06/10/2006 16:34:53	20.34
14	06100612199	06/10/2006 16:35:08	20.28
15	06100612200	06/10/2006 16:37:03	20.14
16	06100612201	06/10/2006 16:37:47	20.18
17	06100612202	06/10/2006 16:38:15	20.14
18	06100612203	06/10/2006 16:38:20	20.39
19	06100612204	06/10/2006 16:38:29	20.19
20	06100612205	06/10/2006 16:38:33	20.26
21	06100612206	06/10/2006 16:38:53	20.42
22	06100612207	06/10/2006 16:38:57	20.28
23	06100612208	06/10/2006 16:39:22	20.27
24	06100612209	06/10/2006 16:39:29	20.32
25	06100612210	06/10/2006 16:39:37	20.14
26	06100612211	06/10/2006 16:39:42	20.14
27	06100612212	06/10/2006 16:39:56	20.43
28	06100612213	06/10/2006 16:40:05	20.20
29	06100612214	06/10/2006 16:40:12	20.10
30	06100612215	06/10/2006 16:40:18	20.32
31	06100612216	06/10/2006 16:40:34	20.19
32	06100612217	06/10/2006 16:40:43	20.29
33	06100612218	06/10/2006 16:40:50	20.31
34	06100612219	06/10/2006 16:40:55	20.08
35	06100612220	06/10/2006 16:41:13	20.27
36	06100612221	06/10/2006 16:41:17	20.25
37	06100612222	06/10/2006 16:41:56	20.29
38	06100612223	06/10/2006 16:42:04	19.96
39	06100612224	06/10/2006 16:42:12	20.36
40	06100612225	06/10/2006 16:42:20	20.10
41	06100612226	06/10/2006 16:42:28	20.27
42	06100612227	06/10/2006 16:42:35	20.23
43	06100612228	06/10/2006 16:43:04	20.15
44	06100612229	06/10/2006 16:43:09	20.32
45	06100612230	06/10/2006 16:43:16	20.25
46	06100612231	06/10/2006 16:43:48	20.36
47	06100612232	06/10/2006 16:44:01	20.19
48	06100612233	06/10/2006 16:44:11	20.17
49	06100612234	06/10/2006 16:44:15	20.34
50	06100612235	06/10/2006 16:44:31	20.29

Total No. of Blocks 50 **Total Weight** 1,012.27

Page 1

Appendix H: Enki's Pyramid Approach to Development