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Strategies for designing and implementing knowledge management systems: An interpretive case study of two Western Australian house-building firms

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Faculty of Business and Law
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Strategies for Designing and Implementing Knowledge Management Systems: An Interpretive Case Study of Two Western Australian House-building Firms

Thesis for the Degree of
Doctor of Business Administration (Information Systems)

Submitted by
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Abstract

Knowledge management is a relatively new concept that has received substantial attention in the academic and industry literature, particularly in the information systems field. Proponents of knowledge management argue that it has been driven by the desire of organisations for greater innovation, cost reduction and process improvements (Wilson, Jackson & Smith 2003). Little research, though, has been conducted from a knowledge management perspective into how Western Australian house-building enterprises develop and implement information systems.

The WA house-building industry forms part of the wider building and construction community. Most construction firms are small-to-medium-sized enterprises that differ from large organisations in that they generally lack internal expertise, financial resources and have IS and IT landscapes that have been shaped by the dominant role played by the owner or manager of the firm (Fink 1998).

The exponential rise in communication technologies — such as the Internet, intranets and mobile digital imaging — is rapidly changing the environment in which the WA house-building industry operates. These emerging technologies are reducing the need for firms to rely on sophisticated proprietary systems to collect, store and disseminate their knowledge.

This situation brings with it its own sets of issues that must be intelligently managed. A strategic approach will leverage technologies to support knowledge-in-action within the social and cultural context of the organisation. At the same time, space must be created to permit the emergence of tools that may strengthen organisational performance and sustainable competitive advantage.

The critical point taken up by this research was that there is a range of considerations in the planning and implementation of an information system, and the use of multiple knowledge management theories in tandem may facilitate this.

The theoretical problem guiding this study was to expand knowledge management theory to include the WA house-building industry. The first objective of this study was to identify how WA house-building enterprises approached their knowledge management initiatives. The second was to construct a framework for analysing the factors that may be used to assist local managers in predetermining the critical success factors and outcomes of their knowledge management initiatives.

A case study methodology incorporating an interpretive perspective was adopted within the research. Case samples were limited to two Western Australian house-building enterprises.

This study contributes to a better understanding of the Western Australian house-building industry and their approach to developing and implementing knowledge management systems. Furthermore, the discoveries and recommendations presented in this research can be applied to the wider construction industry and small to medium sized business community.

Declaration

I certify that this thesis does not, to the best of my knowledge and belief:

1. incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education;

2. contain any material previously published or written by another person except where due reference is made in the text; or

3. contain any defamatory material.

I also grant permission for the Library at Edith Cowan University to make duplicate copies of my thesis as required.

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Date

Acknowledgements

With a sense of trepidation I have finally pieced together the final stage of my thesis. Not unlike the preceding four-and-half years, I find myself once again staring at a blank screen wondering how to condense an overactive mind full of skipping and twisting thoughts into a succinct construct of intelligible and plausible views.

I use the word *trepidation* with caution, but I must admit to having felt, for the most part of this journey, out of my depth. However, as I'm sure you will agree, now is not the time to dwell on past barriers, but rather to acknowledge how I *was* able to complete this degree. The answer is simple. I have been blessed with a beautiful and supportive family and an equally supportive circle of friends, colleagues and associates. Thank you.

I would particularly like to acknowledge Dr Paul Jackson for his tireless enthusiasm and patience in guiding me through this journey. Paul, you are a champion.

I would like to conclude these acknowledgements by sharing some advice that my dad gave me nearly twenty-five years ago when I had just completed my apprenticeship as a carpenter:

> *"Completing your apprenticeship doesn't make you a tradesman. What it does do is prepare you to learn how to be one, and to be a skilled tradesmen you should never stop learning."* (D. J. Wilson, c.1983).

I will apply these same principles to this degree and to my future research explorations.

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Chapter 1: Introduction

The first chapter of this thesis sets the scene. It commences with a description of how the study evolved from the early reflections of the researcher to a professional practitioner's perspective.

This chapter also provides a broad outline of the study and presents a brief summary of each remaining chapter.

1.1 Background to the research

My interest in this study evolved from the growing awareness in the literature of the role knowledge and its appropriate management play in the success and sustainability of organisations. In Australia, this increased awareness has been attributed to five key trends (Hall 2003, p. 1):

1. globalisation and the intensity of competition;

2. changing organisational structures;

3. new worker profiles, preference and predispositions;

4. advances in information and communication technology; and

5. the rise in knowledge management.

It is this fifth trend, knowledge management, that was the focus of this study. Due to its tacitness and inimitability, knowledge is seen as a key source of sustainable competitive advantage in hypercompetitive global and domestic markets. It allows organisations to become more flexible and innovative. However, a scan of the literature identified a paucity of research into knowledge management and the Western Australian house-building industry.

1.2 Why knowledge management, not information systems?

From the outset of this study, I wanted to view all forms of information systems (IS) within the firm. Whether it was called information technology (IT) management information systems (MIS) or strategic information systems (SIS) was, to some extent, irrelevant.

Knowledge takes many forms — from highly structured, explicit forms (for example, data repositories and enterprise-resource-planning systems) through to unstructured emergent forms of IS and IT such as data imaging and e-mail. Therefore, I wanted this

study to look at all forms and systems from a knowledge perspective and to consider how these systems contribute to a firm's overall sustainable competitive advantage.

Gartner (*2006*) defined knowledge management (KM) as:

> *... the creation, capture, organization, access and use of knowledge. We believe, however, that KM doesn't exist without collaboration, which we define as "the heart of the KM process model." We also believe that KM isn't a separate class of technology. Rather, it uses many technology categories, almost none of which are exclusive to KM. For example, knowledge sharing makes use of content management technologies to accomplish the KM processes of capturing, organizing and accessing knowledge (p. 2).*

Within the construction industry, knowledge management as a concept has not been widely adopted by managers. Recent criticism regards it as a "subject of crucial, but generally ignored, importance for the construction sector today" (CIB W102 2005).

In order to highlight examples of why knowledge management is "generally ignored", we need look no further than the introduction of the *Proceedings of CIB* (the International Council for Research and Innovation in Building and Construction) where three clear explanations are presented to defend this critical stance. Table 1 presents a summary of these explanations.

Table 1:   Why is knowledge management in construction generally ignored or
taken for granted? (Source: Proceedings from CIB W102 2005, p.
xi)

1. Members of the world's countless building "teams" — those ephemeral entities composed of representatives selected from many professional disciplines and culture — accumulate knowledge (without being true "learning organisations") and share information (without having a true appreciation of its value).

2. On the one hand, we know that information comes in many forms: contracts, plans, specifications, catalogues, research reports, web sites etc. — each with its inherent biases and relative levels of reliability. On the other hand, we know that reading is not considered by the busy professional to be a productive activity. This leads us to the conclusion that information is only taken up (or, better, taken in and converted into knowledge) when practitioners are obliged — by contract or by law — to do so.

3. We also know that coping with information ("interpreting instruction" in the words of the UN ECE) has — since the end of the '50s — been associated with acquired building skills. In other words, using information is embedded in the rituals of the traditional processes of designing and constructing buildings and infrastructures.

From my experience as a building practitioner, I am constantly reminded how critical knowledge is to the performance and sustainability of building firms. These reminders are presented in many forms, ranging from my need to understand and follow stringent regulatory and contractual procedures to the more subjective ability of "just knowing what to do next". I am also constantly reminded how little we, as an industry, know about the concept and how to approach knowledge management within a strategic context for sustainable competitive advantage.

In order to improve this situation, I believed that there was an urgent need for research to be conducted within a real life setting. Most importantly, however, the results of this study and similar studies should be made available to all participants within the building and construction industry. Currently:

> *... research into information and knowledge management are kept out of the focus of research strategic planners; they concentrate on areas where it is assumed that information and knowledge management are fully understood, just like the air we necessarily breath in order to perform our daily tasks (Proceedings from CIB W102 2005, p. xi).*

Building and construction is a vital industry and influence in a global economy. Within the geographical setting of Perth, Western Australia, the importance of the role played in our community by the industry can be viewed from the following extract from the Australian Bureau of Statistics (2003):

> *The construction industry impacts on the lives of every Western Australian. It provides the homes in which we live, recreational facilities, schools and hospitals, and infrastructure for transport, water and electricity supply and communications. The construction industry is an integral part of the Western Australian economy and is closely linked to other industries such as Manufacturing and Finance (p. 1).*

The following statistics provided by the Australian Bureau of Statistics (2003) further highlight the important role played by the construction industry toward contributing to the sustainable social and economic future of Western Australia:

- The construction industry contributed an estimated $6,659 million (8.1%) to gross domestic product in 2002–03.

- In 2002–03 the construction industry employed 77,900 persons or 8.1% of the State's total workforce.

- Apprenticeship and trainee completions in construction rose by 8.2% over the five years to 2001–02.

What is unique about the Western Australian house-building industry?

A construction industry survey conducted by the Australian Bureau of Statics for the period 1996–97 confirmed that, of the discoveries presented in the survey, the most noticeable was that the construction industry was predominately small firms with less than twenty employees. That is to say, the industry consisted mainly of small-to-medium enterprises.

Small-to-medium enterprises exhibit many of the characteristics similar to those found in most WA house-building firms. Moreover, it is well known that they differ from large organisations. According to Fink (1998):

> *They possess unique characteristics with respect to IT, identified as environmental, organisational, decisional, and psycho-sociological.*

- Small-to-medium enterprises are usually characterised by a high level of environmental uncertainty (e.g. fluctuations in interest rates). This includes the IT environment.

- They are regarded as "poor" in human, financial and material resources. This has caused them to rely on outside help more extensively than larger organisations do.

- Decision making tends to be short-term and intuitive, focusing on reaction rather than anticipation. IT systems and applications in such situations need to be robust and available quickly, preferably as packages.

- From a psycho-sociological perspective, the owner–manager plays a dominant role in the organisation, thereby shaping the organisational culture with respect to the use of IT (Fink 1998).

The IS literature addresses many facets of strategy formulation and implementation of innovative IS (e.g. Earl 1998; Ward & Griffiths 1988). However, it appears that most researchers have focused on large organisations, where formal structures and suitable resources exist, overlooking the fact that small-to-medium enterprises are resource poor (Swartz & Boaden 1997).

A combination of the rising interest in knowledge management and the paucity of literature that takes into account the unique environment of the WA house-building industry was the trigger that initially guided the researcher down the path of investigating knowledge management within a local environment.

1.3 About the researcher

My interest in this study emerged as an active professional practitioner with over 10 years of senior management experience. Having commenced my working career as a qualified tradesperson (a carpenter and joiner), I was employed by James Hardie Building Systems in the late eighties. During this period, I held positions such as Senior Projects Manager, Regional Operations Manager (Victoria and Tasmania) and State Manager (Western Australia) whilst gaining qualifications in applied science (building construction) and business administration. At the time this study was undertaken, I was employed on a full-time basis as General Manager at ABC Homes (not its real name). This company is presented as the first case study.

More recently, my enthusiasm for being a proponent of knowledge management within the building and construction industry has been linked to this study through:

- publishing articles:
  - o Wilson. G, Jackson, P and Smith. W (2003), *Knowledge management strategies in a small and medium sized enterprise: A tale of two systems.* Australasian Conference of Information Systems, PERTH WA 2002.

  - o Wilson, G., Jackson, P. and Hughes, V. (2005), *Achieving competitive advantage in a knowledge-based economy: Supporting communities of practice in the construction industry.* CIB W102 Information and knowledge management in a global economy, LISBON, Portugal.

  - o Wilson, G. and Jackson, P. (2005) *Constructing in the knowledge economy: Knowledge management strategies for small to medium sized construction firms.* CIB W102 Information and knowledge management in a global economy, LISBON, Portugal.

- establishing industry-based communities of practice; and
- improving the efficiency and effectiveness of the participating firms.

1.4 The research problem

Changes in organisational environments are affecting the way organisations need to operate. Tacitness and inimitability of knowledge within the business environment are deemed to be critical sources of sustainable competitive advantage in the emerging knowledge economy. However, we know little about how WA house-building enterprises should approach and implement their initiatives.

The current problem faced within the industry is the paucity of knowledge held by practitioners and researchers alike on the subject of knowledge management and how strategic applications will improve organisational competitiveness and sustainability within the emerging knowledge economy.

This study contributes to the wider body of knowledge by adding to the literature on knowledge management. It does so with a focus on the local house-building industry rather than large organisations, with which most research has been concerned to date.

The theoretical contribution of this research will be the extension and refinement of knowledge management theory to include the WA house-building industry.

The practical contribution of this dissertation will be recommendations that can assist local managers in the adoption of knowledge management systems.

The following key research questions will be addressed:

1. How does the way in which a knowledge management strategy is approached in a Western Australian house-building firm affect the type of knowledge produced?

2. Does the way in which a knowledge management strategy is approached in a Western Australian house-building firm affect the sustained use and benefit of the knowledge management system within the firm?

1.5 Research objectives

My generic research objective was to expand the body of knowledge within the field of knowledge management to include the WA house-building industry. My specific research objectives were as follows:

1. Gain a better understanding of knowledge management practices from the perspective of the local industry.

2. Improve my effectiveness as a manager and practitioner within the local industry though a better understanding and use of knowledge.

3. Share this knowledge and deliver the findings of this study to the wider building and construction community.

1.6 The significance of the study

The practical problem that prompted this thesis was the recognition that there was little assistance available to managers of WA house-building enterprises to guide them in the implementation of knowledge management systems. The practical challenge was to examine whether a good-practice guide to approaching and adopting such a system can be developed that would consider the special needs of the WA industry in exploiting knowledge management systems for sustainable competitive advantage.

The theoretical challenge confronting this study was to expand knowledge management theory to include the Western Australian house-building industry in order to better understand what factors influenced whether knowledge management systems could provide a practical source of competitive advantage for local enterprises.

The goal of this thesis was, therefore, to deepen our understanding of the adoption of knowledge management systems within the local house-building industry by applying and extending knowledge management theory. These insights may be transferable to the wider construction industry as a whole.

1.7 Ethics

The researcher was mindful of the University's ethical requirements for conducting research of this nature. Before collecting data or conducting interviews, the researcher obtained formal ethics clearance from the University. The identities of all participants were disguised throughout the study to ensure that the privacy and anonymity of the participating firms and individuals were protected.

1.8 Outline of the study

The remaining chapters are structured like so:

Chapter 2: Review of the literature: The main objective of chapter 2 is to build a theoretical foundation for the study. This is achieved by presenting a thorough review of the literature pertaining to knowledge management

within the context of the Western Australian house-building industry. This chapter also presents the link between the research problem and the study's theoretical framework.

Chapter 3: Research methodology: This section of the study describes the methodology chosen for the enquiry and presents the research model. Justification of the chosen methodology and philosophical stance is also presented.

Chapter 4: Case study one: Chapter 4 presents the first of two case studies.

Chapter 5: Case study two: Chapter 5 presents the second case study.

Chapter 6: Data analysis: The most important section of the study, this chapter presents the combined results and analysis of the case studies.

Chapter 7: Conclusion and research limitations: This chapter presents the conclusions regarding the research questions and presents the framework that was developed as a result of this research. This chapter also presents a summary of the research limitations uncovered during the process, recommendations for further research and practical implications that emerged as a result of the study.

1.9 Glossary of key words

Data: any signal that can be sent by an originator to a recipient, human or otherwise (Burton-Jones 1999).

Emergent approach: an approach that holds no formal boundaries or hierarchy as initiatives evolve from fragmented, incremental and largely intuitive processes (Mintzberg 1998).

Explicit knowledge: knowledge that is articulated, codified and communicated in symbolic form, unlike tacit knowledge, which evolves from human interaction and experiences (Alavi & Leidner. 2001).

Information: data that are intelligible to the recipient (Burton-Jones 1999);

Knowledge flows: the type of knowledge most often associated with knowledge sharing and person-to-person contact and communication

sharing and person-to-person contact and communication (Hansen, Nohria & Tierney. 1999).

Knowledge management system:	the technical and non-technical tools, processes and procedures employed by an organisation to facilitate improved knowledge management (Gartner 2006).
Knowledge management:	the creation, capture, organisation, access and use of knowledge (tacit and explicit) for the purpose of improving the learning and performance of the organisation (Gartner 2006; Kautz and Thaysen 2001).
Knowledge stocks:	the type of knowledge most often found in technologically based tools such as data repositories, which are designed to capture and store vast amounts of explicit knowledge (Hansen, Nohria & Tierney. 1999).
Knowledge:	information combined with experience, context, interpretation, reflection and perspective (Davenport & Prusak. 1998).
Socio-technical perspective of knowledge management	a perspective in which knowledge management activities can be seen as multi-layered systems, with loosely coupled technological, informational and social elements interacting over time to determine practical outcomes (Pan & Scarbrough. 1999).
Strategic approach:	a top-down management initiative to improve organisational performance (Porter 1985).
Tacit knowledge:	a composite of cognitive and technical components that reside in the human mind, behaviour and perception, and are difficult to express as propositional utterances (Nonaka and Takeuchi 1996; Boisot 1998).

Chapter 2: Literature review

This chapter presents an overview of the literature. It commences with a brief discussion of the concept of knowledge. This literature review further examines the current research on the relationship between strategy, knowledge management and its relevance to effective organisations, particularly those that operate in the building and construction industry.

2.1 Introduction

Understanding the relationship between the way a firm approaches its knowledge management initiatives and the subsequent knowledge produced is critically important to this study as it is endeavouring to provide practical recommendations to firms seeking sustainable competitive advantage from knowledge based activities.

From a strategy perspective, this literature review explores the approach a firm may adopt when considering a knowledge management initiative. It is argued that at either end of the strategy continuum, the approach is considered to be strategic or emergent (Mintzberg 1987).

A strategic approach aligns itself with the more traditional interpretation of strategy; whereby, it is seen as primarily a management endorsed initiative in which a prediction is made of the future and a roadmap is developed to achieve a certain goal. Conversely, an emergent approach can be seen as evolving over time from a variety of sources that are generally fragmented and intuitively based responses to specific situations.

From a knowledge perspective, this study is concerned with the type of knowledge created from a particular approach toward knowledge management. That is, do different strategic approaches create different types of knowledge? Knowledge can be categorised according to two dimensions: *tacit knowledge* and *explicit knowledge*.

Tacit knowledge is viewed as a composite of cognitive and technical components that reside in the human mind, behaviour and perception, and which are difficult to express as propositional utterances (Nonaka and Takeuchi 1995; Boisot 1998). Explicit knowledge, according to Zack (1999) is "more precisely and formally articulated" than tacit knowledge. Explicit knowledge is generally the type of knowledge that is most often seen in codified forms such as procedure manuals, product literature and computer software.

Knowledge does not represent a single, monolithic concept (Nissen 2006), rather, it is dynamic and largely influenced by the social context in which it emerges (Alavi, Kayworht and Leindner 2006). Moreover, Sussman and Siegal (2003, in Alavi et al. 2006) argued that the usefulness of a knowledge management initiative to a firm would be heavily influenced by the way individuals learn and behave in organisations.

This suggests that knowledge management (KM) is not an objective, discrete and independent phenomenon operating in organisations (Alavi et al. 2006). On the contrary, according to Alavi et al:

> *KM processes are heavily influenced by the social settings in which they are embedded and are subject to various interpretations based upon organizational norms and social interactions among individuals (p. 193).*

It follows that this literature review, and indeed the study itself, considers the concept of knowledge management from a socio-technical perspective.

This chapter is presented in four main sections. The next section presents an overview of the concept of knowledge. This is followed with a review of knowledge from an organisational perspective, which examines the different approaches a firm might adopt when considering a knowledge management initiative and the influence the particular approach plays on the knowledge produced. In concluding this chapter, a summary is presented, and gaps within the existing literature are highlighted. It is from this basis that the research model and theoretical propositions of this study were formulated.

2.2 The concept of knowledge

Knowledge is now deemed a key resource for organisations. Moreover, the ability of the organisation to harness and deploy this knowledge across its chosen domain can have a major influence over sustainable competitive advantage (Hahn and Subramani 2001). However, offering a simple, concise definition of knowledge is difficult as our understanding of the term has been the basis of debate dating back to the Greek philosophers (Alavi and Leidner 2001). Moreover, its intangible and fuzzy nature makes it difficult to define (Bhatt 2002).

According to Davenport et al. (1998, in Matensson 2000):

> *Knowledge is information combined with experience, context, interpretation, reflection and perspective (p. 207).*

There has been, however, a tendency within the literature, particularly within the IS discipline to define knowledge in such a way that there is little differentiation between data and information (Alavi & Leidner. 2001).

Distinctions between each term are necessary to avoid confusion (Burton-Jones 1999). Following Burton-Jones (1999):

> *... data are defined as any signals which can be sent by an originator to a recipient — human or otherwise, whereas information is defined as data which are intelligible to the recipient and knowledge is defined as the cumulative stock of information and skills derived from the use of information by the recipient (p. 5).*

Thus, knowledge can be viewed as the result of a cognitive process that has been triggered by the inflow of new stimuli (Alavi et al. 2001). Although knowledge is a cognitive process that resides in people, it can also be made explicit, therefore enabling it to be captured and stored in knowledge management systems.

2.2.1 Understanding the distinction between tacit and explicit knowledge

The philosophers Polanyi (1973) and Ryle (1949) argued that the distinction between tacit and explicit knowledge is critical to understanding how people deal with the world in a purposive manner. Tacit knowledge comprises cognitive and technical components (Nonaka and Takeuchi 1995) that reside in the human mind, behaviour and perception but which are impossible, or at least difficult, to express as propositional utterances (Boisot 1998). Tacit knowledge evolves from human interactions and experiences, which requires differing levels of skill and practice.

On the other hand, explicit knowledge is articulated, codified and communicated in symbolic form (Alavi & Leidner 2001). Examples of explicit knowledge can be seen in organisational procedures and manuals, which have been established for the individual to interpret and follow. Explicit knowledge is generally the dimension of knowledge that is captured and shared through information technology (see Table *2*). Alavi and Leidner (2001) argued that:

> *The two terms (tacit and explicit) are not dichotomous states of knowledge, but mutually dependent and reinforcing qualities of knowledge: tacit knowledge forms the background necessary for assigning structure to develop and interpret explicit knowledge (p. 112).*

Generally, the knowledge that management seeks to exploit is the instrumental and "logistical" knowledge that is directly germane to task objectives.

Table 2: Two types of knowledge (adapted from Nonaka and Takeuchi (1995)

Tacit knowledge (Subjective)	Explicit knowledge (Objective)
Knowledge of experience (body)	Knowledge of rationality (mind)
Simultaneous knowledge (here and now)	Sequential knowledge (there and then)
Analogue knowledge (practice)	Digital knowledge (theory)

Knowledge is also manifest in theories-in-use, which are the assumptions and beliefs that actually govern actions and judgments. Agents may not be aware of, or able to articulate theses theories, so they can be explicit or tacit (Argyris 1999). If we are to make sense of actions and decisions in the course of information-systems implementations, we need to understand and consider both these forms of knowledge (Ackoff 1983; Davis & Naumann 1997). Theories in use, or "mental models" (Senge 1995), affect the transmission of knowledge. Likert and Likert (1999) stated:

> ...*people act on the basis of what they perceive the situation to be, whether the perceptions are accurate or grossly inaccurate... (p.179).*

This according to Kim (1998), proffers the view that the mental models in individuals' heads are where the vast majority of an organisation's knowledge both know-how and know-why lie.

Accordingly, Nonaka and Takeuchi (1995) suggested that through the interaction of tacit and explicit knowledge there are four different modes of knowledge conversion (see Figure 1). These four modes are summarised as follows:

1. Socialisation: From tacit knowledge to tacit knowledge.
2. Externalisation: From tacit knowledge to explicit knowledge.
3. Combination: From explicit knowledge to tacit knowledge.
4. Internalisation: From explicit knowledge to tacit knowledge.

Tacit knowledge   *To*   Explicit

Tacit knowledge	**Socialisation**	**Externalisation**
From Explicit knowledge	**Internalisation**	**Combination**
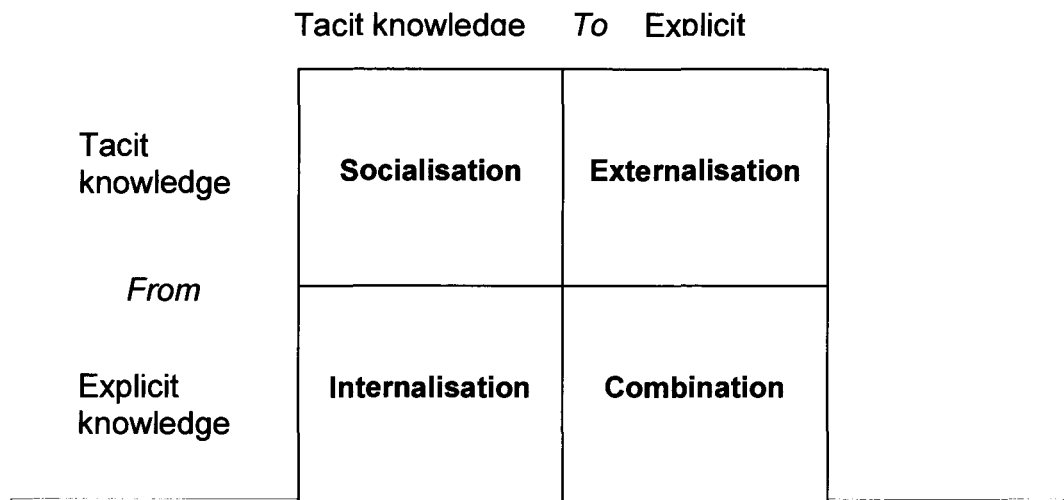
Figure 1:   Four modes of knowledge conversion, following Nonaka and
Takeuchi (1995)

In summary, the knowledge that managers seek to exploit for their competitive advantage can be viewed as tacit or explicit. Tacit knowledge is viewed as a composite of cognitive and technical components that reside in the human mind. Explicit knowledge, however, is more precise and formally articulated, making this type of knowledge more suitable for managers to capture and codify.

Expanding the perception and interpretation of knowledge to an organisational context, knowledge management can be viewed as a process or practice of creating, acquiring, capturing, sharing and using knowledge (explicit and tacit) for the purpose of improving the learning and performance of the organisation (Quintas, in Kautz and Thaysen 2001).

Similarly, Alavi and Leidner (in Hahn & Subramani 2000) argued that, knowledge management through its systematic processes of acquiring, organising and communicating knowledge of employees enables other employees to make use of it and, therefore, become more effective in their work. However, due to the unique nature of organisational knowledge, little is known about how organisations should apply the concept in the hope of enhancing their competitive advantage (Pan 1998).

2.3 Effective knowledge management starts with strategy

Effective knowledge management starts with strategy, but what is meant by the term *strategy*? If we were to consider the term in its traditional form, we could refer to the description taken from the military as a way of preparing broad-based formulas for defeating the enemy. The origins of this can be traced back to around 400 BC and the

writings of Sun Tzu in "The Art of War". From a contemporary organisational perspective, much of the meaning of the term has remained unchanged. Porter's (1985, in Robson 1997) definition of strategy shows this:

> *A broad based formula for how business is going to compete, what its goals should be, and what policies will be needed to carry out those goals. The essence of formulating strategy is relating a company to its environment (p. 4).*

Within this paradigm, strategy development would require the manager of an organisation to make a prediction about the future. According to Beinhocker (1999):

> *... managers make big decisions about the company's focus, the investment of resources, and how to coordinate activities across the company (p. 96).*

Robson (1997) provided a useful summary of *strategy* definitions that contain implications of how strategy should be created. These definitions are presented in chronological order in Table 3.

Table 3:   Summary definitions of the term *strategy* (adapted from Robson 1997, pp. 4-5)

Date	Author	Definition
1965	Ansoff — Corporate strategy	Strategy is a rule for making decisions under conditions of partial ignorance, whereas policy is a contingent decision. Business strategy is the broad collection of decisions rules and guidelines that define a business's scope and growth direction.
1977	Steiner and Miller — Management policy and strategy	Strategy refers to the formulation of basic organisational missions, purposes and objectives; policies and program strategies to achieve them; and the methods needed to ensure that strategies are implemented to achieve organisational ends.
1979	Mintzberg — The structuring of organisations	Strategy formulation involves the interpretation of the environment and the development of consistent patterns in streams of organisational decisions.
1980	Quinn — Strategies for change: logical incrementalism	Strategy is the pattern or plan that investigates an organisation's major goals, policies and action sequences into a cohesive whole. Strategic decisions are those that determine the overall direction of an enterprise and its ultimate viability in light of the predictable, unpredictable and unknowable changes that may occur in its most important surrounding environment.
1987	Hax (Ed.) — Planning strategies that work	The essence of strategy is for a firm to achieve a long-term sustainable advantage over its competitors in every business in which it participates. A firm's strategic management has, as its ultimate objective, the development of its corporate values, managerial capabilities, organisational responsibilities, and operational decision-making, at all hierarchical levels and across all business and functional lines of authority.
1991	Quinn and Mintzberg — The strategy process	There is no single, universally accepted definition of strategy. There is no one best way to create strategy, nor is there one best form of organisation. The world is full of contradictions, learn to appreciate their causes and effects and reconcile them sufficiently for effective action. No single model or theory can incorporate all the factors that influence major business decisions or all the possible combinations of these factors that could be faced. Nor can any anticipate the bizarre changes that occur in real world environments, or even more important, the impacts of your own or other's creative innovations.
1993	Johnson and Scholes — Exploring corporate strategy	Strategic decisions are concerned with: • the scope of an organisation's activities; • the matching of an organisation's activities to its environment; • the allocation and reallocation of an organisation's activities to its resource capability; • the allocation and reallocation of major resources in an organisation; • the values, expectations and goals of those influencing strategy; • the direction in which the organisation will move in the long term; and • Implications for change throughout the organisation.

These definitions imply that management need not only understand the term strategy, but must also create the necessary resources to plan and implement the firm's strategy path. Furthermore, it can be argued that, at the extremes, strategy operates along a continuum from strategic to emergent.

2.3.1 A perspective of strategy as explicit

One of the best known frameworks for analysing and developing a firm's competitive strategy is Porter's (1985) competitive forces model (see Figure 2). Porter's model

highlights five major forces that influence the success of a firm within its chosen industry. The five forces are generalised as:

1. the threat of entry of new competitors;

2. the bargaining power of suppliers;

3. the bargaining power of customers (buyers);

4. the threat of substitute products or services; and

5. the rivalry among existing firms in the industry.
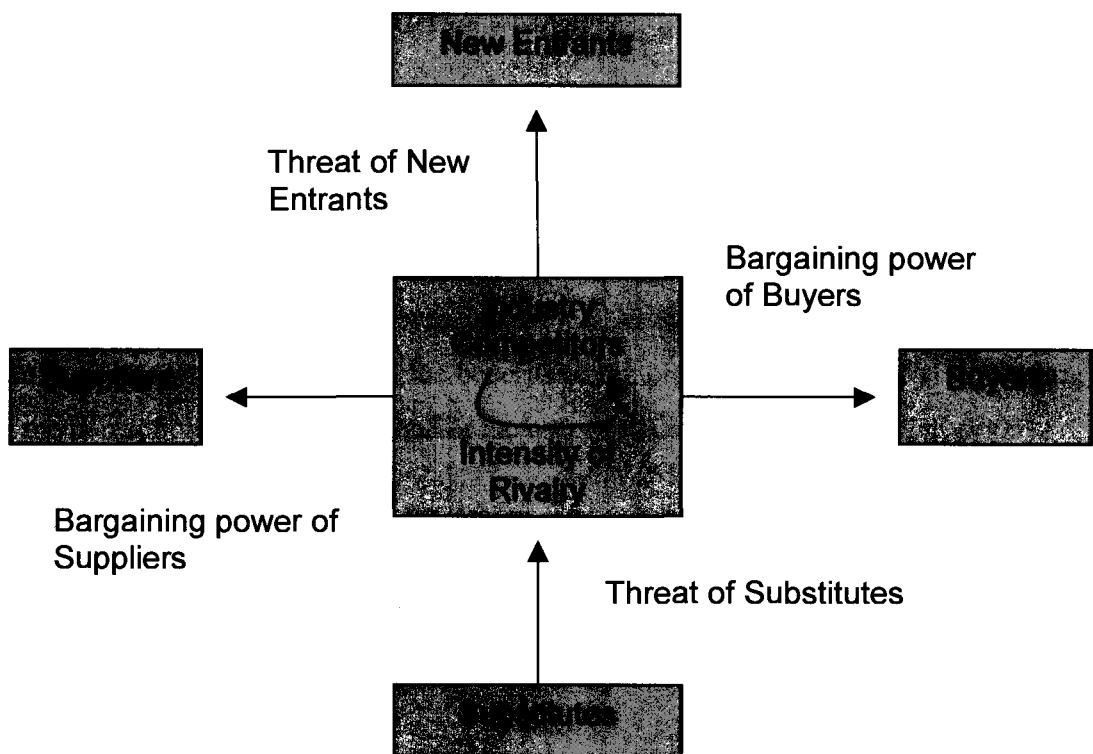
Figure 2:   Porter's five forces model

In more recent times, it has been suggested that Porter's model requires *"semiradical"* changes to maintain its relevance in the emerging knowledge economy (Turban et al. (2006). Absent from Porter's model are the added influences of employee bargaining power (Harmon et al. 2001, in Turban et al. 2006) and the influence of new technologies such as the Internet.

2.3.2 An emergent perspective towards strategy

Despite the theoretical strengths of Porter's model on influencing organisational strategy design and implementation, it is now well known that organisations (particularly small-to-medium enterprises) rarely use a rational, analytical approach (Quinn 1978). Rather, strategies often evolve from fragmented, incremental and largely intuitive processes (Beinhocker 1999).

For that reason, this study will follow Teece (in Groenhaug & Nordhaug 1992) who argued that:

> *The central idea underlying strategy is that organisations must adjust their capabilities (i.e. their resources and skills) to a constantly changing complex and external environment (p. 440).*

The point taken up here is that an organisation's strategy may be explicit or emergent. An explicit strategy will generally resemble the definition of strategy offered from Porter (1998); whereby, management attempts to determine the future and reposition their resources in order to compete. An emergent strategy typically evolves from intuitive management and employee behaviour. As such, each approach will deliver results. However, the results and the benefits to the organisation may differ depending on the perception of the initiator and or the user of the initiative (Wilson et al. 2003).

Within the construction industry, there is growing evidence that prescriptive approaches towards knowledge management and their consequential outcomes (i.e. rigid IT-based systems) do not result in effective knowledge management practices (Egbu, Hayles et al. 2003, p.38).

A recent UK study commissioned by the Department of Trade and Industry (Egbu, Hayles et al. 2003) concluded that, successful knowledge management initiatives conducted within the construction industry needed to be a simple process with a simple human interface. The key findings of this report are presented in Table 4.

Table 4:   Key finding from an analysis of knowledge management practices
            within the UK construction industry (Source: UK Department of
            Trade and Industry 2003, p. 38)

- People rely heavily upon communication to solve day-to-day problems. For project staff, this is almost entirely within the company or the immediate supply chain.

- The industry values experience very highly and personal communication emerges as the most common, and maybe the most effective way of transferring learning from experience.

- External sources are used to develop new business development and gather market intelligence.

- Most companies regard training as a means to improve on their existing knowledge.

- The industry, not surprisingly, finds it very difficult to capture knowledge gained from experience. These difficulties are exacerbated by a temporary, often nomadic workforce, divisions between site and office staff, and a preoccupation with professional liability.

- A formal KNOWLEDGE MANAGEMENT initiative (that the company judged successful) involved a high degree of backing from senior management and some dedicated resource. However, IT investment was low (indeed, for one case — web-enabling a 'proposals library' database — it had been decided that it could not be justified at the present time). Rather, dedicated staff were put in place to deliver and facilitate the initiatives, and appeared to contribute significantly to the initiatives' success.

The socio-technical perspective has been expanded upon by Earl (1993, in Robson 1997), who presented five types of planning approaches towards an IT-enabled strategy. These were organisational, technical, administrative, method and a business-led approach. Earl concluded, "It is the eclectic and continuous organisational approach that appeared the most effective". Earls' five approaches to IT-enabled strategies are presented in Table 5.

Table 5:   Socio-technical approach to IT enabled strategies (adapted from Earl 1998)

Organisational Approach:	Implies a cross-functional views of IS to ensure that investments are targeted on the business objectives and key themes implied by these objectives.
Technological approach:	Implies an incremental adoption of technology as it is available and proven, to enable technology efficiency to substitute for peoples inefficiency.
Administrative approach:	A risk-averse approach that implies that the main object is budgetary control of IS and IT.
Method-driven approach:	Also a risk averse approach that requires a highly analytical and structured approach to determine the critical needs for investment.
Business-led approach:	Strategies are driven by critical success factors of the organisation.

Earl's (1998) socio-technical approach towards IT-enabled strategies led to the realisation that firms operate within a complex environment consisting of discrete multilayered sub-systems. Building on this, strategies have the potential to produce both anticipated and emergent outcomes (Mintzberg 1988). However, by recognising this phenomenon earlier rather than later in the lifecycle of a knowledge management initiative, makes for a better use of resources and improves the pragmatic expectations emanating from the implementation of knowledge management within the firm.

2.4 The influence of strategy and knowledge on organisational performance

Effective performance and growth in the emerging knowledge economy requires the integration and sharing of highly distributed knowledge (Zack 1999). In order to achieve sustainable competitive advantage through better utilisation of organisational knowledge, much of the recent literature has recommended that management focus on two general dimensions of knowledge: tacit and explicit.

Within this understanding of two dimensions of knowledge, it is crucial to distinguish between the types of knowledge and their potential contribution to the firm.

1. Explicit knowledge identifies a preoccupation by management to concentrate their efforts on capturing, storing and disseminating explicitly documented knowledge.

2. Tacit knowledge emphasises interpersonal communication and knowledge sharing (Choi & Lee 2002; Swan et al. 2000; Zack 1999; Hansen et al. 1999).

It will be argued in this study that the approach a firm adopts toward knowledge management will influence the type of knowledge produced. The following section presents several alternative examples of established literature that agree that firms seeking a particular benefit from their knowledge management initiative should adopt a strategy to suit a particular organisational characteristic or goal. The most obvious commonality between these examples is the distinctions made between a strategic and emergent approach and their relationship between the two dimensions of tacit and explicit knowledge.

2.4.1 The codification and personalisation of knowledge

Gray (2001) expanded on this distinction between the two dimensions. He posited that much of the recent literature on the concept of knowledge management presents organisations as aggregations of knowledge *stocks* and knowledge *flows*. According to Hansen et al. (1999), companies with routine outputs should pursue a codification knowledge strategy that focuses on building repositories (knowledge stocks). Alternatively, companies with non-routine outputs are advised to pursue a personalisation knowledge strategy that promotes knowledge sharing and person-to-person contact (knowledge flows).

The focus of the codification strategy is on the explicit dimension of knowledge where:

> *... knowledge is carefully codified and stored in databases, where it can be accessed and used easily by anyone in the company (Hansen ,Nohria et al. 1999, p. 106).*

Alternatively, the focus of a personalisation strategy is on tacit dimension of knowledge, such that:

> *... knowledge is closely tied to the person who developed it and is shared mainly through direct person-to-person contacts (Hansen, Nohria et al. 1999, p. 106).*

2.4.2 The process and practice approach

Turban (2006) segregated the two dimensions by arguing that the two fundamental approaches to knowledge management should be considered as a process approach or a practice approach

The process approach seeks to codify organisational knowledge in order to formalise the firm's rules, processes and technologies (Hansen et al. 1999, in Turban 2006).

Information technology is a significant facilitator to the success of this approach toward knowledge management, as the technologies allow firms to collect, store and disseminate knowledge stocks at levels and speeds not possible by human means alone.

According to van der Speck et al. (2003 in Turban 2006) the process approach can assist in managing a firm's knowledge at three differing levels:

Level one: Knowledge is codified in project descriptions, stories or other forms of documentation where limited filtering has been done.

Level two: Knowledge is codified into structured concepts, frameworks and theories.

Level three: Knowledge is embedded into work practices that give direction to employees.

The process approach does have its limitations. First, this approach is limited in its ability to deal effectively with tacit knowledge due to the rigid and formal nature of the information systems employed to manage the firm's knowledge. Second, the process approach forces individuals to work within fixed patterns of thinking (DeLong & Fahey 2000; Brown & Duguid 2000; Von Krogh 2000; Hargadon 1998, in Turban 2006). This has the potential to limit learning and innovation.

The process approach excels at establishing and supporting controlling mechanisms to deal with specific tasks and processes within the firm. The practice approach relies more on the social and community environments necessary to facilitate the sharing of tacit knowledge (Brown & Duguid 2000; DeLong & Fahey 2000; Gupta & Govindarajan 2000; Wenger & Snyder 2000; Hansen et al. 1999 in Turban 2006).

Table 6 presents a summary of the process and practice approaches toward knowledge management.

Table 6: The process and practice approaches to knowledge management
(Source: Turban et al. 2006, p. 376)

	Process Approach	Practice Approach
Type of knowledge supported	Explicit knowledge-codified rules, tools and processes (DeLong & Fahey 2000)	Mostly tacit knowledge-unarticulated knowledge not easily captured or codified (Leonard & Sensiper 1998)
Means of transmission	Formal controls, procedures, and standard operating procedures with heavy emphasis on information technologies to support knowledge creations, codification and transfer of knowledge (Ruggles 1998)	Informal social groups that engage in storey telling and improvisation (Wenger & Snyder 2000)
Benefits	Provides structure to harness generated ideas and knowledge (Brown & Duguid 2000). Achieves scale in knowledge reuse (Hansen et al. 1999)	Provides an environment to generate and transfer high-value tacit knowledge (Brown & Duguid 2000; Wenger & Snyder 2000). Provides spark for fresh ideas and responsiveness to changing environment (Brown & Duguid 2000)
Disadvantages	Fails to tap into tacit knowledge. May limit innovation and forces participants into fixed patterns of thinking	Can result in inefficiency. Abundance of ideas with no structure to implement them.
Role of information technology	Heavy investment in IT to connect people with reusable codified knowledge (Hansen et al. 1999)	Moderate investment in IT to facilitate conversations and transfer of tacit knowledge (Hansen et al. 1999)

2.4.3 Knowledge management models for firms seeking innovation

Swan and Newell (2000) suggested that firms seeking innovation adopt a set of knowledge management models such as a cognitive model to codify and capture explicit knowledge and information and a community model to encourage knowledge sharing (including tacit knowledge).

Table 7 presents a summary of Swan and Newell's (2000) dominant models of firms seeking innovation.

Table 7: Dominant knowledge management models of firms seeking innovation

Innovation Process Model of KM	Routinisation Cognitive Model	Agenda Formation Network Model	Selection and Implementation Community Model
Understanding of knowledge	Knowledge is objectively defined and codified as concepts and facts	Knowledge is located external to the adopting unit in explicit or implicit forms	Knowledge is constructed socially and based on experience
Primary activity with respect to knowledge	Knowledge capture and storage — knowledge is captured through text-based, searchable archival sources. Information communication technologies play a central role.	Knowledge acquisition — knowledge is acquired through access to external networks and sources of information. Information communication technologies play a central role	Knowledge creation and appropriation — knowledge is created and applied through development of social communities including project teams. Information technologies play a peripheral role.
Primary aim of KM	To codify and capture explicit knowledge and information.	To keep abreast of new developments	To encourage knowledge sharing (including tacit knowledge) amongst and between individuals and groups.
Primary gains from KM	Better recycling of knowledge and the standardisation of systems.	Greater awareness of external developments	Greater application of internal and external sources of knowledge to create new management practices
Dominant metaphors	The human memory Digging/mining	The network Linking/joining	The human community Building/constructing
CSF	Technology	Boundary spanning	Trust and commitment

What can be gleamed from these examples are the distinctions made between a firm adopting either a strategic approach or an emergent approach toward their knowledge management initiative. It can also be argued that a strategic approach (codification, process and routinisation) has a propensity to support structure and control, which are most suited to explicit knowledge or knowledge stocks. On the other hand, an emergent (personalisation, practice and community) approach has a propensity to facilitate the collaboration of different sources of tacit knowledge or knowledge flows.

Table 8 presents a summary of the knowledge management models that were discussed above. Included in the table is a summary of this study's approach and research model. This acts as a comparison between the recent studies.

Table 8:   Summary and comparison of recent KNOWLEDGE
             MANAGEMENT Models

Criteria	Research				
	Zack (1999)	Hansen et al. (1999)	Swan et al. (2000)	Turban et al. (2006)	This study (2006)
Acquisition of knowledge					
Explicit	Exploitation	Reuse	Exploitation	Exploitation	Exploitation
Tacit	Innovator	Interaction	NA	Opportunistic	Opportunistic
Both tacit and explicit	Innovator	NA	NA	Opportunistic	Opportunistic
Sharing of knowledge					
Explicit	NA	People-document	Text	Formal networks	Documentation
Tacit	NA	People-to-people	Social-network	Informal networks	Social relationships
Knowledge management approach	Conservative; aggressive	Codification; Personalisation	Cognitive; community	Process; Practice	Strategic; emergent
Research method	Case	Case	Case	Case	Case
Industry applications	All	Consulting	Manufacturing & financial	Large firms	Building and construction (SME)
Knowledge management style suggested	Aggressive	80-20 split	Community	Socio-Technical	Aligned socio-technical

In summary, these models suggest that management needs to be mindful of the particular dimension of knowledge most appropriate for exploitation. It can also be seen that effective knowledge management starts with strategy, as a strategic approach will increase the chances of providing sustainable competitive advantage (Gropal & Gagon 1995; Zack 1999; Valli 2001).

2.5 Knowledge management systems

Having reviewed the various strategic approaches toward knowledge management, let us now examine knowledge management systems. These allow managers to exploit organisational knowledge. According to Alavi and Leidner (2001):

> *Knowledge Management Systems (KMS) refer to a class of information systems applied to managing organizational knowledge. That is, they are IT-based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer and application (p. 114).*

Although there would appear to be a heavy emphasis placed on the role of IT within the implementation of knowledge management, a preoccupation with IT is made at the expense of social and cultural factors pertaining to effective knowledge management (Davenport & Prusak 1998; Malhotra 1999; O'Dell & Grayson 1998; in Alavi et al 2001). Therefore, it is necessary to note that effective knowledge management systems can also consist of non-technical applications. The use of the term "systems" is used within the wider sense throughout this study.

The following section presents a discussion of two different types of knowledge management systems. The first system discussed aligns itself with the more traditional view of such systems; whereby, there is a heavy influence placed on the role of IT and the capture and dissemination of a firms' explicit knowledge. Referred to as knowledge repositories, this class of knowledge management systems is also more likely to be introduced within the firm as a result of a strategic approach towards knowledge management after management made a strategic decision to implement the application.

The second system discussed has a greater reliance on social and cultural factors. Also, a community of practice would generally be seen to emerge from a series of social encounters based on a logistical or professional need.

2.5.1 Knowledge repositories

Knowledge repositories are knowledge management systems that have a focus on storing knowledge rather than improving the communication links between people (Gray 2001). Liebowitz and Beckman (1998, in Gray 2001) defined a knowledge repository as an:

> *... on-line computer based storehouse of expertise, knowledge, experience, and documentation about a particular domain of expertise. In creating a knowledge repository, knowledge is created, summarised, and integrated across sources (p, 369).*

According to Gray (2001), knowledge repositories differ in purpose from traditional information technology applications, but they are similar in that both applications seek to improve productivity by reducing the time and effort required to carry out a task. Furthermore, both applications can also "change the content of work in ways that alter the distribution of power between employees and managers".

The ability to change the content of work and the distribution of power within the workplace make knowledge repositories an attractive tool for many managers seeking control in complex conditions. However, "control" can create a double edge sword for organisations as, according to Gray (2001):

> *The use of knowledge repositories creates a set of conditions that allow managers to increase their control over most employees (p. 369).*

Orlikowski (1991) argued that there are two forms of control emanating from knowledge management tools such as knowledge repositories, as:

> *Control mechanisms are understood to be both enabling and constraining: enabling in that they facilitate the coordinated action of individuals in the production process — what Boland (1979) termed 'control with,' and constraining as they restrict the manner and outcomes of individuals' actions — what Boland (1979) termed 'control over' (p. 10).)*

However, not all knowledge management systems are necessarily about technology and control, as will be discussed in the following section. Non-technical initiatives such as a community of practice have the ability to enhance competitive advantage within a building-and-construction environment with little reliance on technology.

2.5.2 Communities of Practice

Communities of practice are often described as groups of people informally bound together by shared expertise and passion for a joint enterprise (Wenger & Snyder 2000). Communities of practices have also been explained as a volunteer group that emerges through work-related interests (Brown & Duguid 1991). Moreover, Wenger et al. (2002) posited that the field of knowledge management has evolved through three distinct waves: technology, culture and communities of practice. Wenger et al. also argue that communities of practice proved a "practical way to frame the task of managing knowledge" and, thus, developing a true learning organisation.

Lave and Wenger (1991) posit that human minds develop through social interaction, insofar as learners inevitably participate in communities of practitioners and that the mastery of knowledge and skill requires newcomers to move toward full participation in the socio-cultural practices of a community. Thus, communities of practice can be defined as composed groups of individuals united in action (Liedtka 1999).

Communities of practice are, according to Wenger et al. (2002), "groups of people who share a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on a continuous basis". Communities of practice evolve from shared learning and a shared purpose to improve not only the individual's knowledge and understanding but also that of the whole group in participation and thus providing a practical means of framing the task of managing knowledge (Wenger et al. 2002).

2.5.3 Benefits of communities of practice

Using a wide range of IT and social abilities, community of practice sites provide a space where practitioners can share ideas, information and knowledge. They build upon the knowledge sharing that occurs in the discussions by capturing the wealth of the information exchange, and serve as a resource for future discussions (The World Bank Group 2003). Table 9 is a review of the benefits of communities of practice.

Table 9:   Contributions of communities of practice (adapted from Wilson, Jackson and Hughes 2005)

Wenger, McDermott et al. 2002, p.14	They can:
	Connect local pockets of expertise and isolated professionals
	Diagnose and address recurring business problems whose causes cross team boundaries
	Analyse the knowledge-related sources of uneven performance across units performing similar tasks and work to bring everyone up to the highest standard
	Link and coordinate unconnected activities and initiatives addressing a similar knowledge domain
Lesser and Storck 2001, p.836	Decrease learning curve of new employees
	Help employees respond more rapidly to customer needs and inquiries
	Reduce rework and prevent reinvention of the wheel
	Facilitate the spawning of new ideas for products and services
Wenger and Snyder 2000, p. 140-41	Foster new approaches to problems
	Help drive strategy
	Start new lines of business
	Solve problems quickly
	Transfer best practice`
	Assist in developing professional skills
	Help companies recruit and retain talent
Brown and Duguid 2000	Those involved in communities of practice develop very rich industry specific knowledge

Communities of practice versus other network structures

A community of practice should not be confused with project teams or other forms of alliances. Lessor and Storck (2001) argued that a community of practice differs from a project team in many ways and, unless distinctions are made, confusion between the two terms is inevitable.

Distinctions between a team and a community of practice have been characterised by Storck and Hill (in Lesser et al. 2001) as follows:

1. Team relationships are established when the organisation assigns people to be team members. Community relationships are formed around practice.

2. Similarly, authority relationships within the team are organisationally determined. Authority relationships in a community of practice emerge through interaction around expertise.

3. Teams have goals, which are often established by people not on the team. Communities are only responsible to their members.

4. Teams rely on work and reporting processes that are organisationally defined. Communities develop their own processes.

Table 10 outlines the distinction between a community of practice and other organisational structures.

Table 10: Distinctions between communities of practice and other structures
Source: Wenger et al. (2002)

	What's the purpose?	Who belongs?	How clear are the boundaries?	What holds them together?	How long do they last?
Community of practice	To create, expand and exchange knowledge, and to develop individual capabilities	Self-selection based on expertise or passion for a topic	Fuzzy	Passion, commitment, and identification with the group and its expertise	Evolve and end organically (last as long as there is relevance to the topic and value and in interest in learning together)
Formal departments	To deliver a product or service	Everyone who reports to the group's manager	Clear	Job requirements and common goals	Intended to be permanent (but last until the next reorganisation
Operational teams	To take care of ongoing operation or process	Membership assigned by management	Clear	Shared responsibility for the operation	Intended to be ongoing (but last as long as the operation is needed)
Project teams	To accomplish a specified task	People who have a direct role in accomplishing the task	Clear	The project's goals and milestones	Predetermined ending (when the project has been completed)
Communities of interest	To be informed	Whoever is interested	Fuzzy	Access to information and a sense of like mindedness	Evolve and end organically
Informal networks	To receive and pass on information, to know who is who	Friends and business acquaintances, friends of friends	Undefined	Mutual need and relationships	Never really start or end (exist as long as people keep in touch or remember each other)

Technology as a key enabler

According to Wenger et al. (2002), the concept of communities of practice is not new, but the need for organisations to focus on the management of organisational knowledge as a key asset is. The change of focus to communities of practice and knowledge management can be attributed to the recent exponential advances in

technology. Most dramatic have been the increased development and usage of Internet communication technologies and collaborative systems that have drastically reduced barriers to participation for many organisations and individuals. This has been done through common language protocols and relatively cost effective hardware. This has resulted in more effective and efficient means of participating in the storage and transferring of knowledge.

Within the WA house-building industry context, this has proven to be a critical success factor enhanced by popular operating systems and "open ended" technologies such as e-mail, Lotus Notes, chat rooms and blogs. These types of technology facilitate collaboration and active participation of all stakeholders within a diverse industry structure, ranging from multinational manufacturers though to sole-proprietor subcontracting firms.

Bringing the community of practice to life

Communities of practice require an environment that facilitates natural evolution rather than radical change. Although a culture of natural organic evolution between different parties is a somewhat distant concept to the current project-focused and short-term mindset of the construction industry, the simple and pervasive nature of a community of practice, supported by open technological systems and applications means that adoption barriers are quite low in terms of costs and disruption to the organisation.

Observations made by Wenger et al. (2002) have shown that a key element in the success of communities of practice is the ability to keep the community alive as "many intentional communities fall apart soon after their initial launch because they don't have enough energy to sustain themselves". Furthermore, "communities, unlike teams and other structures need to invite the interaction that makes them alive".

According to (Wenger et al. 2002, pp. 20–21), knowledge generating communities and business process where knowledge is applied must be integrated or "tightly woven". In other words, the two must create a "double knit" organisation where operational workers bring not only their expertise and tacit knowledge to the community but they also receive help with their own problems. It is this "multi-membership" concept that allows the learning cycle to continue, as depicted in Figure 3.
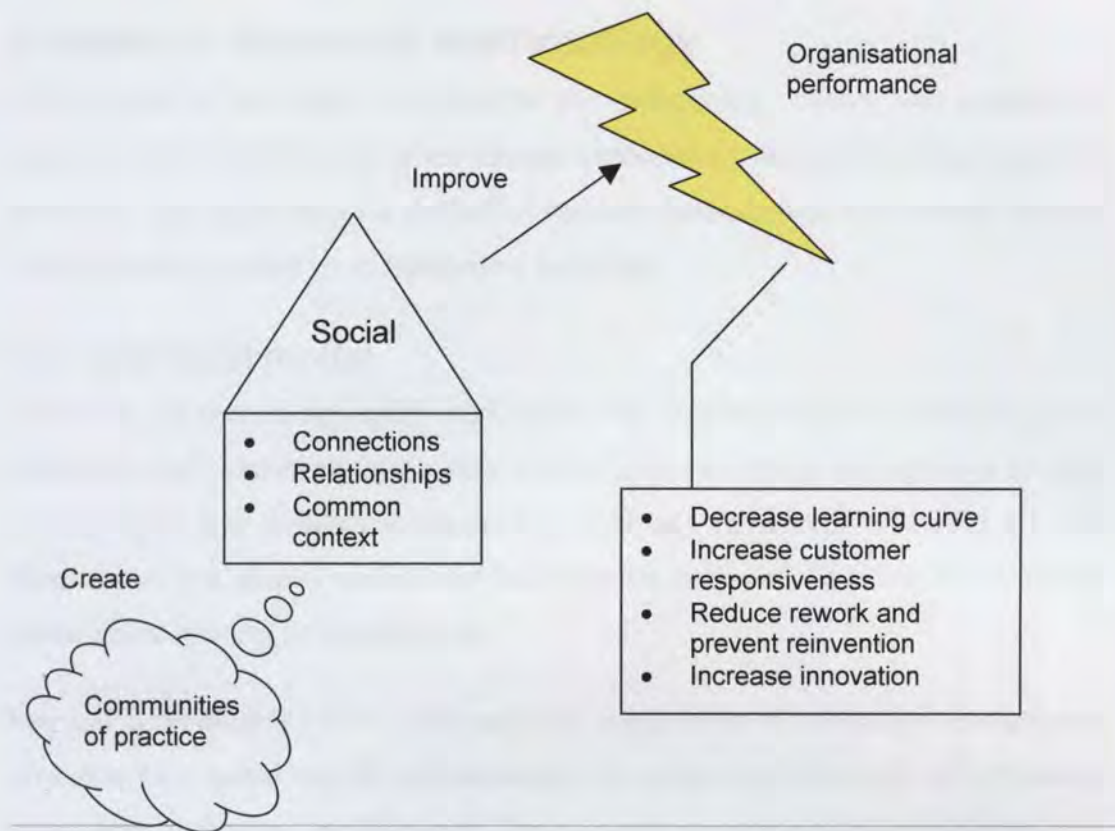
Figure 3: Communities of practice are linked to organisational performance through the dimensions of social capital. Source: Lessor and Storck (2001).

2.6 Summary

This literature review began with an introductory discussion of knowledge and how its effective management has the potential to create and sustain competitive advantage for the firm. However, the approach adopted by the firm will affect the knowledge produced and the subsequent benefits offered to the firm.

Accordingly, management has a role in developing a strategy that considers not only its operational objectives but also its socio-technical elements. From this basis, a research model and theoretical propositions have been established. These are presented in the following chapter.

The literature suggests a strategic approach will be more suited to the proliferation and exploitation of explicit knowledge; whereas, an emergent approach will be more suited to supporting tacit knowledge (Zack 1999; Hahn 2001; Gray 2001; Hansen et al. 1999; Turban and Leidner 2006).

Chapter 3: Research methodology

This chapter of the study will describe the methodology chosen and present the research model. Justification of the chosen methodology and philosophical stance is presented. The study adopts a qualitative research methodology, the research strategy is the case study guided by an interpretive paradigm.

3.1 Research model

This study focuses on strategies employed by the Western Australian house-building industry in their endeavour to develop and maintain knowledge management systems to build upon their sustainable competitive advantage. In order to achieve this it was necessary to first adopt a method that facilitates a holistic understanding of knowledge management systems in organisations.

Pan and Scarbrough's (1998) socio-technical perspective of knowledge management proved to be a useful tool for understanding the moderating influences on knowledge management initiatives (see Figure 4). They argued that organisational knowledge is:

- socially constructed;

- shaped by the emergent interplay between technological context and organisational factors; and

- structured by both tacit and explicit forms and by the organisational context.

A social-technical perspective of knowledge management has been critiqued by Pan and Scarbrough (1999). They cautioned on the concept's strengths and weaknesses:

- Early socio-technical principles and practices were developed for, and applied to routine, linear work systems (Fox 1995).

- In the 1950s and 1960s, socio-technical systems thinking around the concepts of "joint optimisation" of technical and social factors and open systems planning were revolutionary and provided a fresh viewpoint for creating new organisation designs, distinct from that of industrial engineers or behavioural scientist (Trist 1982).

- In more recent years, however, the socio-technical systems approach has come under fire for becoming overly prescriptive and for failing to address important empirical trends. Thus, according to Pava (1986), some of the problems stem from

an over-reliance on one successful method and a single template (the autonomous work group) for organisation design.

- Equally, broader changes such as the advent of IT and new possibilities of networked organisations and virtual pattern of interaction have posed problems for the conventional socio-technical focus on the point of production (Scarbrough 1995).

Pan & Scarbrough (1999, p. 362) "propose that knowledge management activities can be seen as multi-layered systems, with loosely coupled technological, informational and social elements interacting over time to determine practical outcomes".

This socio-technical perspective is summarised into the three following layers:

1. Infrastructure: The hardware and/or software that enables the physical and/or communicational contact between network members;

2. Infostructure: The formal rules that govern the exchange between the actors on the network. These provide a set of cognitive resources (metaphors, common languages) whereby people make sense of the events on the network;

3. Infoculture: The stock of background knowledge that actors take for granted and which is embedded in the social relations and norms surrounding work group processes.

In essence, the authors argue that when viewing organisational knowledge from a socio-technical perspective the three constituent elements of infrastructure, infostructure and infoculture should all be considered and also their interrelationships. Within this context, the technically rationalised element of infrastructure is more objective and "hard". As we move toward the cultural aspects of knowledge management, the constituent elements of infostructure and infoculture become more subjective and socially determined. As shown in Figure 4.
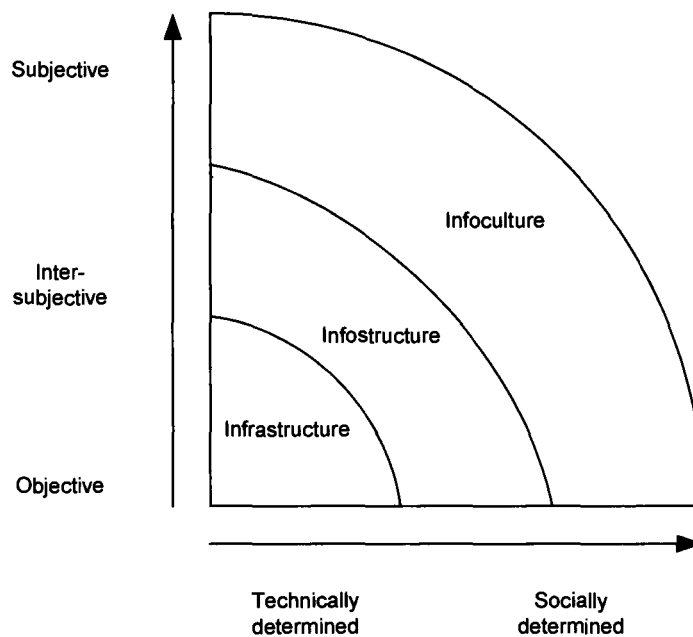
Figure 4:   A socio-technical perspective of knowledge management. Source:
            Pan and Scarbrough (1998).

The socio-technical perspective of organisations has long established roots in the social sciences. The well known Hawthorne studies (conducted at the Hawthorne Works of the Western Electric Company in Chicago between 1924 and 1932) are considered the beginning of the social-systems approach to organisational theory and, later, the socio-technical approach to organisational design (Hassard 1993, pp. 33–4).

A holistic approach to analysing knowledge management, according to Pan & Scarbrough (1999):

> *... highlights the interweaving of social and technical factors in the way people work. It also underlines the complex interaction which takes place between the subjective perceptions of employees and the objective characteristics of work processes (p. 361).*

It follows then that this study sought to answer the following questions:

1. How does the way in which a knowledge management strategy is approached in a Western Australian house-building firm affect the type of knowledge produced?

2. Does the way in which a knowledge management strategy is approached in a Western Australian house-building firm affect the sustained use and benefit of the knowledge management system within the firm?

In order to achieve optimal outcomes from any knowledge management system initiative; management must understand and consider links between the constituent elements of Infostructure, Culture and its Infrastructure. A misalignment between the subsystems will produce a sub-optimal result. These elements will act as the moderating variables of this study as shown in Table 11.

Table 11:   The research model

The Approach	

Strategy	Implementation
Emergent	Evolve from fragmented, incremental and largely intuitive processes
Strategic	Prediction made of the future (a big decision)

Observable influences affecting the strategy and knowledge outcome		

Role of Infostructure	Role of Infoculture	Role of IT Infrastructure
Formalised rules? Formalised roles? Clear definitions of information? Process driven?	Innovative, encouraging trusting Top down?	Value adding? Support tool of perceived value adding activities (i.e. marketing & production) High quality or error prone?

Knowledge outcome	

Knowledge creation	Contribution to organisation
Knowledge flows (tacit knowledge)	Empowerment/ innovation
Knowledge Stocks (Explicit knowledge)	Control

It can be seen from the preceding literature review and the research model presented above that effective knowledge management is a socio-technical process in which the constituent elements of infrastructure, infostructure and infoculture all have a role to play. The following section discusses the three major concepts of the model.

3.1.1 The "strategy"

The existing literature on strategic management is broad. At the two ends of the strategy spectrum, it is argued that a knowledge-management-system initiative is either emergent or explicit. Emergent initiatives generally evolved from the combination of

access to new technology and a desire to improve logistical needs. For example, technically simple and ubiquitous tools such as e-mail, digital cameras, the Internet and intranets allow employees to fulfil individual logistical needs and facilitate deeper understandings of non-routine tasks that generally escape textual codification, with a focus on tacit knowledge rather than explicit knowledge. When compared to Earl's (1993) generic approaches to IT-enabled strategies, similarities between emergent knowledge management initiatives and the organisational approach begin to emerge.

On the other hand, explicit knowledge-management-system initiatives are generally management (top down) initiatives, established to harness, store and control knowledge. For example, traditional ERP systems (enterprise resource planning) are designed to enhance overall organisational efficiency and ameliorate risks to the business. Comparisons with explicit knowledge management initiatives that support Earl's (1993) generic approach can be seen in the technical, administrative, method-driven and business-led approach.

3.1.2 Observable influences within the context of infostructure, infoculture and infrastructure

As discussed earlier, managers considering a knowledge management initiative should view their organisation as a set of interrelated subsystems operating within a chosen domain. According to Pan et al. (1998, 1999), this socio-technical perspective allows the organisation to be viewed holistically from three summarised layers: infrastructure, infostructure and infoculture. There are factors within each of these contexts that will determine the outcome of the knowledge management initiative, both directly and in interaction with other factors from within another subsystem. For example, open-ended tools (infrastructure factors) in combination with supportive and trusting leadership (infoculture factors) may facilitate emergent strategies and knowledge flow outcomes.

Infrastructure can be observed in the tools and technologies applied. Infostructure will be seen in procedures, roles, databases and process rules of key applications. However, infoculture is the most difficult of the three elements to explain. Schein (1990) contested that the word "culture" needs to be used with some caution as it portrays different meanings and connotations to different people. Furthermore, he asserted that "when it is combined with another commonly used word, 'organisation' we are almost certain to have conceptual and semantic confusion" (p. 5).

Following Schein (1990), some common meanings of "culture" are presented below:

1. Observed behavioural regularities when people interact, such as the language used and the rituals around deference and demeanour (Gofman 1959, 1967; Van Maanen 1979b).

2. The norms that evolve in working groups, such as the particular norm of "a fair day's pay for a fair day's work" that evolved in the bank wiring room in the Hawthorne studies (Homans 1950).

3. The dominant values espoused by an organisation, such as "product quality" or "price leadership" (Deal and Kennedy 1982).

4. The philosophy that guide an organisation's policy toward employees and/or customers (Ouchi, 1981; Pascale & Athos 1981).

5. The rules of the game for getting along in the organisation, "the ropes" that the newcomer must learn in order to become an accepted member (Schein 1968, 1978; Van Maanen 1976, 1979b; Ritti & Funkhouser 1982).

6. The feeling or climate that is conveyed in an organisation by the physical layout and the way in which members of the organisation interact with customers or other outsiders (Tagiuri & Litwin 1968, p. 6)

Schein (1990) offered a succinct summary of the above definitions as follows:

> *... at any of these structural levels, I will mean by "culture": a pattern of basic assumptions—the invented, discovered or developed by a given group as it learns to cope with its problems of external adaptation and internal integration—that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems (pp. 8 – 9).*

3.1.3 Knowledge outcomes

As previously highlighted, much of the recent literature on the concept on knowledge management presents organisations as aggregations of knowledge stocks and knowledge flows (Gray 2001). Moreover, Hansen et al. (1999, in Gray 2000), offered managers an either–or approach to knowledge management, whereby companies with routine outputs are advised to pursue a codification strategy that focuses on building and enhancing knowledge repositories (knowledge stocks). Alternatively, companies with non-routine outputs are advised to pursue a personalisation strategy with the aim

of enhancing tacit knowledge through person-to-person contact and communication (knowledge flows).

In summary, this study will argue that there appears to be a relationship between how a knowledge management initiative arises, the kinds of knowledge created and the contribution to the firm. This research is investigating the extent to which this relationship holds and is seeking to discover any attenuating factors within the socio-technical categories of infrastructure, infostructure and infoculture.

3.2 Research methodology

Conventional research approaches within the information systems discipline have a propensity toward positivism. This has deeply influenced the approach of information systems practitioners and theorists to requirements of capture, design and implementation (Orlikowski and Baroudi 1991). Development and implementation methodologies have largely modelled themselves upon the principles of natural science, the ultimate goal being to describe the world in C++ or Java.

Ontology is realist and the epistemology is Cartesian and dualistic: a reflective and perceiving subject, taking cognisance of an objective world, with the assistance of symbols manipulated by computers.

Developments in the analysis of human knowledge, manifested in philosophical, anthropological and sociological scholarship are advancing in the management arena and into systems research. The correspondence theory of truth states that knowledge is manifest in propositions expressing facts about the world ("justified true belief"). This is being augmented by relativist and sociological conceptions of the nature of conceptual understanding (Berger & Luckman, 1967).

The dualist model does not acknowledge the socially constructed nature of knowledge and so ignores the social processes by which objective knowledge is built up within social groups over time (Nonaka & Takeuchi 1995). Knowledge is now regularly described along a number of dimensions such as socialisation externalisation, internalisation and combination (Nonaka et al. 1995).

Research methodologies are often divided into two themes: quantitative and qualitative. Quantitative research methods emerged from the natural sciences with cause and effect being the main objects being searched for (Harvey et al. 1995).

Qualitative research methods emerged from the social sciences "to enable researchers to study social and cultural phenomena" (Myers 1999) where meaning in context is the most important framework being sought (Harvey et al. 1995).

Burrell and Morgan (1979) identified four paradigms of analysis for conducting social and organisational research. The four paradigms identified fundamentally different assumptions concerning epistemological views toward our understanding of the nature of social science. These paradigms (functionalism, interpretivism, radical structuralism and radical humanism) are presented in Figure 5.

Radical change

| Radical humanism | Radical structuralism |
| Interpretivism | Functionalism |

Subjective   **Objective**
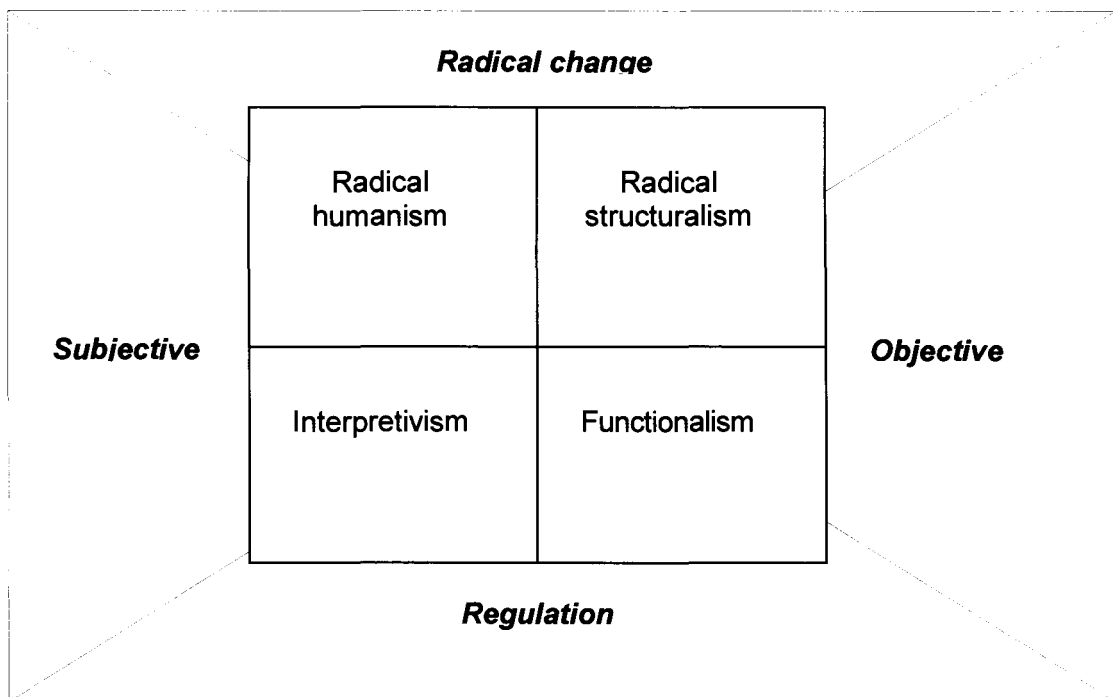
Regulation

Figure 5:   Burrell and Morgan's (1979) four paradigms matrix

3.2.1 Functionalism

Functionalism (objective – regulation): This is considered the dominant paradigm for much of the research that has been conducted in the information systems field. The functionalist seeks to provide rational explanations of human affairs. It is pragmatic and deeply rooted in sociological positivism.

According to Myers (1999, available at www.qual.aukland.ac.nz/interp.htm):

> *At the heart of the positivist mind frame is the concept of deduction. There are three steps in deduction:*
>
> - *Testing internal consistency, i.e., verifying that there are no internal contradictions.*

- *Distinguishing between the logical basics of the theory and its empirical, testable, predictions.*

- *Comparison with existing theory, showing that the new theory advances knowledge. Specifically, it is necessary to show that the new theory has superior empirical substance and hence more predictive power.*

Empirical testing is aimed at falsifying the theory with data. When the data do not contradict the hypothesised predictions of the theory, it is temporarily corroborated. The objective of this test is to falsify, not verify the predictions of the theory. Verifications can be found for almost any theory if one can pick and choose what to look at (Myers, 1999)

3.2.2 Interpretivism

Interpretivism (subjective – regulation): The interpretive and radical humanist paradigms contain psychological constructs that stem from the existential and humanist disciplines. To be understood, reality is phenomenological. No objective reality exists; rather, reality is what the "beholder" perceives it to be. Existence is better understood from the vantage point of "process" rather than "content". To that point, this study has adopted an interpretivist paradigm in order to illuminate the process of knowledge management rather than content. It also follows that a qualitative approach is more suitable than a quantitative one.

Quantitative researchers generally gather their research data from sources such as surveys, experiments, statistics, structured observation and contingent analysis (Silverman 2000). On the other hand, qualitative researchers tend to source their data through participative and non-participative social interaction and observation. It is argued that a concentration on the natural sciences and reliance on pure quantitative data alone leads to a compromise of the distinctive role that humans play as actors and observers in the research process. This according to Silverman (2000) "is what the qualitative researcher seeks to correlate and understand". It is this rich human influence that we seek to better understand from the perspectives of knowledge management and the Western Australian house-building industry. The aim is to seek richness of data and to allow factors and their interrelationship to emerge.

Unlike the positivist approach, which "acknowledges only phenomena which are systematically connected to one another by way of invariable and universal laws"

(Hassard 1993, p. 6), the social world of the interpretive paradigm "possess a precarious ontological status" (Hassard 1993, p. 89). Hassard (1993) thus noted:

> *... the interpretive researcher seeks to deconstruct the phenomenological processes through which shared realities are created, sustained and changed (p. 89).*

3.2.3 Radical humanism

Radical humanism (subjective – radical change): This approach has much in common with the interpretive paradigm. However, its frame of reference is committed to a view of society that emphasises the importance of over-throwing or transcending the limitations of existing social arrangements.

3.2.4 Radical structuralism

Radical structuralism (objective – radical change): This approach shares much with functionalist paradigm; however, it is directed at fundamentally different ends. Radical structuralism is committed to radical change, emancipation and potentiality. It emphasises structural conflict, modes of domination, contradiction and deprivation. Radical structuralists are inclined to concentrate on the structural relationships within a realist social world.

It follows that the research strategy used in this inquiry was guided by an interpretive analysis. The context within which this strategy was embedded was the case study. The following section discusses this in more detail.

3.3 Case study research

According to Yin (2003), what distinguishes a case study methodology from other research strategies — such as an experiment, survey, archival analysis or history — and which makes it the preferred research methodology for this dissertation, is its fit with three key conditions:

1. the type of research question posed;

2. the extent of control an investigator has over actual behavioural events; and

3. the degree of focus on contemporary as opposed to historical events.

Table 12 compares these different types of research strategies against the requirements of this dissertation.

Table 12: A comparison of potential research strategies (adapted from Yin 2003, p. 5)

Strategy	Form of research question	Requires control of behavioural events?	Focuses on contemporary events
Experiment	How, why?	Yes	Yes
Survey	Who, what where, how many, how much?	No	Yes
Archival analysis	Who, what where, how many. How much?	No	Yes/No
History	How, why	No	No
Case Study	How, why, what?	No	Yes

The main aims of this study were to increase the understanding of knowledge management phenomena within the context of the Western Australian house-building industry and to produce a framework of understanding and action. Yin (2003) argued that, the research methodology must address the research questions. This research sought to investigate a contemporary phenomenon in which the ideal setting for the investigation would be within a real-context. It follows that the research strategy most suitable for conducting an empirical enquiry is a case study as this "investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin 2003).

Finally, as my world-view and preference leans toward a qualitative interpretive approach, it follows that a case study methodology was most suitable for conducting this investigation. In this study, the phenomena were strategy initiation and knowledge outcomes, and the context was the socio-technical environment within the Western Australian house-building industry.

3.4 Data interpretation and analysis

According to Miles and Huberman (1994), the most important aspect of well collected qualitative data is that "they focus on naturally occurring, ordinary events in natural settings, so that we have a strong handle on what 'real life' is like". Moreover, "qualitative data in their richness and holism, with strong potential for revealing

complexity; such data provide 'thick descriptions' that are vivid, nested in real context, and have a ring of truth that has strong impact on the reader".

However, the quality of information received and translated relies upon the quality of the collection of the evidence by a competent researcher. It is argued that through triangulation of multiple means of data collection (for example, documents, observation and interviews), not only is the likelihood of the gaining rich insights increased but the validity is as well (Voss et al. 2002).

Within the information systems field, there are well established and accepted sets of methodological principles for case study data collection and analysis. However, these principles lean towards the conventions of positivism (Klein et al. 1999). Research conducted from this paradigm is not appropriate for interpretive case study research. As such, I propose the adoption of the hermeneutic cycle as presented by Klein and Myers (1999) in their set of principles for the evaluation of interpretive field research in information systems. These principles are set out in Table 13.

Table 13:   A set of principles for conducting Interpretive field research (Klein
             & Myers 1999)

1.	The fundamental principle of the hermeneutic circle: This principle suggests that all human understanding is achieved by iterating between considering the interdependent meaning of parts and the whole that they form. This principle of human understanding is fundamental to all other principles
2.	The principle of contextualisation: Requires critical reflection of the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged
3.	The principle of interaction between the researchers and the subjects: Requires critical reflection of how the research materials (or data) were socially constructed through the interaction between the researchers and participants
4.	The principle of abstraction and generalisation: Requires relating the idiographic details revealed by the data interpretation through the application of principles one and two to theoretical, general concepts that describe the nature of human understanding and social action
5.	The principle of dialogical reasoning: Requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings
6.	The principle of multiple interpretations: Requires sensitivity to possible differences in interpretations among the participants as are typically expressed in multiple narratives or stories of the same sequences of events under study. Similar to multiple witness accounts even if all tell it as they saw it
7.	The principle of suspicion: Requires sensitivity to possible 'biases' and systematic 'distortions' in the narratives collected from the participants

The critical point taken up by Klein and Myers (1999) is that interpretive research, with its ability to offer deep insights into IS phenomena, is becoming an increasingly accepted research approach. However, questions have been raised as to the approach a researcher should adopt in conducting their enquiry and methods to ensure the quality and reliability in the interpretation of the data are maintained.

The overarching principle of interpretive research of a hermeneutic nature is the principle of the hermeneutic circle. "The idea of the hermeneutic circle suggests that we come to understand a complex whole from preconception about meaning of its parts and their interrelationships" (Klein & Myers. 1999, p. 71).

The hermeneutic circle will be adopted as the meta-principle of this inquiry, supported by the following six principles:

1. The principle of contextualisation: The study was set within the context of the Western Australian housing industry, the companies' history and the histories of

the participants. A detailed exposition of the industry and participants involved in the study has been developed.

2. The principle of interaction between the researcher and the subjects: This principle was addressed by describing the preparation of the interviews, the questions asked, how the responses were directed and how the researcher interacted with the participants.

3. The principle of abstraction and generalisation: The research data was related to the general concepts within the context of the overarching thesis. For example, within the research framework I have clearly defined the input and output constructs. What I wished to *discover*, though, were generally valid attenuating influences within the general categories of infrastructure, infostructure and infoculture.

4. The principle of dialogical reasoning: This was addressed by presenting a biography of the researcher. The researcher examined the source of his observations in his own preconceptions and background, asking himself why and how certain observations and deductions were made. However, the conclusions stand by themselves as reasonable propositions.

5. The principle of multiple interpretations: This principle evolved through interviews that asked the participants what their views were on the influences of the chosen constructs. Reflection and dialogical reasoning also assisted this process for seeking alternative explanations and insights.

6. The principle of suspicion: Scepticism was applied to the interpretations from different sources to identify false consciousness, defensiveness or lack of authentic reflection.

In addition to the above, a key requirement in maintaining the quality of case studies was the willingness of the researcher to use multiple sources of evidence, the creation of a case study database and maintaining a thorough chain of evidence (Yin 2003). I have also chosen to adopt Eisenhardt's (1998) advice about conducting case study research (see Table 14).

Table 14: Eight steps of case study research (adapted from Eisenhardt 1998)

Step	Activity	Reason
Getting started	Definition of research question possibly priori constructs Neither theory or hypotheses specified population	Focus efforts Provides better grounding of construct measures
Selecting Cases	Theoretical not random sampling	Retains theoretical flexibility Constrains extraneous variation and sharpens external validity Focuses efforts on theoretically useful cases-i.e. those that replicate or extend theory by filling conceptual categories
Crafting instruments and protocols	Multiple data collection methods Qualitative and quantitative data combined Multiple investigators	Strengthens grounding of theory by triangulation of evidence Synergistic view of evidence Fosters divergent perspectives and strengthens grounding
Entering the field	Overlap data collection and analysis including field notes Flexible and opportunistic data collection methods	Speeds analysis and reveals helpful adjustments to data collection Allows investigators to take advantage of emergent themes and unique case features
Analysing data	Within case analysis Cross case pattern search using divergent techniques	Gains familiarity with data and preliminary theory generation Forces investigators to look beyond initial impressions and see evidence thru multiple lenses
Shaping hypotheses	Iterative tabulation of evidence for each construct Replication, not sampling, logic across cases Search evidence for 'why' behind relationships	Sharpens construct definition, validity and measurability Confirms, extends and sharpens theory Builds internal validity
Enfolding literature	Comparison wit conflicting literature Comparisons with similar literature	Builds internal validity, raises theoretical level and sharpens construction definitions Sharpens generalisability, improves construct definition, and raises theoretical level
Reaching closure	Theoretical saturation when possible	Ends process when marginal improvement becomes small

Figure 6 presents an overview of the research framework that has been adopted to ensure a reliable chain of evidence.
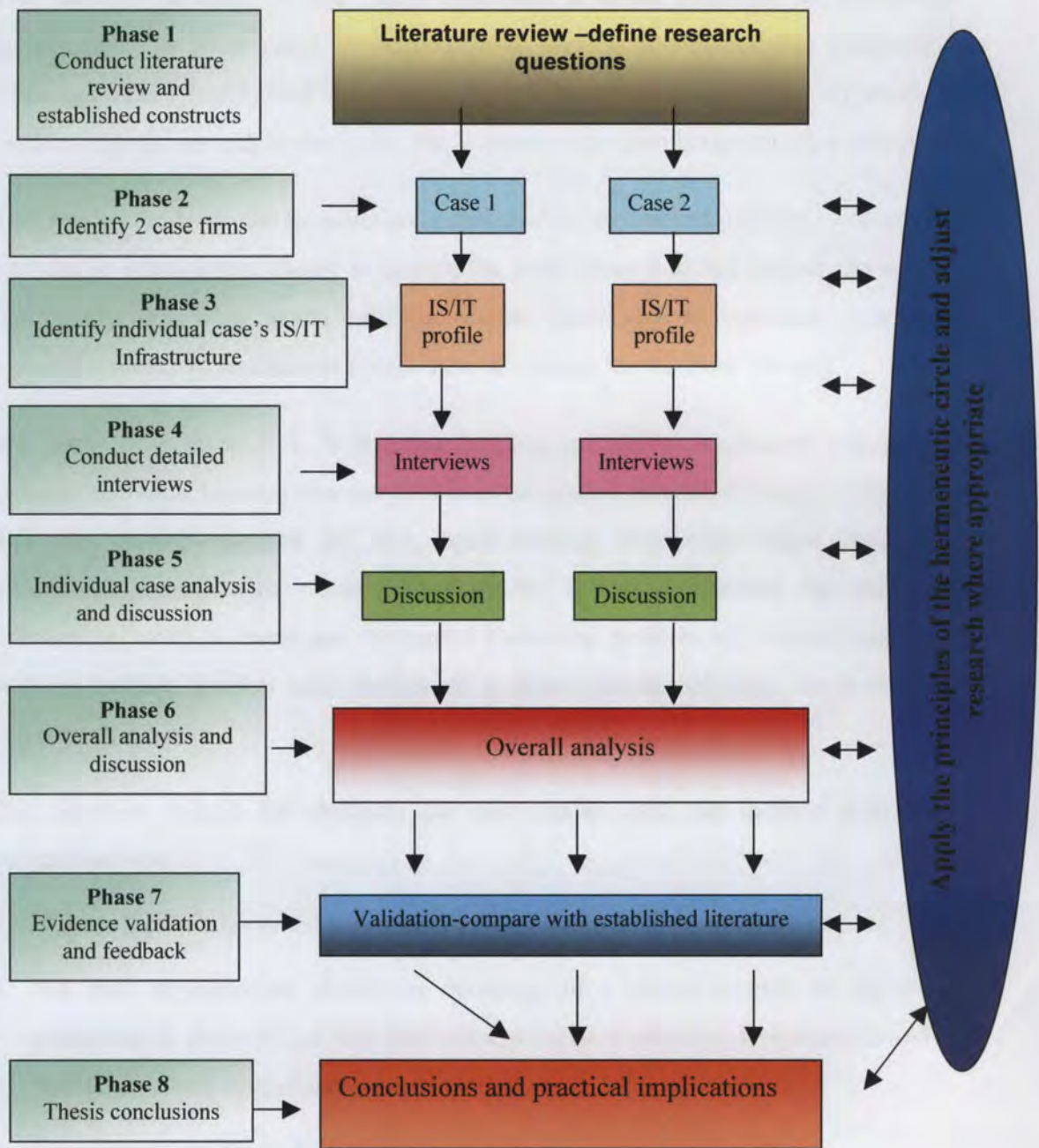
Figure 6:   The chain of evidence adopted for this study

In summary, this chapter has presented a brief critique of contemporary research methodologies within the information systems field and justified the research approach most suitable for this study. This study adopted a qualitative research methodology and a case study approach guided by an interpretive paradigm.

3.5 Case selection criteria and research limitations

The previous sections of this thesis presented a broad overview of knowledge management, its relationship to organisational success and sustainable competitive advantage. They highlighted the paucity of research conducted to date on small-to-medium enterprises and, in particular, the Western Australian house-building industry.

This has led the me to the foundations of this studies' theoretical problem — to expand knowledge management theory to include the local house-building industry so we can better understand what factors influence whether knowledge management systems are a practical source of sustainable competitive advantage for the local industry.

We know little about how WA house-building enterprises implement information systems and what factors influence this. For that reason, this thesis sought to examine different methods adopted by WA house-building enterprises when developing information management systems. Furthermore, it was determined that the most practical approach to investigate the central theoretical problem and research questions was to conduct detailed case studies of a select number of local house-building enterprises.

The selection criteria for choosing the case studies and this thesis's subsequent limitations were:

- Choose a privately owned and operated WA house-building enterprise.

- All case organisations should be operating in a similar market to allow the researcher to observe and take into account industry-specific idiosyncrasies and to reduce unrelated distortions.

- There should be access to rich and open information by the researcher.

- The enterprise should have been exposed to the five key trends driving Australia's shift towards a knowledge-based economy.

This research was focused on two medium-sized Western Australian house-building enterprises.

3.6 The Australian housing industry

The Australian housing industry is a $35 billion industry that constructs more than 140,000 new homes every year, in turn creating jobs for more than 370,000 people and contributing 3.5% to the Australian economy (HIA 2001). A highly competitive and fragmented industry, it consists of mainly small- and medium-sized enterprises. Recent figures have identified that in Australia there are 40,000 home building businesses in operation, of which 39,762 were classified as small (1–19 employees), 288 were medium (20–99 employees) and only 10 employed 100 or more staff (HIA 2001).

The Australian housing industry exhibits undesirable characteristics of fierce competition and fragmentation, resulting in familiar industry detriments such as delays, cost overruns, and client dissatisfaction (Egan 1998; Latham 1994; Holt et al. 2000). Moreover, recent advances in technology such as Internet and other technological tools used to support and promote knowledge within organisations appear to have had little impact on the industry, which is also known for its lack of innovation and adoption of technology (ABS 2002; Price Waterhouse Cooper 2001).

Construction firms face a range of unique limitations when attempting to manage their knowledge. Often, it is the short-term mindset of the construction industry participants, brought about by a highly competitive project-based industry that restricts long-term planning. Research conducted by Rezgui (1998) and Vakola (1999) presented six key limitations of construction firms when attempting to manage their knowledge (Vakola & Rezgui 2000, p. 175):

1. Much construction knowledge, of necessity, resides in the minds of the individuals working within the construction domain.

2. The intent behind decisions is not often recorded or documented. It requires complex processes to track and record the thousands of *ad hoc* messages, phone calls, memos and conversations that comprise much project-related information.

3. People responsible for collecting and archiving project data may not necessarily understand the specific needs of actors who will use it, such as those involved in the maintenance of buildings.

4. The data are usually not managed while they are created but, instead, are captured and archived at the end of the construction stage. People who have knowledge about the project are likely to have left for another project by this time. Their input is not captured.

5. Lessons learned are not organised well and are buried in details. It is difficult to compile and disseminate useful knowledge to other projects.

6. Many companies maintain historical reports of their projects. Since people always move from one company to another, it is difficult to reach the original authors who understand the hidden meanings of historical project data.

From this brief overview, it is clear that the Australian Housing industry is a major contributor to the economic and social wellbeing of Australia. It is also an industry that exhibits unique characteristics

3.7 Summary

In summary, this chapter has presented the chosen research methodology and research model adopted for this study. It has also presented an overview of the Australian Housing industry, which this study has a central focus on.

The following two chapters provide a detailed insight into the daily lives of two Western Australian house building firms and how organisational knowledge is managed from their perspective.

Chapter 4: Case study one

4.1 The aim of the chapter

This chapter investigates real life strategies employed by Western Australian house-building enterprises when designing and implementing their knowledge management systems. It begins with ABC Homes, the first of two case studies presented in this study. ABC Homes is a family owned and operated firm that has been building residential housing in Perth's metropolitan suburbs for nearly 40 years.

Guided by an interpretive philosophical perspective, multiple sources of data were collected during the investigation, ranging from IS and IT audits to semi-structured interviews and focus groups in order to triangulate the data, thus enhancing the validity of the data and the conclusions.

The case study proved particularly useful in providing empirical data to allow a greater understanding of the theoretical and practical problems guiding this study. It presented two unrelated information systems and their interrelatedness of the three layers of Pan and Scarbrough's (1998) socio-technical framework.

The first system can be classified as an explicit, strategic "knowledge stocks" initiative utilising database and forms-driven technology in the form of a job tracking system. The second system, an emergent intranet-based initiative, was shown to enhance knowledge flows. Through these real life examples, it became more evident that the outcomes of knowledge management initiatives were influenced by more than strategy alone and, in order to maximise the potential of a knowledge management initiative, similar consideration must also be given to the socio-technical elements of infrastructure, infostructure and infoculture that co-exist within the firm.

As a fulltime employee of ABC Homes for the duration of this research, I was mindful of the implications this relationship could have on my research, such as:

- potential stewardship of data collection and analysis;

- the ability to reflect upon my lived experiences.

4.2 Chapter layout

This chapter is presented in six major sections, as shown in Figure 7. Commencing with the introduction, the chapter offers a description of the methodology and sources of data collected in order to conduct the case study. This section is followed by an overview of the participating firm. The results of the case study are then presented using the three interrelated sub-systems that makeup the socio-technical elements of knowledge management: infrastructure, infostructure and infoculture. The chapter is concluded with a discussion and a summary of findings from the case study.
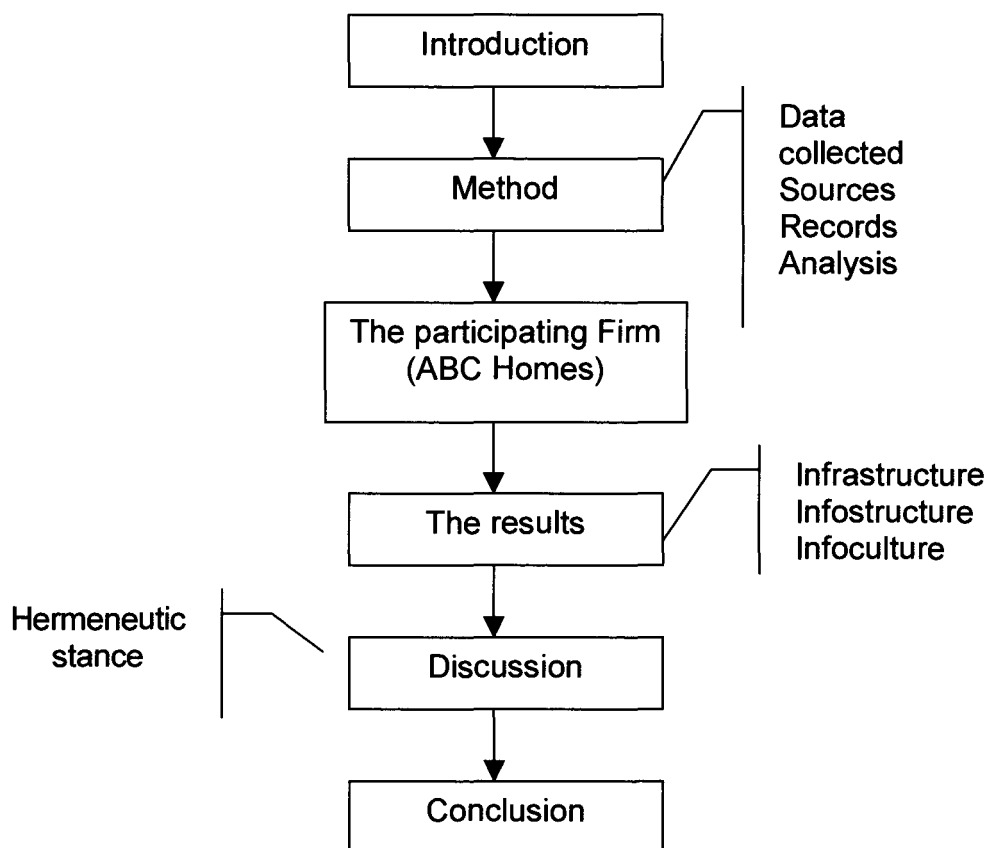
Figure 7:   Chapter four layout

4.3 Method

The main aim of this study was to conduct research that investigated a contemporary phenomenon within a real-life context. The research methodology most suited to this type of research was the case study (Yin 2003). Guided by an interpretive perspective, I found the case study approach most beneficial as it allowed me as a researcher and professional practitioner to achieve the aims of the study and increase the

understanding of knowledge management within the context of the WA house-building industry.

4.3.1 Sources of data collected

A variety of sources were used to collect data from the participating firm. These ranged from ethnographic observation, semi-structured interviews, focus groups and the review of several of the firm's business plans, reports and inter-office memos. This ensured that a triangulation of the data emerged.

The bulk of the fieldwork for this study was conducted on-site at ABC Homes' head office. Site visits were also carried out to various projects under construction, both unattended and attended by ABC Homes' staff. Semi-structured interviews were conducted with a broad spectrum of employees (see Figure 8) as it was my aim to gain to a holistic perspective of knowledge management within the firm.

Sources of data		Comments
IS/IT Audit	Conducted with the Commercial Manager	3 separate interviews ranging in time from ¾ hr to 1½ hours were conducted. The audit of the firms IS/IT was also carried out in conjunction the researcher and the Commercial Manager.
Field observations	Conducted on site by researcher over a 24 month period	As a full-time employee of ABC Homes, I was able to document my observations on a daily basis for the duration of this study.
Semi- structured interviews	MD, F&C Manager, Drafting Manager, Estimating Manager	Interviews varied in time from ¾ hr to 1½ hours. A total of 12 interviews were conducted
Focus groups	2 focus group sessions were conducted. Each session involved 6 participants from none management positions	Focus group sessions allowed me to not only gain a wider perception of the firms IS/IT environment at ABC Homes, also a forum by which I could question my bias and preconceived views.
Company business plans	3	The firm produced 3 formal business plans over a 10-year period, one of which was produced at the commencement of this study.
Reports	24	The firm produced a monthly board reports. A full 24-month cycle was made available to this study
E-mail messages between staff	8	E-mail had become a main source of intra-organisation communication at ABC Homes as such during the duration of this study I received many e-mails. However, I did identify 8 e-mails that succinctly described the phenomena this study was seeking to investigate.

Figure 8:   A summary of the data collected

4.3.2 Records

A coded database of all data collected for this study was established and maintained. In addition to the data base, transcripts of my interviews were issued to the participants to confirm that their interpretations were sound.

4.3.3 Analysis

Particular attention was paid to ensure the validity of the data and its interpretation within this study. This was achieved by following a thorough chain of evidence (Yin 2003). The chain of evidence commenced with a literature review and field test. The

literature review allowed me to assess established views on knowledge management within the wider research community and assisted with the development and facilitation of the semi-structured interviews and focus groups.

The next phase in the chain of evidence consisted of an audit of the firm's IS and IT infrastructure. By conducting this audit, I was in a position to map the firm's IS and IT profile in a way that made it clearer to understand what tools were being used to facilitate the firm's knowledge management.

Following the audit, I conducted the interviews and focus-group sessions. These included five one-on-one interviews and two focus-groups sessions.

It is important to mention that my initial intention was to conduct all the interviews using a pre-prepared layout and structure; however, during the first interview I felt this method to be too constraining and opted for a more open approach where the interviews were guided more by the content of conversation rather than a prescriptive set of interview questions. This was done by prompting the participant with leading questions and additional "why" type questions. This allowed me to dig deeper into their world.

In keeping with the interpretive paradigm adopted for this study, the data was analysed using the principles of the hermeneutic cycle as presented by Klein and Myers (1999) in their set of principles for the evaluation of interpretive field research in information systems.

My role as an active participant in this study cannot be overlooked or underestimated. From the outset of this study it was my purpose to not only conduct sound research that met the standards of acceptable academic criteria but also, and equally importantly, to conduct research that improved the lives of the research participants. Though reflection-in-action I was in a position to act-out my research in a real life setting. In a sense, this helped to establish what Whitehead (1998) referred to as living theories:

> The creation of living theories begins in practice. The creation begins in the kind of enquiries which I think you will have engaged in of the kind, 'How do I do this better?', or 'How can I help you to improve your learning?', or 'How can I live my values more fully in what I am doing?', (p. 2).

4.4 The participating organisation

ABC Homes is a well-established project house-building firm that has been operating within the Western Australian metropolitan market for over 40 years, having been established by the current owner–manager in 1964. At the time of this research, the firm was constructing approximately 150 houses, with a further 125 houses in the administrative stage of being prepared for construction. The majority of ABC Homes' clients are private, one-off owners who intend to either live in the home or to sell shortly after hand-over for a profit.

ABC Homes has an annual sales budget in excess of $30 million and employs approximately 40 staff who conduct their daily work from the firms' main office. Full time employees' duties typically consist of administrative activities (e.g. marketing, estimating, drafting, administration and project co-ordination). As is the typical operating practice in Perth, Western Australia, all works conducted on-site that are required to construct the houses are outsourced. The firm's on-site supervisors manage this component. At the time of this research, ABC Homes employed six full-time on-site supervisors who oversaw the work of approximately 300 subcontractors, constructing more than 150 active projects ranging in value from $130,000 to $250,000 (see Figure 9).

```
                    ┌─────────────────────┐
                    │  Managing Director  │
                    └──────────┬──────────┘
                    ┌──────────┴──────────┐
                    │   General Manager   │
          ┌─────────┴──────────┬──────────┴─────────┐
┌─────────┴─────────┐┌─────────┴─────────┐┌─────────┴─────────┐
│      Sales        ││  Administration   ││   Construction    │
└─────────┬─────────┘└─────────┬─────────┘└─────────┬─────────┘
┌─────────┴─────────┐┌─────────┴─────────┐┌─────────┴─────────┐
│    Consultants    ││     Accounts      ││    Supervisors    │
└─────────┬─────────┘└─────────┬─────────┘└─────────┬─────────┘
┌─────────┴─────────┐┌─────────┴─────────┐┌─────────┴─────────┐
│    Estimators     ││        HR         ││  Site coordinators│
└─────────┬─────────┘└─────────┬─────────┘└─────────┬─────────┘
┌─────────┴─────────┐┌─────────┴─────────┐┌─────────┴─────────┐
│     Drafters      ││    IT Support     ││   Client liaison  │
└───────────────────┘└───────────────────┘└─────────┬─────────┘
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                                          │     Schedulers    │
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                                          │   Subcontractors  │
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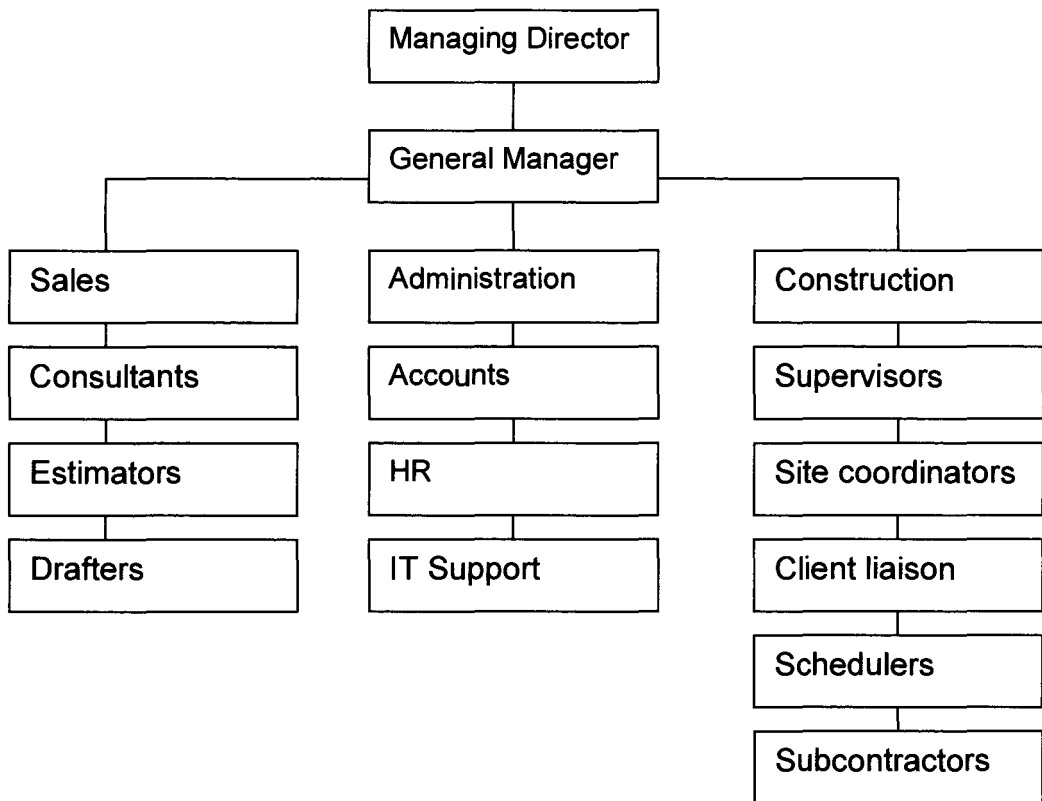
Figure 9:   ABC Homes organisation chart

The company competes in a highly competitive, $35 billion industry. The Australian housing industry consists of mainly small- and medium-sized business and is one of the most regulated of Australia's industries (HIA 2001).

ABC Homes' market is characterised by a number of changing trends in consumer expectations and behaviour. Homebuyers are becoming increasingly educated, demanding and sophisticated in their expectations of builders. The range of housing options from which to choose is greater than ever before, and builders are having to work hard to close sales and to sustain satisfaction throughout the building process. Customers are also far more likely to resort to legal action than in the past. The litigious nature of the industry has created an environment that places a greater focus on control and regulation than on innovation and experimentation.

Figure 10 provides a representation of ABC Homes' costs and their relative distribution through the firm. Figure 11 provides a pictorial representation of the product built by ABC Homes.

Figure 10 is a representation of costs and their disbursement through the firm.

3%
1%
6%
8%
5%
77%

Cost of construction
Sales Commission
Warranty/Maintenance
Admin/Overheads
Staff Expenditure
Trading Profit
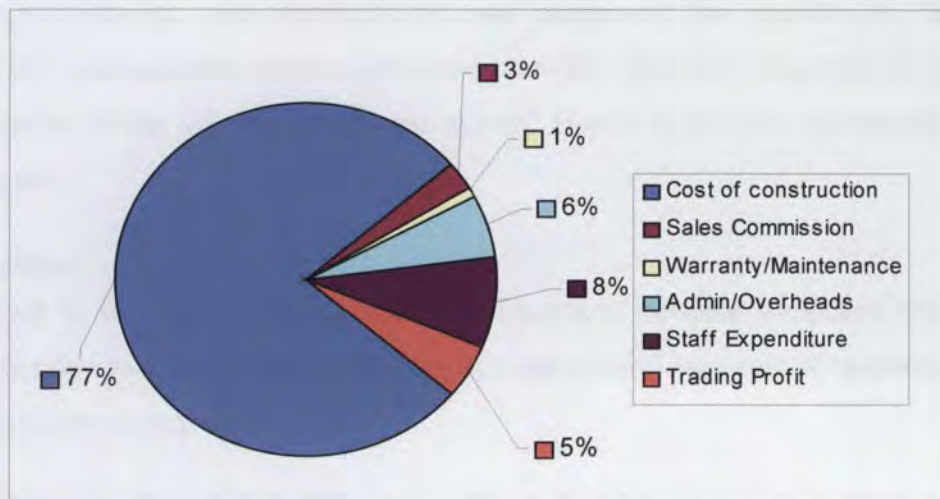
Figure 10:   Costs disbursements at ABC Homes

The amortisation of costs presented in the figure above was derived from reports prepared by the firm over a five-year period.

Figure 11:   Pictorial representation of the product built by ABC Homes

4.5 Results

The results of this case study are presented using Pan and Scarbrough's (1998) socio-technical framework, which considers the firm from three interrelated elements: infrastructure, infostructure and infoculture. By investigating the firm's knowledge management environment through this socio-technical lens, this study aimed to achieve a multi-layered, socio-technical perspective of knowledge management within the firm, thus allowing a more pragmatic and workable set of insights and recommendations to emerge from the study.

4.5.1 Infrastructure

According to Pan and Scarbrough (1998), infrastructure consists of the firm's hardware, software, and physical tools and equipment that enables the firm to physically communicate with its networked members. The following sections present an overview of the infrastructure in-use at ABC Homes at the time this research was conducted.

Hardware

Hardware in use at ABC Homes consisted of a mix of personal computers connected via data cable to a 16-port hub. Desktops PCs and general hardware all appeared to be in reasonable running order.

Software

ABC Homes operated a Microsoft Windows Workgroup network utilising Ethernet network switches and a shared co-axial Ethernet segment to connect the PCs to a Windows 2000 file-and-print server and an Internet-and-e-mail gateway. They developed an in-house enterprise planning system, which covers the company's accounts, estimating, scheduling and project-tracking functions. The remaining systems can be viewed as traditional administrative, information-management systems for human resources, and accounts payable and receivable.

Figure 12 presents a conceptual network diagram depicting the network layout of ABC Homes.
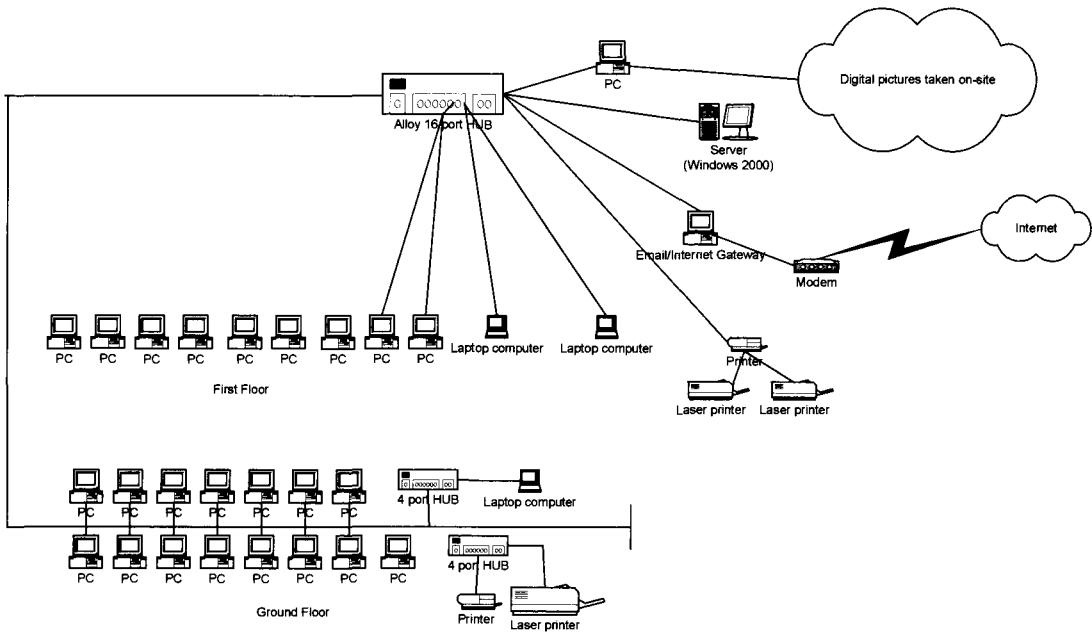
Figure 12: Network schematic of ABC Homes

Communication tools

Recent advances in the diffusion of new technologies in the form of mobile communication and digital cameras etc. were proving to be a useful tool for the organisation. The audit discovered that all on-site supervisors communicated with mobile phones (voice and SMS), and four of the six on-site supervisors carried a digital camera in their vehicle at all times.

4.5.2 Infostructure

Infostructure refers to the rules and regulations that exist within the firm that apply to the way work practices and procedures are governed and exchanged across the firm's networks (Pan et al. 1999). Furthermore, infostructure provides the networked participants with a set of cognitive resources (such as metaphors and common languages) that allow them to make sense of the events occurring within their network.

The business model employed by ABC Homes is one that has evolved over time through a combination of lived experiences and the need to follow a rather strict regulatory process that is enacted within the *Western Australian Home Building Industries Act 1991* and policed by the Builders' Registration Board of Western Australia.

From the observations made during this case study, it is apparent that the owner–manager has had, and still has, the most significant influence on shaping the firms'

explicit rules, regulations and procedures. The bulk of systems and processes in place appear to be descendents of past processes and ways of conducting work, as proffered by the Managing Director:

> *I see the computers as expensive tools for replicating the manual processes we have had in place for years. ... In fact, I'm still not convinced that they are any better.*

With the current IT and IS systems designed to reflect the "old ways of doing things", staff were, to a certain extent, forced to create their own individual systems and processes, such as Excel spreadsheets, calendars and e-mail directories of knowledge workers and contacts. These were seen to run in parallel with the management sanctioned processes and procedures.

The overarching business model for ABC Homes is most simply classified into three main processes and/or stages. These are sales, administration and construction. Below is an overview of each of the three main business processes as employed by ABC Homes.

Sales

The house-building process begins with the client interacting with the sales representative. The sales department consists of eight independent sales consultants who are primarily off-site and operate from display homes.

Display homes are a feature of most WA home builders. They serve two main functions. They are a prototype for future building projects, and they act as a full-scale model for consideration by prospective clients. ABC Homes has eight display homes located in various housing estates within the Perth metropolitan area. It is from these display homes that the majority of initial client and builder liaisons takes place in the form of fine-tuning the display home's features to suit the client's individual needs and pricing.

Once the final design and price has been accepted by both the client and the builder, the building process enters its second stage: administration.

Administration

Following the sale of a new home, all the documentation is passed to the fifteen-member administration team who take ownership of the preparation of the plans and specifications of the house. They also ensure that all statutory requirements are met.

The administration process forms the link between the sales and construction process in that it processes and verifies all the documentation necessary for the construction and management of the home, such as obtaining building licenses and the preparation and signing of contracts.

The documentation required to build a house is quite substantial as every aspect of the project is documented. This includes geographical surveys of the building site, which determines retaining walls requirements and driveway falls; specialised engineering; local shire requirements; and individual colour and material selections. All of which needs to be clearly identified and documented in such a way that all stakeholders are able to understand sufficiently to build the house. The Commercial Manager noted:

> *It's critical to get this stage of the process spot-on and to some extent it's the hardest, because what were are trying to do is match together all the thoughts and proposals from the client and sales consultant with that of the drafter, estimator, regulators, suppliers and contractors into something that can be transformed from the initial thought process to a physical structure for a and set price and time frame. The only person who will lose out if it isn't will be the builder.*

Once all the documentation is complete, the final plans approved and the regulatory licences are in place, the client's file is passed to the construction department and construction of the home begins.

Construction

Although it is the single largest component in the building process, in terms of costs (representing nearly 80% of the overall cost of the project), ABC Homes outsources all of the works performed on site, leaving only the site management and supervision in-house.

Each of the eight supervisors would manage between 20 to 30 homes at any one time. This is highly efficient and is made possible by several factors that are somewhat unique to the Western Australian home building industry:

- The local industry operates by sharing its labour resources from a pool of skilled, predominantly subcontract, labour conversant in the ways of building residential housing in Western Australia, which in many aspects are replicated from one building firm to another.

- Repeated house design with minimal changes allows repeated processes from one job to the next.

- Materials and applications vary little between one builder to the next.

- It is a cost effective means of building affordable housing.

Thus, the competitive edge for a building company like ABC Homes is its ability to:

- Design and build attractive yet affordable display homes that meet the needs of the customers.

- Have an effective and efficient administration process throughout the entire building process.

- Ensure the construction of each home utilises the skills of the industries' pool of subcontract and established labour in an effective and timely manner.

Figure 13 presents an overview of the business process employed by ABC Homes.
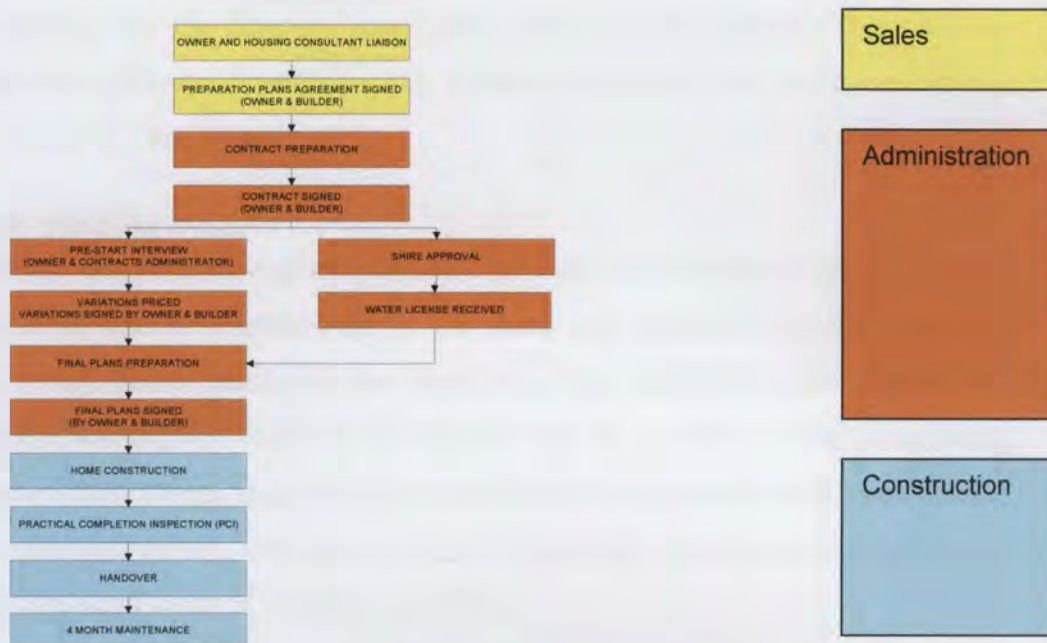
Figure 13: ABC Homes' business process

When it comes to the firms' IS and IT, the role of computer systems within the firm appeared to focus on ensuring compliance. Confirmation of this was highlighted by the Managing Director when he was commenting on the idiosyncrasies of the industry:

It's an easy market to get started in, but it's just as easy to go broke ... there are too many external influences determining our processes and we are dealing with mums and dads who don't really understand the system, or worst still, the ones that think they do and try it on the builders.

These responses prompted me to question how the firm dealt with these issues. It became apparent that structure and control played a leading role in the operation of the firm. An example of this can been seen in the following discussion with the Finance and Administration Manager collected during one of the semi-structured interviews:

We need to keep a very close eye on things; otherwise they can go terribly wrong with little warning.

He was asked "How do you keep such a close eye on things when your projects are so geographically dispersed?"

On site we rely on our site supervisors to keep us informed, this is backed-up with our IS/IT systems that allow us to track all our processes, projects and clients.

To support these infostructural rules and roles, two unrelated knowledge management tools employed by the firm are investigated further in this chapter. These are the management-initiated and endorsed job tracking system and the employee-initiated and endorsed "photo systems".

The job tracking system

The primary design feature of the job tracking system is its ability to allow real-time access for all staff to communicate on the status and progress of each construction project. A key facility attached to the system is a "note function" to allow input from any person wishing to contribute or comment on the progress of the home being constructed from design stage through administration, construction and maintenance. Sales consultants do not have access to the job tracking system, but are linked to the intranet by a stand-alone PC in their sales office.

Figure 14 shows a screen shot depicting the presentation and data found in the job tracking system.

Project Details	House Type	Sales Consult	Client Liaison	Original Start Date	End Dates	22/8	29/8	5/9	12/9	19/9	26/9	3/10	10/10	17/10	24/10	31/10	7/11	14/11	Days Won	Status %
1744A - WILKS	SPECIAL SINGLE	STEV	AS	14-05-02	O 07-08-02 / S 09-01-04	-40	-45	-50	-55	-60	-65	-70	-75	-80	-85	-90	-95	-100	0	40
1805 - JAMES	2 STOREY SPECIAL	GH	AS	17-01-03	O 24-04-03 / S 12-08-03	0														100
1862 - HOOKER	AVONLEA	SJ	AS	06-02-03	O 02-05-03 / S 08-12-03	-16	-21	-26	-31	-36	-41	-46	-51	-58	-61	-66	-71	-76	0	70
1897 - EAVES	CHATEAU	IP	JF	11-03-03	O 04-06-03 / S 08-12-03	-40	-45	-50	-45	-50	-55	-60	-61	-66	-71	-76	-73	-76	2	70
1904 - BRANCH	SPECIAL SINGLE	GT	AS	21-03-03	O 16-06-03 / S 09-01-04	-40	-45	-50	-55	-60	-65	-70	-75	-80	-85	-90	-95	-100	0	40
1905 - STRIBRNY	AVON	MB	JF	26-03-03	O 19-06-03 / S 26-11-03	-30	-31	-36	-33	-38	-41	-38	-43	-48	-53	-58	-63	-68	0	83
1921 - FAWCETT / SCARGILL	SHENTON	HJ	AS	21-04-03	O 15-07-03 / S 08-12-03	-16	-21	-26	-31	-36	-41	-46	-51	-56	-61	-66	-71	-76	0	70
1922 - ATKINS	SPECIAL 2 STOREY	SJ	AS	28-04-03	O 01-08-03 / S 28-11-03	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60	-65	-70	0	83
1937 - WATSON	BROADWATER	STEV	AS	29-04-03	O 04-08-03 / S 10-12-03	-20	-25	-30	-35	-40	-45	-50	-55	-60	-65	-68	-73	-78	0	70
1938 - HOWELL-MORGAN	SPECIAL TWO STOREY	SJ	AS	06-09-03	O 11-12-03 / S 12-11-03	59	59	59	54	53	44	39	35	35	35	23	22	20	3	100
1941 - VERNEDE / LIMOPRANOTO	MONACO	IM	AS	04-05-03	O 28-07-03 / S 22-12-03	-57	-60	-65	-65	-68	-72	-74	-75	-80	-85	-80	-81	-86	0	58
1944 - LENBINK	AVONLEA SP	SJ	JF	17-04-03	O 11-07-03 / S 21-10-03	-18	-15	-20	-23	-28	-33	-38	-43	-48					100
1945 - TORRANCE	AVONLEA	SJ	AS	17-05-03	O 11-08-03 / S 10-10-03	-16	-21	-26	-31	-36	-33	-38	-43	-46	-51				100
1948 - ROBSON	DYNASTY MKII	GH	JF	21-05-03	O 26-08-03 / S 12-12-03	-43	-49	-54	-55	-60	-65	-58	-63	-63	-68	-65	-70	-75	0	68
1955 - MOSLEY	MONTEREY	GT	JF	31-05-03	O 25-08-03 / S 26-11-03	-10	-16	-21	-26	-31	-36	-41	-46	-43	-48	-53	-58	-63	0	83

ACTION GROUPS APPROXIMATE %

SALES 1   DRAFTING   ESTIMATING 2   CLIENT LIAISON

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

ESTIMATING 1   SALES 2   SALES 3   ADMINISTRATION
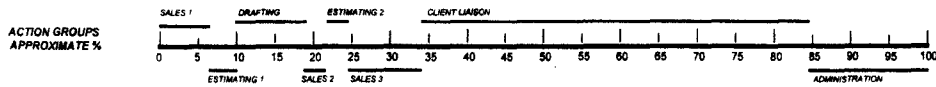
Figure 14: A screen shot of presentation and data found in the job tracking system

All office and administration staff have access to desktop PCs. However, only selected staff members have access to inputting data into the job tracking system. The Managing Director is reluctant to grant access to staff members who have no direct "need to know". The Director expressed concern that the chance of data entry error would increase with the number of people involved; therefore, participation should be kept to a minimum. All office staff have access to e-mail and the intranet. The office and administration personnel are the most active participants with both the job tracking system and the photo system. On-site construction personnel do not have access to the job tracking system, e-mail or intranet.

Weekly progress reports are compiled by the construction supervisors and are issued to the construction coordinator who inputs data into the job tracking system every week. Hard copies of the system's reports are issued to the construction supervisors.

The Director has access to the job tracking system via a notebook computer, but very rarely accesses live information, instead preferring to review weekly reports and the key performance indicators generated from the system. He openly admits to not being technically expert. The key performance indicators within the system embody

management's decision to implement optimum project task scheduling and reflect the best-case completion times for tasks.

Simply changing the key performance indicators to reflect how projects really run is not feasible, as best practice is required if the business is to compete. In reality, this is rarely possible as there are too many factors outside the organisation that affect the workflow (e.g. clients, subcontractors and regulatory bodies). Moreover, the industry is known for its cyclical nature, resulting in large variances in peak and troughs of new projects, making the allocation of resources difficult. The job tracking system is limited in its ability to cope with these fluctuations and changes. Whilst the system does supply an important guideline for planning and sequencing, there is too much variability in real world circumstances to maintain the times for task completion.

Every project requires the input of milestone progress into the job tracking system's database, and each project maintains a hard file that contains drawings, correspondence, contracts licences and so on. Attached to this file is a summary progress schedule sheet, which indicates the amount of time each milestone task has been allocated.

The prescribed time allowed rarely matches the actual time the majority of tasks take. As the General Manager stated:

> *This creates two issues, in the first instance, I have a management team constantly on my back complaining that the KPIs [key performance indicators] are slipping and something needs to be done about it; secondly, I have the administration team rejecting the JTS [job tracking system]data as being inaccurate and irrelevant.*

Surprisingly, although data was entered faithfully into the job tracking system, there was little evidence of it being subsequently used. Rather, staff chose alternative methods of communicating and documenting progress and significant points of interest, such as handwritten notes attached to the project file, individual Excel spreadsheets stored on PCs and general conversation and socialisation within the office environment.

Knowledge management systems with a primary purpose to record and store seem to be highly influenced by perceptions of organisational power through their ability to

control risk and enhance compliance. This can be seen from the comments made by the Managing Director when reflecting on the development of the job tracking system:

... when I started work on the system, I wanted something that could cover me, as I could see a trend whereby more and more people were starting to sue builders for poor performance. By having this system in place I could be sure that everyone knew the importance of meeting timeframes and following our proper procedure.

Another perspective came from an employee:

...the job tracking system is good in the way it forces you follow the procedures set out by management, but because it is so complex, trying to change or improve our system is almost impossible.

Some staff felt the job tracking system was primarily a management tool to track the performance of staff. Others felt the system was too cumbersome and of little benefit to the overall performance of each project, let alone a knowledge-enhancing tool. One staff member commented:

The job tracking system is OK for looking at historical data, and following the correct procedure, but I don't see how it can expand my knowledge of the building process ... I think most people don't know how to use it properly.

The "photo system"

In contrast to the job tracking system, the "photo system" (which had no formal name) exhibited traits that are characteristic of an emergent knowledge management strategy. It appeared to have evolved from a combination of employee initiative and the availability of new technology in the form of intranet, e-mail and digital cameras.

Employees have intuitively turned to the use of the intranet and digital photos as a means of communicating and sharing information and knowledge about methods of construction and general interest. The most popular of these tools has been the setting up of a project history repository that includes digital images of various stages of house construction with succinct captions explaining significant factors of each image.

Figure 15 shows a typical usage of the photo system, contained in an e-mail and stored in a Windows folder.

Note: the levels used on this job are taken from the AHD, which is a mean height determined by sea level. Typically we use an assumed height datum of 10.00, which is taken from the crown of the road.

Level at top of marina wall is 1.04. Therefore, 2.7m below the proposed fished floor level

Due to the sharp drop-off to the marina, the earth worker has had to cut a driveway in the soil to gain access to the back of the block

Figure 15:   A sample of an annotated construction site photo from the 'photo system'.

The views of the staff regarding the photo system were quite different to those presented regarding the job tracking system. For example:

> *... most of the staff that work for a building company rarely get to see what happens on site, take for example our drafters, they could draw 3 or 4 homes every week and not visit a single site all year ... since we started taking digital photos and e-mailing them with brief comments it has created a new talking point and common interest between the site guys and office staff, in fact there is more interest now for the drafters to visit a site than there was before.*

Other staff commented that "the format is fabulous", and one piece of e-mailed feedback stated "pictures are clear for estimating wise and it is critical we get info like this to see and feedback from the supervisors to let us know problems & areas of extra costs".

It can be argued that this system of capturing and distributing knowledge is nothing new. However, what is exciting is the potential of using basic information technologies such as the Internet, intranets, web browsers and digital cameras to capture, store and distribute knowledge which is immediate, dense and meaningful to all areas of an organisation (Alavi et al. 1999, in Gottschalk 1999).

It can be argued that the driving force behind systems like this are the ubiquitous tools supporting such systems. These include simple but very effective and widely used applications such as Excel and Word. During the audit of the firms' infrastructure, I could not help but notice the extent to which most employees possessed and utilised personalised files in their daily tool kit.

Excel files, for example, had been formatted to enhance or fine tune data contained in the job tracking system to suite individuals' personal needs that may not have been present in the details of a full report prepared by the system.

4.5.3 Infoculture

It became apparent early on in the research that ABC Homes' market was characterised by a number of changing trends in consumer expectations and behaviour. In essence, the firm believed that homebuyers were becoming increasingly educated, demanding and sophisticated in their expectations of builders. The range of housing options from which to choose was greater than ever before, and builders were having to work hard to close sales and to sustain satisfaction throughout the building process. Customers were far more likely to resort to legal action than in the past. The litigious nature of the industry has created an environment that places a greater focus on control and regulation rather than innovation and experimentation.

The physical presence of ABC Homes

What was encountered at a visible level with ABC Homes was a company that likes to be portrayed as being well established, reliable and traditional. This was made evident in its office building, which was built by the founder nearly fifteen years ago and reflects the style of homes designed and constructed by the firm.

Stepping inside the office we sense a traditional layout that embodies a hierarchical structure and atmosphere. The building sits on two floors, with the reception, MD's office and administration located on the first floor. The ground floor appears to be for the workers, in particularly the estimators, schedulers, drafters and sales representatives. All departments are clearly segregated and occupy their own space.

Furniture and fittings are somewhat of a mix and match of old and new with the old resembling left over or surplus stock no longer required in the display homes, and the new leans towards a conservative aesthetic of light greys and creams.

Underlying assumptions and espoused values

Shifting to the underlying assumptions at ABC Homes, there appears to be a high regard for personal and family values, and a mutual respect for all staff members. Individuals are expected to maintain the highest degree of ethical standards both during work and in their family life. Bad language, alcohol and fraternising among staff was frowned upon and people knew that this behaviour would result in being reprimanded or dismissed.

The company has explicitly laid out its purpose and approach in the form of a mission statement drafted and endorsed by the Managing Director. Extracts presented below offer an insight into the espoused views and direction of the firm:

On the firm's philosophy:

> *To honourably achieve a fair return upon investment, compatible with firm, trustworthy principles, absolute integrity and complete fairness to all people with whom we come in contact.*

On the firm's people:

> *We shall encourage teamwork and mutual self-respect, fostering wise use of our resources by all employees.*

On the firm's products:

> *The MD accepts the responsibility to continually seek better methods of providing current and new services to every single one of our customers, at better value.*

> *Our business revolves around the design and production of high quality homes that provide each client with satisfaction and a sound investment.*

> *We are committed to pursuing excellence in material selection, technology and product innovation.*

On the firm's plan:

> *It is the constant goal of the company to grow in quality to become 'better' rather than just 'bigger'. At the same time, we recognise the absolute need to grow and we intend to develop in a sound and prudent manner.*

On the firm's purpose:

> *To provide commitment and direction to our people on a way that will mobilise the energies and resources of our business to serve wholeheartedly the needs of all our customers.*

Interpersonal communication between employees and management plays a significant role in shaping the culture of the firm. I found that the company was structured in the way in which it shared information between its stakeholders. Typically, managers and senior staff conducted regular meetings; however, I observed little evidence of regular open communication forums between all levels of staff. There were several regular meetings such as monthly board meetings, weekly managers', sales and construction meetings, and fortnightly job tracking meetings.

Observations that I made during these meetings were that little attention was given to the relevance of the data in the reports; rather, the reports were used as a prompt to discuss other issues of relevance. For example, discussing what the particular client's personality was like and how best to handle that, or a difficult job was discussed and knowledge from the forum shared by people with more knowledge in a particular field. For example, the construction manager shared his experiences with administrative staff.

The atmosphere within the office appeared professional, with little chatter or noise. There seemed to be few deleterious elements within the climate of ABC Homes. The owner–manager was personable and perceived as fair. The staff appeared content, and the environment was characterised by low levels of conflict and staff turnover.

But a significant portion of infoculture is characterised by a group's ascription of value to the social constructs that the group has embodied in its symbols and practices. Regarding the information systems, there appear to be low levels of commitment amongst staff to the established key performance indicators within the job tracking system. There was a perceived lack of value ascribed both to the *inputs*, which consisted of data which were of no subsequent use within the workflow of staff, and the *outputs*, which consisted of performance reports measured against key performance indicators considered to be unachievable.

The importance of conforming to routine procedures within a highly litigious and regulated environment cannot be underestimated. The staff have internalised that such a detailed prescriptive system can and should be supported for the good of the firm. This has bred a culture of *forbearance* with the job tracking system. Furthermore, the

rigidity of the system also has a negative effect on the company's efforts to become more innovative and flexible. According to Orlikowski (1991), "IT tends to be designed to reflect the status quo, and that the use of IT encourages institutionalisation and reification".

In summary, elements of Orlikowski's concerns can be seen as a consequence of the very nature of the job tracking system. As a tool for facilitating routine procedures and creating information and knowledge stocks, the job tracking systems appears to be successful. However, as a tool for creating knowledge flows and generating motivation and creativity, the tool is less effective.

The photo system, however, is used enthusiastically and is being enhanced by users, who now annotate pictures with observations and warnings. The relationship between draftsmen, administrative staff and the object of their efforts (the house) has been personalised, and communication carries more meaning than was previously possible. The photo system is a tool that services the needs of a community of practice (Lave and Wenger 1991). It helps to form community relationships around the practice of building houses and the promotes the emergence of authority relationships built upon interaction and around expertise.

4.6 Discussion

4.6.1 Infrastructure openness
The technologies within the infrastructure themselves have different degrees of openness and allow different degrees of situated responsiveness. The technologies of the photo system (a digital camera, e-mail and a filing system) are highly malleable forms of technology with substantial local negotiability. The implementation of the technology was technically simple. In contrast, the job tracking system permitted a narrow usage, and was tightly constrained by the requirement for explicit documentation of certain pieces of information in a specified format. The open-ended nature of the available infrastructure seems important.

4.6.2 Emergence versus strategy
The photo system evolved directly from the task at hand. The movement was from a situated process requirement (i.e. infostructure) to a technology solution (i.e. infrastructure), resulting in a high degree of readiness at hand and a snug task–technology fit. This capability was enabled by the open-endedness of the technology discussed above. Management, whose personal infostructure and culture was that of a

litigious and threatening commercial environment, imposed the job tracking system to protect the company. Line staff, however, did not inhabit this subset of infocultural space, and did not use the tracking system as required. It was not only irrelevant to their task needs, but there was no institutionalised pressure on them to do so.

4.6.3 Tacit and explicit knowledge

The nature of the knowledge embodied in the infostructures for the two systems was quite different. The photo system supported a non-routine task and provided non-codified, pictorial knowledge. The job tracking system supported routine work and was textual and controlled. However, this does not appear sufficient to increase adoption of the provided functionality, as codifying, even of routine tasks, did not lead to adoption by users.

4.6.4 Latent infocultural need

The major function of the picture system was to fulfil a logistical need to understand construction progress and highlight salient facts about a property that may escape textual codification. But this capability was previously not present, and the work had been carried out with no such support. Furthermore, there was a cultural and emotional need for draftsmen and office bound staff to see the results of their labours. The photo system fulfilled this need.

4.6.5 Systems and infoculture

There is a dialectic of power within the domain of infoculture. Management mandated the initiation and orientation of the job tracking system, imposing the social objectivation of their commercial reality onto the staff. This power elite understood the regulatory process and the strategic need for "best practice", but did not have the knowledge of the real-world business process to define a useful, working system. This alienated the staff who, whilst intellectually understanding the need for the system, ascribed motivations of scrutiny and control to management and ascribed little value to the associated key performance indicators.

4.6.6 Strategic knowledge

In contrast to the photo system, the job tracking system contributed little to the wider dissemination of knowledge and learning for the organisation or its individuals. it contributed to stocks of knowledge as well a stricter implementation of procedures. But this knowledge was of little competitive value, being in the public domain and easily imitated. The photo system operated at a different level: in one e-mail, many

aspects of a building could be addressed and annotations drawn onto a photo. The example of a photo of a risky retaining wall, within an incrementally growing e-mail received considerable attention, because in one page many issues were addressed and the knowledge grew within the flow of work. The photo was greeted with comments such as: "Oh, that's how it works" and "That's why it takes so long to build". If described textually, interest would be lost after the first paragraph.

4.6.7 Knowledge stocks and knowledge flows

The existence of the computer network contributed to the capture, building and dissemination of both sets of knowledge. However, one clear difference between the applications was that one attempted to create knowledge stocks and the other nurtured knowledge flows. The job tracking system, to all appearances, was a "write only database", with information never used in practice. The rigid nature of the job tracking software and the inference of a control mechanism meant there was a greater focus on the input of routine data such as progress reports and time schedules.

The photo system implemented more flexible tools such as e-mail and the intranet and was considered far more subjective in its nature and importance, resulting in a more casual approach to communication and knowledge flows across all areas of the company. The information maintained by the job tracking system fitted neatly into the knowledge stock category. The intranet program, by virtue of its subjectivity and tacitness, promoted a greater participation in knowledge sharing and development.

The rigid and codified job tracking system failed to enhance creativity and innovation, in that individualism and personalisation of processes were not openly supported by management. This can, to some extent, be a reflection of the very nature of the firm's external environment, which requires a certain element of prescriptive guidance. It can be argued that this technology more than adequately fulfils this requirement.

In summary, the investigation of ABC Homes observed that, within this firm's IS and IT environment, knowledge management initiatives appeared to be either strategic or emergent. The management initiated (strategic) knowledge management system proved to be a useful tool for coding and storing knowledge stocks. However, staff participation was driven by management, who believed the system was necessary to maintain control. The employees did not appear to embrace it.

On the other hand, the employee initiated (emergent) knowledge management system (using tools such as the intranet, digital photos and Excel spread sheets), evolved from a desire to fulfil a logistical need and the availability of ubiquitous open-ended IS and IT. This resulted in enhanced knowledge flows. It was also observed that management did not widely support this approach.

As a result, there appeared to be elements of conflict surrounding both knowledge management systems, resulting in a less than desirable knowledge management processes. In order to offer a better means of describing the "rich moving pageant of human relationships" (Checkland & Scholes 1999), within ABC Homes, a rich picture is presented in Figure 16.

The rich picture represents two world-views, the first (top section) being the world-view of the Managing Director (MD) and the second (bottom section) world-view, being that of the staff. The hidden story behind both views is that of the customer.

The Managing Director has reacted to the changing and competitive environment by implementing a strategic knowledge management system that allows greater control over routine outputs and daily events. The result is the creation of a knowledge repository. The staff, on the other hand, show little interest in this system as they are more concerned with achieving their daily logistical needs and expanding their peripheral knowledge. One strategy that has emerged to address this need is that of sharing information via e-mail and digital photos.

I have chosen to depict the customer as the hidden story in the rich picture, as I felt from my time spent in the firm that little consideration was given to arguably the most important stakeholder in the firm's future success.
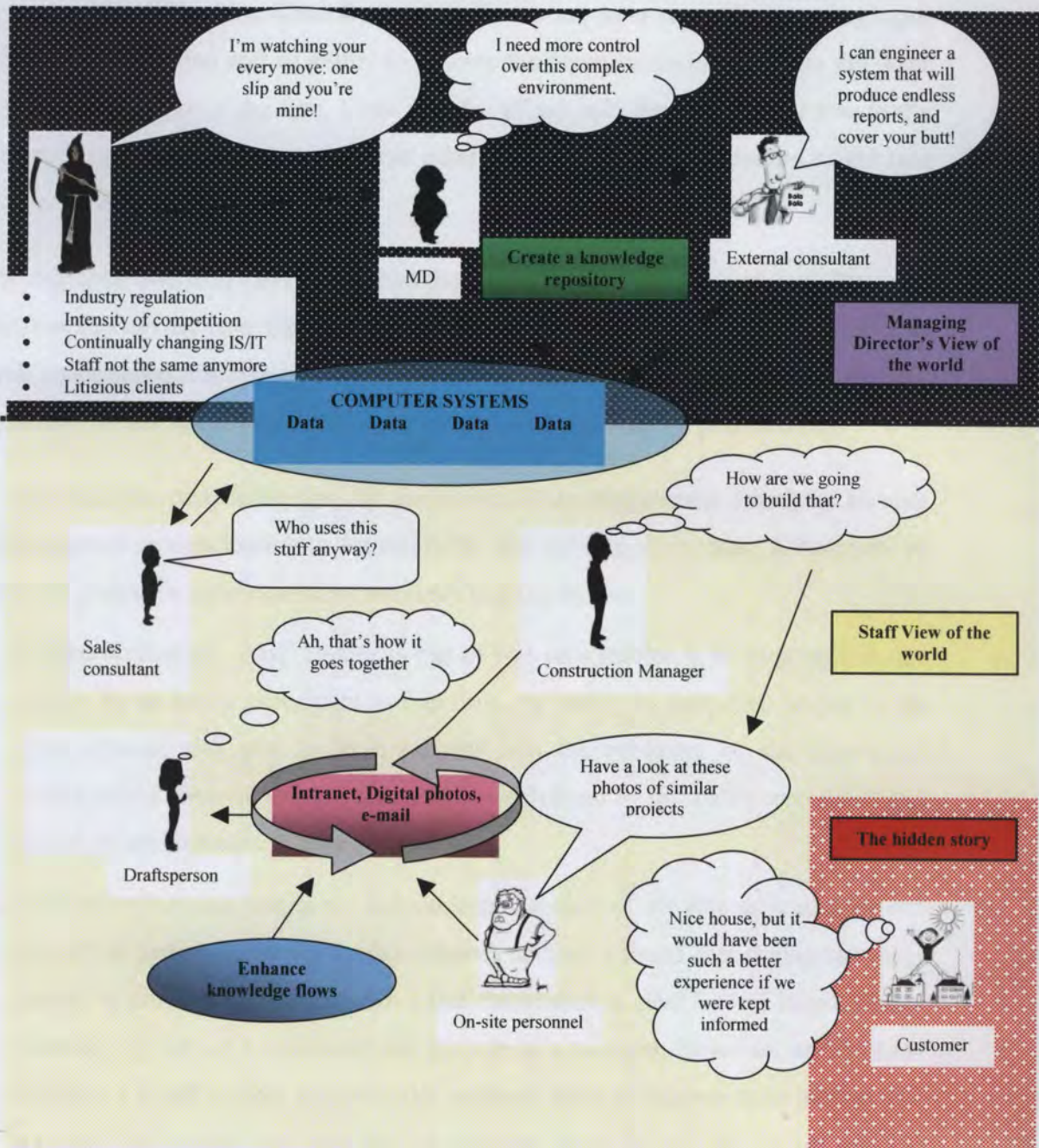
Figure 16: A rich picture of ABC Homes showing the Managing Director's and the staff's worldviews.

4.7 Hermeneutic stance

As presented earlier, I was employed on a full-time basis in a management position with ABC Homes for the duration of this study. This situation presented both benefits and potential difficulties. The obvious benefits to me as a researcher was my open access to information and an ability to observe the organisation in detail. On the other hand, as a manager of the firm, I was mindful of not only the potential for bias in the interpretation of the data but also how other members of the organisation might bias the data presented to me.

For example, bias may have influenced the comparison of the two systems. That is to say, employees may have highlighted the benefits of the photo systems in an attempt to seek concurrence from their manager and downplayed the benefits of the job tracking system in an attempt to protest its potential to control and monitor performance.

It was from this perspective that the integration of the hermeneutic principles became advantageous in contributing to the reliability and validity of the data. A summary of how the principles influenced this case study is given below:

1. Contextualisation: ABC Homes is one of two case studies to be presented in this study. As an active participant in this firm, my ability to gain open access to the firm allowed rich and in-depth insights into the evolution of the knowledge management environment. This was further enhanced by my ability to conduct and report on my reflective research in action.

2. Interaction between researcher and subjects: Mindful of my role as researcher and an active participant living in the research setting, I found that during the early stages of conducting this research I had established a clear line of responsibility between my role as a researcher and my role as a manager. However, as this study evolved, I found (as did, I believe, the subjects) this line became more blurred. For example, my approach toward the improvement of the job tracking system required me to carry out both functions (researcher and manager) simultaneously bearing the responsibility to the subjects as a manager and an ethical researcher.

3. Abstraction and generalisation: The literature review proved beneficial in providing a solid background in the fields of IS and IT, organisational strategy and knowledge management. In particular, Pan et al.'s 1998 model. I was able to abstract out of the data insights pertaining to the theoretical constructs.

4. Dialogical reasoning: This principle suggests the researcher examine the source of his observations and how certain observation and deductions were made. Not withstanding this principle, the conclusions deduced and presented stand for themselves as being reasonable.

5. Multiple interpretations: By conducting interviews with various levels of staff (management and employees), different views were obtained. Furthermore, data collected was not confined to the interviews as multiple sources were included allowing the researcher to triangulate the data.

6. Suspicion: Scepticism played a leading part in the interpretation and analysis of the data. This was enhanced by the acknowledgement of multiple interpretations.

4.8 Conclusion

In summary, my observations found that the job tracking system embodied a need to harness, store and control knowledge and was a management-initiated knowledge management strategy focusing on the organizational knowledge stocks needed to ameliorate risks to the business.

By comparison, the photo system emerged in support of knowledge flows, exhibiting many characteristics of the organisational approach to strategy (Earl 1998). Several of the tenets of knowledge management theory are confirmed in this case study. They demonstrate how a richer view of information systems implementation and usage is gained if we consider the knowledge context and exploit the conceptual apparatus of knowledge management. Within the same organisational environment, I observed quite different behaviours towards items of infrastructure and quite varied performance in achieving explicit goals. These were based upon the nature of the content of the three levels, and the way they interacted with each other.

Based on the findings and analysis of the ABC Homes case study, it was possible to identify a relationship between the way their knowledge management strategy was approached and the type of knowledge produced. That is to say, I observed that the management initiated job tracking system was an explicit strategy; whereby management purposely set out to make a prediction about the future based on past experiences. The implementation of this strategy was carried out with little consultation with staff, which may have contributed to the poor perception held by the staff of the system.

In contrast, the photo system emerged through opportunistic behaviour and the availability of new open ended and ubiquitous IS and IT. The implementation of the photo system was largely an intuitive process championed by staff that identified this knowledge management initiative as a tool to assist with their day-to-day logistical needs.

As diverse as the two strategies were, equally diverse was the type of knowledge produced. The job tracking system with its focus on process and control produced knowledge stocks, resulting in a knowledge repository. The photo system facilitated knowledge flows, exhibiting elements more familiar with the concept of a community of practice.

The interpretive paradigm proved useful in the way it helped to facilitate deep insights into information systems from a Western Australian house-building industry perspective. The adoption of the hermeneutic principles became advantageous in contributing to the reliability and validity of the data.

4.9 Researcher reflections and an update on changes made to the job tracking system

One factor that cannot be overlooked in this study was my active and on-going role within the firm. As such, I felt it appropriate, in both my role as researcher and manager of the firm, to implement potentially positive discoveries from the investigation. One example of this influence and intervention occurred in relation to the performance of the job tracking system. This was done after this chapter was completed and discussed with fellow colleagues from both academia and ABC Homes.

The job tracking system was considered by both management and staff of ABC Homes as being the major IS tool within the firm for collecting and disseminating operational knowledge. It had become apparent quite early in this study that it was not operating at desirable levels, and participation by staff to contribute to the knowledge contained within the tool was almost non-existent.

The job tracking system was a strategically implemented knowledge management tool that enabled staff to communicate and log the status and progress of each project. However, it became obvious that staff felt that the rigid nature and computer-generated program eroded the dynamic and at times unpredictable nature of managing a construction project. Furthermore, staff indicated that project targets, albeit very

important to the running of the projects, were either unattainable and/or lacked real-time relevance. As such, participation with the knowledge management tool was kept to a bare minimum and was generally not considered relevant or a workable tool by most staff.

What followed was a series of management meetings and staff focus-group sessions with an agenda to improve the participation and usefulness of the system. From these sessions, I was able to identify several key roadblocks that needed addressing in order to improve the participation and usefulness of the job tracking system:

1. The system was considered too cumbersome to use being an MS-DOS based system;

2. Staff held little faith in the accuracy of computer-generated program and forecasting of projects.

3. Staff were reluctant to use a note-taking function as the system was cumbersome to use and the fragmented information contained in the facility gave it little credibility

After considerable consultation with the management team and employees, consensus was reached to implement the following recommendations:

1. Update the system to be Microsoft Windows based, thus making use and connectivity more inline with other popular operating tools such as Microsoft Word and Microsoft Excel.

2. Review all key performance targets with those staff most affected by the targets, and expand the fields to allow for more flexibility and individualism regarding project types and complexities.

3. Enhance the note-taking function to promote better use and relevance.

In order to carry-out the recommendations the firm engaged the services of the IT consultant who supplied the original job tracking system and, over a period of 12 months, set about upgrading the system.

At the time of writing this, the newly updated system had been up and running within the firm for just over 12 months. Without going into detail about the implementation process, it is important however, to briefly discuss how the implementation was conducted and reflect on some of the experiences encountered.

The most time consuming and technical component of the upgrade was transferring all the data from MS-DOS to Microsoft Windows format; however, this technical component was undertaken solely by the consultant and did not require a great amount of input from the firm.

Running in parallel with the above, a series of key stakeholder sessions were run in order to re-visit the key performance indicators and project expectations. Surprisingly to me and the management of ABC Homes, the changes made were negligible, but were deemed critical by the staff, and one could sense an increased level of ownership by key stakeholders in achieving targets.

One of the more abstract issues we faced was enticing the staff to be more diligent in recording their comments and key occurrences during the project in the note-taking tool. Initially it was thought that the improvements realised with the more user-friendly Windows-based system and realigned key performance indicators would be enough to generate a better participation rate. However, this was not the case. We found that many staff still felt uneasy about initiating the comments for several reasons. In particular:

1. There was a lack of justification for the effort required to contribute to a data repository that would only be reviewed in times of potential litigation.

2. Should the data be retrieved for a litigious purpose then ownership or contribution to the problem may be linked to the author of the notes.

A solution came about through an informal session with the IT consultant and key team members involved in revising the key performance indicators. During the session it was noted that the new reports were a more accurate reflection of what was happening, but they still lacked the individualism and flexibility necessary to reflect the dynamic nature of building projects. "What they need", commented one staff member, was a "live construction comment" under each weekly project summary. This would not only add to the justification of participation but also go some way to alleviate the concerns expressed about the data being used solely for litigious reasons.

Technically this initiative was quite simple to implement by creating a new field for data entry on the main screen that was automatically copied to the weekly printed reports. The firm had a process within the construction department that reviewed every project on a weekly basis, and it was felt this was the best forum to capture live

feedback from site. In addition to this, I volunteered to collect and enter the data from the weekly reviews. In doing so, we agreed that the data should be presented in a way that espoused general discussion as opposed to the rigid nature of tightly worded legal speak that had dominated previous note imputations. The results were positive, resulting in a wider spectrum of staff being able to rely on data contained in the reports.

4.10 Summary

In summary, the job tracking system formed a key role within the firm in managing knowledge, but lacked the support of staff. By revisiting the issues raised from this case study it became apparent that negative perceptions combined with the rigid and prescriptive nature of the tool was hampering management's attempts to promote participation. What these reflections also highlight was the influence a particular approach can have on the outcome of a knowledge management initiative. In this example, the firm adopted an organisational approach (Earl 1998), whereby the views and considerations of the firm as a whole (multiple perspectives) were considered. This view adds a wider context to the approach as they have been formed by performing different roles and processes rather than a single view in isolation.

This approach allowed a better alignment between the firm's socio-technical elements. The firm's upgraded job tracking system was more related to workflow, bringing the infrastructure in-line with the infostructure. Fear was overcome by management leading by example in initiating a change in infoculture through trust and commitment building measures. Furthermore, these reflections have also shown how knowledge stocks and knowledge flows can work in conjunction with knowledge management initiatives. They do not necessarily need to be separated as some have suggested (for example Hansen et al. 1999).

Chapter 5: Case study two

5.1 The aim of the chapter

This chapter extends the empirical investigation into real life strategies employed by building and construction firms when designing and implementing their knowledge management systems. Due to the sensitivity of this research, all names and identifying references to the firm have been fictionalised. It should be noted that the construction industry is renowned for being highly competitive and an industry where trust and openness between competitors is not a priority. Overcoming this obstacle was a necessity for the successful completion of this study.

This second case study presents Lakeside Homes. Lakeside Homes is a privately owned and operated firm that has been building upper-market residential housing in Perth's metropolitan area for nearly 10 years. Although early acceptance to participate in this study was granted, I felt that obtaining rich insights into another firm would require a strong sense of trust and respect between the two firms. As it turned out, during the process of the research stage I developed a close professional relationship with the Managing Director of Lakeside Homes. As such, we found that the reality of sharing knowledge and experiences between competing firms goes a long way toward dismissing the widely held the perception that sharing knowledge may compromise your competitive advantage. Rather, we found through our experiences that by sharing knowledge and experiences both firms produced the essential elements of a community of practice (Wenger et al. 2002; Lesser & Stork 2001; Wenger & Snyder 2000; Brown & Duguid 2000). In essence, an inter-organisational, non-technical, knowledge management initiative emerged.

Additional sources of data were also collected during the investigation, including IS and IT audits, semi-structured interviews and joint focus groups.

This case study proved useful in two substantial ways. First, comparisons can be drawn between this case study and the previous case in that both firms presented clear knowledge management strategies. Knowledge management outcomes and management's espoused desires both bore resemblances between the two firms, even though both strategies were at different stages of maturity and implementation.

For example, the first knowledge management initiative I examined at Lakeside Homes was similar to the photo initiative presented earlier for ABC Homes. This emergent strategy exhibits traits that promote knowledge flows.

On the other hand, the second strategy investigated can be seen as a strategic knowledge management initiative. Although this initiative was at the planning stage, comparisons were drawn to the job tracking system in use at ABC Homes that showed an espoused desire to capture and store knowledge stocks. By viewing these knowledge management strategies of Lakeside Homes through the lens of Pan and Scarbrough's (1998) socio-technical framework, a greater understanding of the theoretical and practical problems guiding this study was illuminated.

The second way in which the case study proved useful was the emergence of a community of practice between the firms. This provided real life, empirical data on the evolution of trust and knowledge sharing between firms in a highly competitive industry. A discussion and review of the community of practice are presented at the end of this chapter.

5.2 Chapter layout

This chapter is presented in six main parts, as presented in Figure 17. Commencing with the introduction, there follows a description of the methodology and sources of data followed by an overview of the participating firm. This is followed by the results of the case study. The results are presented using the three interrelated subsystems that make up the socio-technical elements of knowledge management: the firm's infrastructure, infostructure and its infoculture. The chapter concludes with a discussion of the case study and a summary of findings.
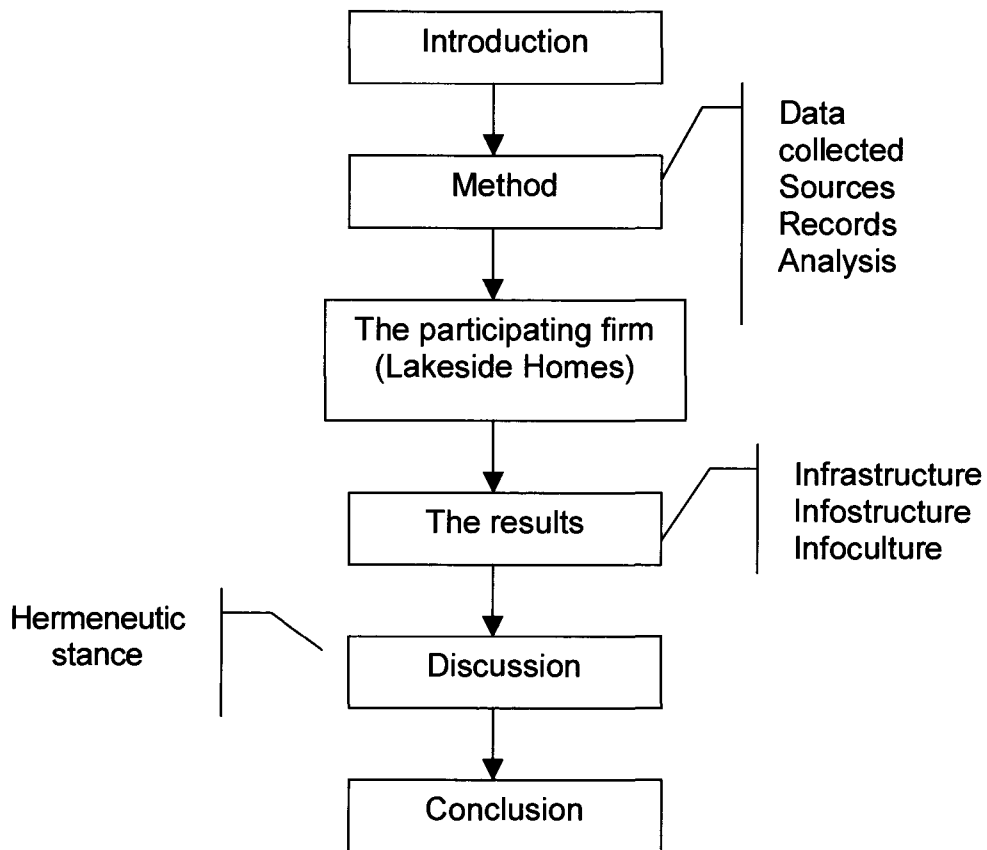
Figure 17:   Chapter 5 layout

5.3 Method

A major dilemma confronting contemporary IS researchers is striking a balance between rigour and relevance. One of the more challenging tasks I encountered in conducting this research was choosing the "right" methodology. My criterion for finding the right methodology was based not only on my personal epistemological assumptions, but also on adopting a research strategy that would allow me to gather the information needed and fulfil the outcomes I hoped to achieve.

What sets this case study apart from the previous one is that, at the time the research was conducted, I was employed in a senior management position with ABC Homes, a competitor to Lakeside Homes. As a means of establishing trust and openness between the firms, several off-site meetings were conducted between the Managing Director of Lakeside Homes and myself. The espoused agenda for our meetings was along the lines of:

- What research was needed to improve the current undesirable condition of the Western Australian house-building industry?

- What was the progress on my research?

More often than not, though, we would devote a significant time discussing the similarities of the many issues experienced by both firms. These similarities ranged from technical issues such as:

> *Based on your previous experience, how did you overcome this construction detail?*

To more explorative and explicit issues such as:

> *Have you ever had to deal with a situation where ... ?*
> *Yes, we have actually, and this is how we resolved it.*
>
> *Do you mind if I borrow your approach?*
> *Of course not, why don't we get the relevant people together and see if we can improve the way we did it?*

5.4 Data collected

In addition to the above, a variety of sources were used to collect data from the participating firm. These included ethnographic observation, semi-structured interviews, focus groups a review of the firm's business plans, reports and inter-office memos; and an IS and IT audit of the firm's infrastructure. As was the intent with the previous case study, this detailed and varied source of data was sought to ensure a triangulation of the data.

The bulk of the fieldwork for this study was conducted on-site at Lakeside Homes' head office. Site visits were also carried out to various projects under construction, both unattended and attended by Lakeside staff. Semi-structured interviews were conducted with a broad spectrum of employees (see Table 15), as we aimed to gain a holistic perspective of knowledge management within the firm.

5.4.1 Sources

Table 15: A summary of the data collected

Sources of data		Comments
Action research project	I conducted this research with the Managing Director of Lakeside Homes	In order to gain the trust of the owner and staff and Lakeside Homes prior to conducting the audit and interviews, a community of practice was formed between the firms over an 18 month period
IS and IT Audit		The audit of the firms IS and IT was conducted
Semi- structured interviews	Owner/Manager, Drafting Manager, Estimator	Interviews varied in time from ¾ hr to 1½ hours. A total of 8 interviews were conducted
Focus group	A focus group session was conducted between both owners and managers of ABC Homes and Lakeside Homes	The focus group session allowed the researcher to consolidate the data
Company business plans	1	Segments of Lakeside Homes 2003 business plan were presented to the researcher
E-mail messages between staff	24	i identified more than 24 e-mails that succinctly described the phenomena I was seeking to investigate.

5.4.2 Records

A database was established and maintained of all data collected during this study. Authorised taped interviews and hand-written notes taken by the researcher were transcribed and issued to the participants to confirm interpretation. Furthermore, a diary of events and reflections was maintained during this research.

5.4.3 Analysis

As was the case for the previous chapter, particular attention was paid to ensure the validity of the data and its interpretation within this study. This was achieved by following a thorough chain of evidence (Yin 2003).

For this chapter, the chain of evidence commenced with an enhanced and extended literature review preceding the experience gained from conducting the case study on ABC Homes. Following this phase, I was invited to conduct the remaining elements of the chain of evidence on the premises of Lakeside Homes. These activities involved conducting an audit on the firm's IS and IT infrastructure followed by the semi-structured interviews. The interviews included one-on-one interviews and one focus-

group session between myself and the Managing Directors of ABC Homes and Lakeside Homes. During the transcription and interpretation of the data, I found it necessary to contact the participants and clarify points of interest and comments made in order to further validate my interpretations.

5.5 The participating organisation

Lakeside Homes is a privately owned up-market homebuilder that has been operating in the Western Australian metropolitan market for more than 10 Years. Ownership and directorship of the firm consists of four directors: two working and two non-executive directors. At the time of conducting the interviews, Lakeside Homes were constructing approximately 20 homes ranging in values from $300,000 to $1.5 million, with a similar number in the administrative stage of being prepared for construction. Figure 18 presents an organisational chart of Lakeside Homes.

```
                      ┌─────────────────┐
                      │ Board of Directors │
                      └─────────────────┘
                       /               \
        ┌──────────────────┐    ┌──────────────────┐
        │ Managing Director │    │   Construction    │
        └──────────────────┘    │ Manager (Director) │
                 │               └──────────────────┘
        ┌──────────────────┐              │
        │  Accounts and    │    ┌──────────────────┐
        │   IT Support     │    │   Supervisors    │
        └──────────────────┘    └──────────────────┘
                 │                       │
        ┌──────────────────┐    ┌──────────────────┐
        │   Consultants    │    │    Schedulers    │
        └──────────────────┘    └──────────────────┘
                 │                       │
        ┌──────────────────┐    ┌──────────────────┐
        │    Estimators    │    │  Subcontractors  │
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        ┌──────────────────┐
        │     Drafters     │
        └──────────────────┘
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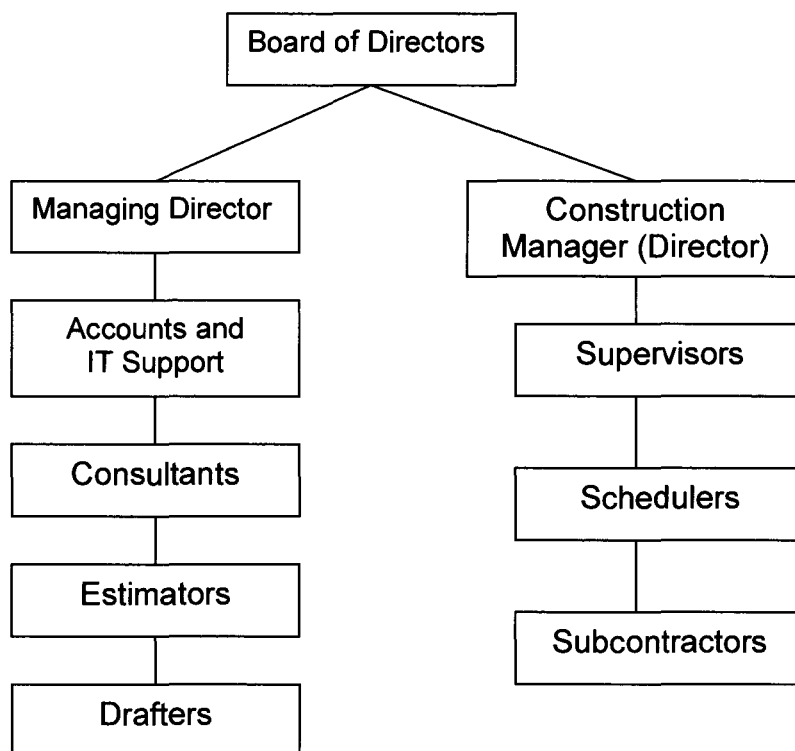
Figure 18:   The organisational chart for Lakeside Homes

Lakeside Homes perceived competitive strengths are based on their unique design of houses and the quality finish achieved on the end product. This differs slightly from ABC Homes, whose key strengths are derived from an ability to produce homes of a similar perceived quality, but on a larger scale, with lower costs and an emphasis on repeat designs.

During my earlier meetings with the Managing Director of Lakeside it came as little surprise that factors, both internal and external, that affected the way the firms operate were quite similar. As such several dominant characteristics of the building industry played a leading role in shaping the firms' knowledge management strategies. Key factors observed at Lakeside Homes that appeared to shape their knowledge management strategies that were also identified in the previous case study were:

- competing in an environment of high uncertainty in terms of market conditions, including the IS and IT environment;

- lacking the resources (human, financial and material) often taken for granted in larger firms;

- having a tendency to make decisions based on short-term problem solving rather than anticipatory innovation; and

- a strong reliance on the owner–manager to shape the organisational culture with respect to IS and IT.

It should also come as little surprise that the above factors are those that affect not only medium-sized building companies operating in Perth, Western Australia, but also the larger and more ubiquitous small-to-medium-enterprise industry segment in general.

Figure 19 shows a pictorial representation of the product built by Lakeside Homes.

Figure 19: A pictorial representation of the product built by Lakeside Homes

5.6 Results

In order to explore how these factors affect the knowledge management strategies at Lakeside Homes, the following sections of this chapter consider the case study of Lakeside Homes through the socio-technical lens of infrastructure, infoculture and infoculture.

5.6.1 Infrastructure

An audit was conducted within the firm to ascertain the physical infrastructure that Lakeside Homes had implemented for enhancing their knowledge management initiatives and objectives. The following audit results are presented in three sections, hardware, software and communication tools.

Hardware

What I first observed about the physical hardware on display at Lakeside Homes was its modern styling: matching flat screens, new PCs, the latest in digital copiers, printers and network tools. This was somewhat of a contrast to ABC Homes, where I got the sense that most of the technology had been put together in a piecemeal way, and upgrading was only carried out as a last resort.

The company's emphasis on keeping up-to-date with the latest technologies was emphasised by the Managing Director who espoused a positive view of new technology:

> *... firms who integrate the right technology into their business will be the ones that grow and survive ... those that don't will fall by the wayside.*

It is common knowledge that having the "right" technology within the firm is a critical source of competitive advantage. However, knowing exactly what that right technology is can be a different story. As shown by this case study, having a positive attitude towards technology does not necessarily result in having the right technology. When questioned directly on what was considered the right technology for the firm, the Managing Director of Lakeside Homes replied:

Yeah, well, I don't know that yet.

Software

There was evidence of the Managing Director's disposition towards information technology displayed in the presence of modern and up-to-date hardware and technologically based tools, but the firm appeared to be less clear on its direction with software and operating systems. The MD noted:

At the moment we have a pretty good team of experienced guys who really know what they are doing. I rely on them to set up their own systems, using mainly Excel spreadsheets and Word documents, but we can't go on like that forever; eventually we will have to install a standard package.

Lakeside Homes operated from a Microsoft Windows network utilising a Microsoft SharePoint server and Cisco routers, connected to the Internet and e-mail gateway. All office staff had access to e-mail, the firm's intranet and limited access to the Internet. In addition to this, the firm owned and ran the latest software in terms of multifunction devices and 3-D computer-aided drafting (CAD) software. However, at the time of the audit, unlike ABC Homes, Lakeside Homes did not support a structured enterprise planning system or project management tool.

Figure 20 presents a conceptual network diagram depicting the network layout of Lakeside Homes.
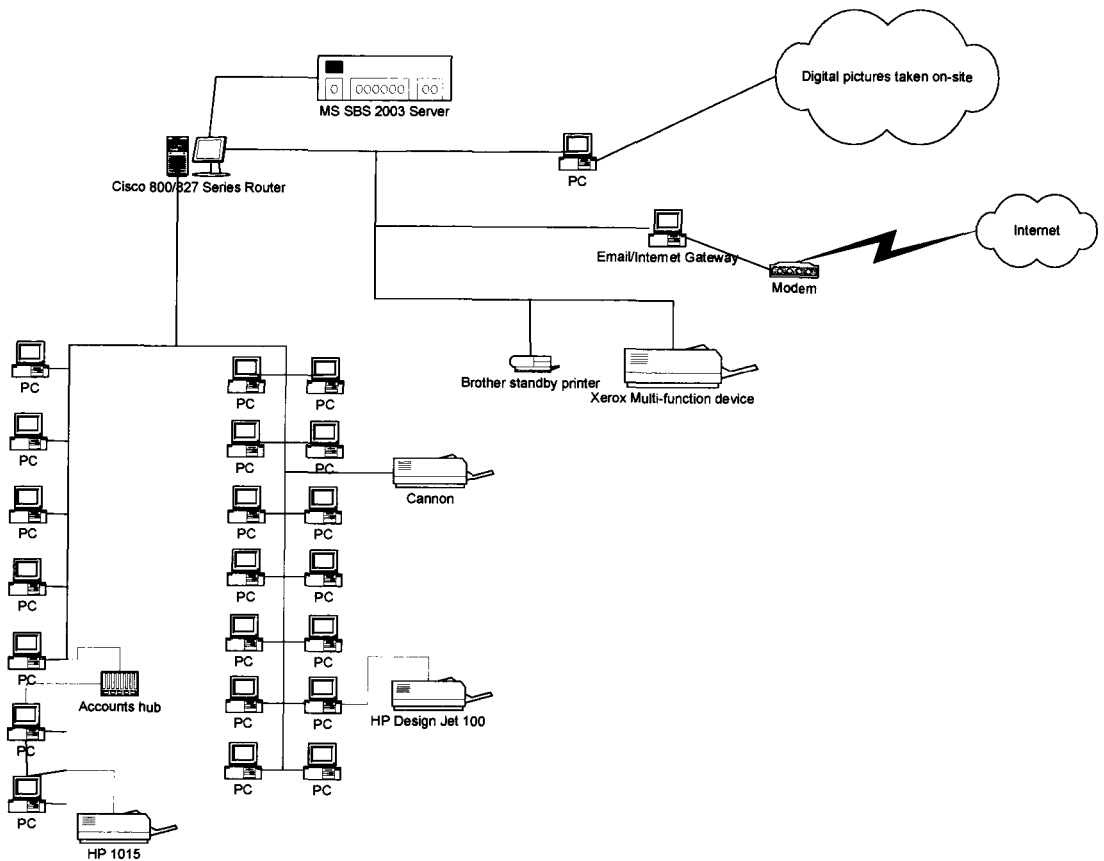
Figure 20:   A network schematic of Lakeside Homes

Communication Tools

The mobile phone proved to be the single most prolific communication tool used to link the office with the site-construction personnel, as was the case for ABC Homes. The reliance and take-up of mobile phone technology has been rapid over the last five to eight years, superseding two-way radios as the main source of site to off-site communication. An on-site supervisor noted:

> *I can't do without my mobile phone these days ... I'd be buggered*
> *without it. Gone are the days when we would have to 'two way' the office*
> *to make our urgent calls during the day then make all our other calls at*
> *night ... it really has streamlined my job.*

In summary I found that the infrastructure and technologically based tools displayed at Lakeside Home were more prevalent and modern that those I observed at ABC Homes.

In order to understand how these tools contribute and interact with the rules, roles and procedures employed at the firm, the following section describes Lakeside Homes' infostructural environment.

5.6.2 Infostructure

The overall building process at Lakeside Homes was divided into three core areas: sales, administration and construction. Unlike the rather prescriptive environment of rules, regulations and procedures exhibited in the previous case study, Lakeside Homes appeared to be at an early stage of development and maturity, albeit being in successful operation for more than a decade.

The lower number of houses under construction may account for Lakeside's ability to operate for so long without a structured project management process, and the higher value and uniqueness of each home may also account for the concentration on implementing better tools for designing individual homes such as 3-D computer aided drafting tools.

The following section investigates these infostructural differences in more detail under the three core activities of sales, administration and construction.

Sales

Due to the individual design requirements for each home built by Lakeside Homes, the use of display homes and prototypes was not viewed as effective as it was with ABC Homes. Instead, Lakeside Homes relied more heavily on new technology, in the form of 3-D modelling as a key sales tool. The 3-D modelling software allowed prospective clients to gain a better perspective of their proposed house rather than rely on detailed working drawings alone. The Managing Director commented:

> *The 3-D modelling has been a great asset for the business. Not only does it allow the owners an opportunity to see their home in living colour and perspective before its built, it can also show-up any potential design flaws that may have been overlooked if we had relied on the traditional black-and-white one-dimensional plan.*

The uniqueness of the design and style of each home sold by Lakeside Homes also meant that were there was no clear demarcation of roles and responsibilities between the sales and administrative function, in contrast to ABC Homes where these distinctions were made very clear.

Administration

Acting as a procedural link between the sale process and the actual construction of the home, the administration function of Lakeside Homes differs only slightly from that of the previous case study. Reasons for this can be narrowed down to the similar statutory requirements for the building of all residential housing in Perth Western Australia. These include the *Western Australian Home Buildings Act 1991*, home owner's warranty insurance, and local shire and council requirements to name a few.

How these regulations affect the firm is described below by the Managing Director.

The Western Australian *Home Building Act 1991*

This Act is governed and policed by the Builders Registration Board of WA (BRB) and its adjunct the Builder's Dispute Tribunal (BDT):

> *Although we try to be innovative with our designs and construction methods, we have to be extremely cautions when trying something new, because, as it has happened to us before, if whatever we are doing doesn't turnout exactly as the owner wants it they can go to the BRB and more often than not if its new and they're not familiar with it they will rule against us ... its just not worth the risk*

Home owner's warranty (HOW) insurance

It is mandatory in Australia for every builder to have an individual insurance policy for each building contract it proposes to commence. The main purpose of HOW insurance is to protect the home owner in the event the builder ceases to operate or fails to complete the works. In March 2001 HIH, which was the largest insurer in Australia providing HOW insurance, collapsed leaving many builders unable to obtain adequate insurance cover. This resulted in substantial delays in obtaining building licenses:

> *Up until a couple of years ago we never had a problem with HOW insurance, but when HIH collapsed the whole thing went crazy. To start with we had trouble getting insurance and this pushed a lot of our jobs back. Then, when we caught-up our new insurer put a cap on the number and value of jobs we could build each year...*

Local shire and council requirements

A major role and responsibility of shires in Western Australia is to provide building services to their rate payers. Some of these functions include conducting building inspections, licensing, certification, enforcement, and planning and development approvals. Guiding the shires in determining the development of residential housing are residential design codes (R-Codes). The R-Codes are set out in a Statement of

Planning Policy under section 5AA of the *Town Planning and Development Act 1928* and were published in the Government Gazette in October 2002:

> *Because of the size of our homes and areas we generally build, you can just imagine the hassles we go through trying to get approval from shires...each one has a different interpretation of how to read the R-Code, and of course add in the typical disgruntled neighbour who, now that his house is finished, doesn't want anymore homes built in his street*

Due to the nature of the value and size of each home built by Lakeside Homes, a greater amount of complexity in each stage of the building process is experienced compared to ABC Homes, where the bulk of their product is repeat design and construct.

This heightened complexity requires a greater amount of attention to detail for each project. This affects the amount of reliance the firm could place on a prescriptive set of rules and procedures. A recent attempt to streamline a process by implementing more prescriptive guidelines failed when it was discovered that the client's attitudes and responses to the change in process were negative. The Managing Director noted:

> *Recently we tried to streamline our pre-start procedures because we felt that too much time was being spent unnecessarily chasing up clients with colour selections and appliance specifications during construction. So what we did was what most builders do and that's have the client select all these before construction commence. We would have all the selections done and there would be no need to follow-up or change sizes mid way through construction. But, what we found was the pre-start was taking twice as long and clients were edgy about selecting a tile colour 12 months before it would be laid. It didn't take long before we realised that the old way suited us better*

The view that the complexity of each project limits procedural structure was found in other areas of the firm also. I discovered that only a limited amount of structure was employed in rules and processes as all projects under the control of the firm were managed and tracked in a semi *ad hoc* fashion using either a Word or Excel. When questioned about the absence of any formal project management tools, I was advised by the Managing Director that:

In the past we have been able to get by without any formal means of tracking our jobs ... I guess our numbers were small enough for everyone to know what was going on without the need for formal "job tracking" procedures and systems.

At first glance, this view differs to the previous case study. The Managing Director of ABC Homes claimed that he initiated their job tracking system to fend-off potential litigation by ensuring tight controls were observed and followed by employees. However, Lakeside Homes wanted to implement a more formal system of managing and tracking of their projects, as the current status of *ad hoc* job tracking was perceived to be a potential weakness by the owners in the firm's ability to grow. The Managing Director commented:

We see that in order for us to maintain our competitiveness in the market we have to grow, but in order to grow we need better tools for managing our job. Me and the other board members see a better job tracking system as being essential for our future and I have made it a priority of mine to have one implemented by the end of the year.

What can be drawn from this comment is that there is a perception held by the managers of Lakeside Homes that there is a relationship between growth in a firm and their ability to maintain control.

Construction

The level of construction work on site that has been outsourced varies little from the previous case study. All but the site supervision and project management functions were performed by subcontractors or specialist companies and trades such as electricians and plumbers.

The degree of complexity involved in constructing a Lakeside designed home affected the efficiency of each supervisor. Lakeside Homes employed three full-time site supervisors with each supervisor being accountable for the management and supervision of approximately eight to 10 homes at any one time. This is in comparison with a supervisor at ABC Homes who could be accountable for up 30 homes at any one time.

Despite the increased complexity in each of Lakeside Homes' product, the firm relied on the same pool of industry resources (both labour and materials) utilised by ABC Homes.

5.6.3 Infoculture

The external influences affecting infoculture at Lakeside Homes follow a similar pattern to the concerns expressed by the managers of ABC Homes. For example, reflecting on the changing environment he was experiencing, the Managing Director of Lakeside Homes commented:

> *Our industry is highly competitive and I guess it always has been. But things are changing ... when I started in this business all you needed was a ticket (Builder's Registration) a little bit of money and a lot of guts. Now days you still need your ticket but you also need a lot more money and a lot more guts ... these days you have to set things up properly ... you just can't rely on good luck and cunning to get you through.*

The emerging changes within the Western Australian house-building industry is making a medium-sized firm like Lakeside Homes feel vulnerable. When reflecting on these changes the Managing Director offered the following comment:

> *Well, the most obvious is where there is a lot of consolidating of market share taking place, essentially a large portion of the market share is shifting towards a small number of the largest builders, this is pushing the smaller firms out of the market, and making people like me very nervous about our future*

These changes have affected the way Lakeside Homes strategise their business. The quotation below from the Managing Director provided insight into the strategic thinking of an owner–manager and his approach to managing in a changing environment:

> *I tend to spend a lot more time focusing on improving our systems and processes ... in the past we could allow each individual to do their work in almost any way they wanted so long as it was done. No longer can we do this ... everything has to be sanitised to ensure we are conforming to industry regulation and we are not exposing ourselves to potential legal action from opportunistic clients*

5.7 The physical presence of Lakeside Homes

At a visible level, Lakeside Homes takes on the appearance of a fashionable and well-resourced firm. This is evident in the office location, which is set among one of the more wealthy suburbs of Perth, and the modern design and architecture of the building. On the inside of the office we find a single floor open-plan layout, furnished in modern

non-pretentious fittings that are colourful, clean and professional. This is somewhat of a contrast with ABC Homes, which displayed more of a traditional hierarchy with their physical layout and a greater conservatism in design and interior layout. The underlying assumptions of Lakeside Homes are less obvious than ABC Homes; however, there is still sufficient evidence of a high regard for personal and family values playing a leading role in shaping the culture of Lakeside Homes.

5.8 Underlying assumptions and espoused views

The board of directors at Lakeside Homes has laid out the foundations of its mode of operation in the form a mission statement. The mission statement set the boundaries and guidelines on the firm's purpose and direction. Some examples of this espoused purpose are presented below:

On the firm's espoused view towards their customers:

> *Our first responsibility is to our customers for whom we work. By meeting their need we ensure the success of the company as a business. In meeting our customer's needs we must do so while operating at a profit.*

On the firm's decision making process:

> *The members believe that ethical principles should support all decisions made in the company. The board undertakes to make careful and considered decisions and to set budgets and broad guidelines for the company to follow. Employees agree to carry out the boards decisions to the best of their ability. Board and employees will always seek professional advice on matter about which they are not fully informed.*

On the firm's employee values:

> *"All employees have the freedom to make mistakes and the obligation to bring them to others attention. All employees are entitled to fair compensation and a clean orderly and safe working environment. The company acknowledges the importance of employees; family and wider social commitments and will take all reasonable steps to provide sufficient flexibility to allow each employee to properly attend to these issues. The company must provide adequate resources to each employee to allow them to properly perform their duties and each employee must provide sufficient time, effort and diligence to their tasks"*

On the firm's social responsibilities:

The company is committed to meeting any and all legal and community obligations. We undertake to act in such a way as to minimise any negative impact from our operations on neighbours and the environment generally. The company accepts that it has obligations to the wider society as well as its customers, staff, subcontractors and suppliers. Subcontractors and suppliers while they work for Lakeside Homes are to be viewed as if they were employees of the company. They should receive respect and support in completing their allotted tasks.

On the firm's competitiveness:

We must never accept that we are operating as well as possible. At all times we will seek to improve the way we carry out our business. We must seek to provide ongoing training and development for all staff. We must seek to keep the business at the forefront of our market sector. We must seek to construct homes of outstanding quality and finish. We must seek to meet our sales and profit targets as laid out by the board.

Lakeside Homes appears to be mindful of the importance of sharing knowledge between individuals. For example, during all the interviews, a constant message was delivered that talked of the importance of communicating and sharing experiences and knowledge. The office layout appeared to accommodate this. I noticed that the atmosphere within the office appeared fresh and modern without pretension. There were a few single offices, but even they had full-length open glass. So nearly all staff could be seen and heard from any desk in the office. This appears to support sharing knowledge as explained to me by the Drafting Manager:

Having our office like this is sort of like having a radio on in the background, there's always something playing and I'm able to tune into the conversations as and when I need; if for example, the estimator is on the phone to a supervisor, I can almost tell by his tone of voice that I need to get involved and generally I do and we sort out the problem straight away.

It was also openly acknowledged that this form of *ad hoc* communication was vital to the firm's success. Below the surface, though, was the perceived concerns of the senior managers and the Board that unless more prescriptive measures of communicating and following laid out procedures were initiated, the firm could be faced with restrictive growth or exposed to litigious clients or non-conforming legislative requirements.

5.9 Discussion

5.9.1 Infrastructure openness

There has been a propensity in the past for the management of Lakeside Homes to concentrate on open and malleable forms of technology, such as off-the-shelf Excel, and Word, further supplemented with 3-D drafting and imaging packages. However, there appears to be a shift in this view whereby future plans and spending are being directed towards more constrained technologies such as a new project tracking system that will focus on explicit documentation and stocks of knowledge.

The main driver for this shift in mindset is management's perception that, in order to grow, greater controls are needed over employees' actions to limit their individualism and to increase conformity. This is a risk-averse strategy but one that was rather obvious in both firms, although both were conscious of the prospect of limiting innovation and change.

5.9.2 Emergence versus strategy

Based on the observations made during this study, it would appear that the dominant approach toward the design and implementation of a knowledge management system at Lakeside Homes was opportunistic and emergent. This was evidenced by the lack of any formal project management system, and the reliance management placed on individual employees to manage their daily logistical needs. However, unlike ABC Homes, the degree of complexity and uniqueness of each house built at Lakeside Homes required substantially more flexibility and individual input.

5.9.3 Tacit and explicit knowledge

Designing, administrating and constructing each house requires a series of routine and non-routine tasks to be performed and understood across a large group of stakeholders within the firm. The impression I received during the audit and interviews was that there was a strong reliance on individuals' expertise and knowledge by management for the effective performance of these routine and non-routine tasks.

In essence, a culture (an infoculture) was established within the firm that supported person-to person sharing of knowledge. This was embedded deeper in the firm's socio-technical subsystem; thus, the rules and procedures (infostructure) performed by staff were flexible, and were controlled by the individuals. So were the technological tools (infrastructure) that facilitated, stored and communicated the firm's tacit and explicit knowledge.

5.9.4 Strategic knowledge

According to Egbu et al. (2002), a formal strategy should be adopted by construction firms to avoid staggered and inefficient use of IT, as failing to do so could lead to ineffective knowledge management. At the time this research was conducted, Lakeside Homes had no formal means of tracking or planning their construction projects. However, as explained by the Managing Director, the key strategic priority for the coming year was the implementation of an information system that could potentially track and maintain the construction schedules of all the projects simultaneously. However, caution was also expressed about the limitations that could jeopardise the firms' flexibility in delivering customer service, should there be a change of policy.

5.9.5 Knowledge stocks and knowledge flows

The absence of any formal means of managing the firm's knowledge has led Lakeside Homes to focus on non-routine outputs; thus, they have personalised their knowledge management strategy by relying on knowledge sharing and person-to person contact (knowledge flows).

This example coincides with recent literature that suggests that organisations present as either aggregations of knowledge stock or knowledge flows (Gray 2001). Lakeside Homes, with its focus on non-routine outputs, exhibits many traits that would have it considered as an aggregation of knowledge flows. This would support the argument presented earlier that firms with routine outputs should pursue a codification knowledge strategy (knowledge stocks), and firms with non-routine outputs are advised to pursue a personalisation knowledge strategy (knowledge flows) (Hansen et al. 1999).

This demonstrates the importance of enhancing tacit knowledge through sharing knowledge in the development of competitive advantage. Moreover, Egbu et al. (2002) asserted, "Technological capabilities should not overshadow the capacity for people to interact".

5.10 Conclusion

What I have observed and presented in this case study is a firm whose current IS and IT environment has been largely influenced by emergent knowledge management initiatives. The outcome of this approach has enhanced the flow of knowledge through the firm using open technologies such as the intranet, digital photos and Excel spreadsheets. However, despite this, management had a strong desire to implement

strategic knowledge management systems that will facilitate the coding and storing of knowledge stocks; and, as a consequence, potentially alter the current knowledge management environment, which was operating openly and flexibly.

Alongside the current knowledge management environment at Lakeside Homes is the influence this study had had on both Lakeside and ABC Homes. The most significant influence has been the forming of a community of practice between the two firms.

The following sections of this chapter present a review of the overarching research approach adopted by this study and an overview of how elements of action research played a major role in elucidating the formation of a community of practice within a Western Australian house-building industry setting.

5.11 Elements of action research within this case study

The overarching methodology adopted for this research was the case study. It was also deemed that an interpretive perspective would be most suitable in allowing this study to investigate contemporary phenomena in a real life setting. However, an unexpected extension to this case study was elements of action research.

The relevance of action research to this case study was experienced in the domain that characterised my social setting. According to Baskerville (1999, p. 7) the ideal domain of the action research method is characterised by a social setting where:

1. The researcher is actively involved, and there is an expected benefit for both researcher and the organisation.

2. The knowledge obtained can be immediately applied. There is not the sense of the detached observer, but that of an active participant wishing to utilise any new knowledge based on explicit, clear conceptual framework.

3. The research is (typically cyclical) process linking.

5.11.1 Action research ideal setting # 1

Active involvement of the researcher with an expectation that both the researcher and firm will benefit.

My active involvement was established through periodical meetings with the Managing Director of Lakeside Homes. These resulted in obtaining rich insights into the workings a medium-sized Western Australian house-building firm. Lakeside

Homes benefited from the experience through expanding their immediate knowledge in factors relevant to their day-to day operation.

5.11.2 Action research ideal setting #2
Knowledge obtained can be immediately utilised.

One of the most significant experiences that resulted in an immediate benefit to Lakeside Homes was the findings of case study 1 (ABC Homes); in particular, the photo system. It was during our first meeting that the Managing Director of Lakeside Homes mentioned the issues involved in building houses in regional areas. When problems on site occurred, a lot of time was wasted in travel, and there seemed to be little in the way of shared learning from their mistakes across the firm.

Having just completed the case study of ABC Homes, with the benefits achieved through the implementation of the photo system fresh in my mind, I suggested Lakeside Homes should also consider implementing a digital photo system, whereby the site supervisor could capture images and e-mail them instantly to the office for further consideration and knowledge sharing. Within days of this meeting I received a call from the Managing Director of Lakeside Homes thanking me for the advice and letting me know that they were having immediate success with the strategy.

5.11.3 Action research ideal setting #3
The research is (typically cyclical) process linking.

Following on from the photo system example given above, I also encountered an example in which the initial knowledge shared with Lakeside Homes was not only absorbed and put to immediate use by the firm, but it was also improved, and this knowledge and expertise was reciprocated. For example, Lakeside Homes deals with many clients who do not reside in Western Australia. As such, communication between the builder and customer can be scarce. A suggestion made by an employee of Lakeside Homes was:

> *If we are getting all this information from site, why don't we send some of it to our customers as well?*

As a result, Lakeside Homes have subsequently implemented a knowledge management strategy that extends beyond the boundaries of the organisation and now includes the customer as part of their knowledge domain.

The next section presents a more detailed reflection of how the Community of Practice formed and its impact on both firms. In addition, I take the opportunity here to expand these reflections to the appropriateness of Communities of Practice to the wider construction industry.

5.12 Reflections on forming a community of practice with ABC Homes and Lakeside Homes

Upon reflection, it was becoming apparent that my research with Lakeside Homes was extending beyond my initial objective of straightforward observation and was facilitating reciprocal knowledge flows. That is to say, during the collection of data I was able to share experiences and knowledge from the perspective of ABC Homes, which contributed to the running of Lakeside Homes. In essence a community of practice was emerging.

As discussed in Chapter 2, communities of practice are often described as groups of people informally bound together by shared expertise and passion for a joint enterprise (Wenger & Snyder 2000). Communities of practices have also been explained as a volunteer group that emerges through work related interests (Brown & Duguid 1991). Wenger et al. (2002) posited that the field of knowledge management has evolved through three distinct waves: technology, culture and communities of practice. Wenger et al. argued that communities of practice proved a "practical way to frame the task of managing knowledge" and thus, developing a true learning organisation.

Lave and Wenger (1991) suggested that human minds develop through social interaction, insofar as people wishing and willing to learn participate in communities of practitioners. Therefore, the mastery of knowledge and skill requires newcomers to move toward full participation in the socio-cultural practices of a community. Thus, communities of practice can be defined as composed groups of individuals united in action (Liedtka 1999).

This case study experienced the development of a community of practice between two competing firms. It found the literature pertaining to *intra*-organisational communities of practice also bore relevance to the establishment and sustainability of *inter*-organisational communities of practice. Three fundamental elements are common for both forms of communities:

1. a domain that defines a set of issues and creates a common ground and a sense of identity;

2. a community of people who care about this domain thus creating the social fabric of leaning; and

3. the shared practice that they are developing to be effective in their domain, which develops a set of common ideas, tools, styles and language that the community share.

An examination of the relationship that emerged between Lakeside Homes and ABC Homes demonstrates that these elements were present. For example:

1. The domain of "construction culture" between the two firms created a well defined common ground, commitment and sense of common identity. An example of this common ground and commitment were identified in areas such as the use of specific construction language in dealing with day-to-day events.

2. There is a strong sense of community within the construction culture of both firms, but each community seems disjunct and isolated, with significant attitudinal differences. This did not constrain the development of overarching communities of practice but rather enhanced interaction and helped to facilitate relationship building that proved critical to the community element.

3. The element of practice was also strong between the two firms. Where the domain element denotes the issues on which the community concentrates, practice denotes a set of skills, know-how, frameworks, ideas, tools, information styles, language, stories and documents that community share (Wenger et al. 2000). Through these mediums, firms were able to explore existing and advancing solutions to issues. The term practice denotes a set of defined ways of doing things in a specific domain as such the practice of the two firms was seen as the glues that connected the community.

So we see that the three elements necessary to successfully cultivate a community of practice were present within the two firms. This opens the way to examine the seven principles for developing a successful community of practice for the wider construction community.

In order to assist the informal and formal groups within construction, there is a need to give them assistance in forming structured, high-performing communities of practice. Wenger's et al's (2002) seven principles for the successful formation and performance

of communities of practice will be used to evaluate the potential of this group to function as a high-performance community. The seven principles are:

1. Design for evolution.

2. Have open dialogue between inside and outside perspectives.

3. Invite different levels of participation.

4. Develop both public and private community spaces.

5. Focus on value.

6. Combine familiarity and excitement.

7. Create a rhythm for the community.

5.12.1 Design for evolution

Communities of practice differ from teams in that they have no formal hierarchy (Hildreth et al. 2000). In construction projects, by the very formality of the contractual relationships, roles and responsibilities are rigidly defined. This mitigates against the development of loose ties where knowledge can flow easily and smoothly, and where learning can take place through "peripheral participation".

In communities of practice, members earn their status through participation. This, in turn, leads to legitimisation (Lave & Wenger 1997). In addition, a team is established when an organisation assigns people to a project that usually has a defined timeline and outcome (Wenger & Snyder 2000; Lesser & Storck 2001). Teams are tightly integrated and driven by deliverables and outputs; whereas, communities of practice are "loose knit" and are driven by value and learning (McDermott 1999).

Figure 21 shows a design for the essential elements of a construction community that will evolve and develop over time.
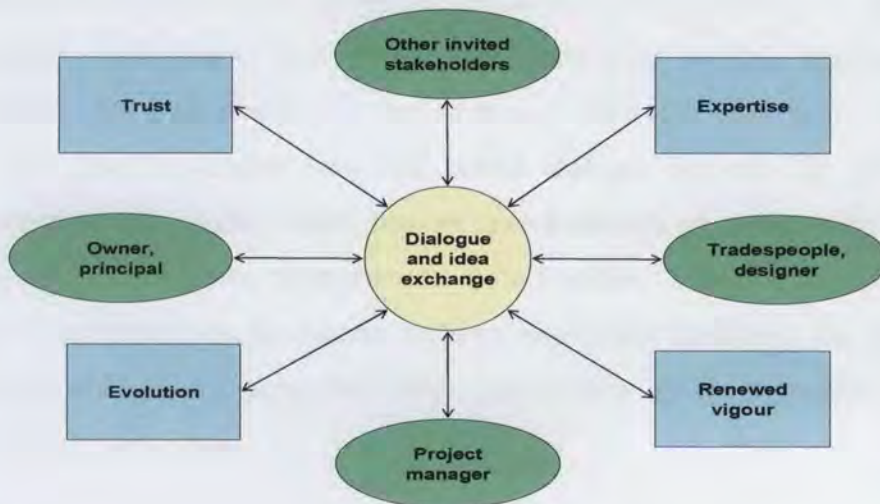
Figure 21:   Designing for construction evolution

In construction, the evolution of loose formations of stakeholders into communities of practice would require a broadening of the perceptions of participants to include a more holistic industry view. Whilst the need to successfully complete projects on time and on budget is still of primary concern, participants should be encouraged to view themselves as part of a wider process of community development through the built environment.

Currently, project knowledge is usually lost as a project team disperses after construction completion. In order to learn from the past, the potential value of knowledge gained in previous projects first needs to be recognised and then methods of capture need to be designed. There are many methods of documenting project lessons, such as post-project reviews and histories, but communities of practice create robust repositories for lessons learned.

5.12.2 Open dialogue between inside and outside perspectives

While good community design requires an insider's perspective, an excellent community design caters for outside input (Wenger et al. 2002). This principle is also supported by Storck and Hill (2000) who suggested a need to encourage interaction to promote openness and allow for serendipity. This can be done by bringing together people from within and outside the organisation who share a common interest, exchange ideas and endeavour to assist each other (McDermott 1999).

The typically adversarial nature of the construction industry would not appear to be a suitable environment for cultivating open and honest dialogue between a cross section of industry participants. However, a significant step toward improving these undesirable characteristics would be addressed once an environment has been established that encourages open and honest dialogue between the stakeholders. Although there are industry bodies that are geared towards the longer-term view, they usually take the particular perspective of their founders. These include the Housing Industry Association and the Master Builders Association (builders), the Chamber of Commerce and Industry (corporate clients), universities and the Consumer Protection Authority (private clients).

Loosely formed communities of practice could integrate the views of these external organisations, bring a more powerful understanding of their expertise and concerns, and enable networks to be built with participants in previous, similar projects.

5.12.3 Invite different levels of participation

The need to ensure different levels of participation and interaction is important. However, this is a more difficult task than it appears on the surface. Wenger et al. (2002) asserted that communities are divided into three groups, with members moving between the groups at different times. The first group is a small core of people who push the agenda and sometimes become the drivers of the community. This group usually comprises 10–15 percent of the members. The second group, comprising an additional 10–15 percent of the membership, are those who actively participate in discussions. The remaining members make up what is known as the peripheral group. These members tend not to participate in discussion. Some of the reasons put forward for their position is a sense of wanting to belong but feeling that their comments are not appropriate or that they carry no authority.

The key according to Wenger et al. (2002) is to design the community so that all members feel like full members. One strategy is to appoint a strong, respected and well connected coordinator to organise and facilitate community interaction and keep peripheral members connected (McDermott 1999; Milstein & Coutts 2003).

Within the context of the construction industry, it is well known that projects require the knowledge and participation of a diverse range of stakeholders, who possess their own unique knowledge, skills and experiences. In order to increase the peripheral

knowledge of construction projects, different levels of stakeholder participation is essential.

For example, it is often the case that designs and blueprints cannot be practically implemented. Experienced tradespersons at the sharp end overcome the deficiencies in conceptual plans and *make things work* or insist on design changes that cause delays and contribute to project time and cost overruns. The realities of construction implementation need to be fed back to planners and designers so they can improve. Communities of practice that transcend the boundaries between white and blue collar would enrich the working knowledge of both.

5.12.4 Develop both public and private community spaces

The importance of developing private as well as the usual public spaces is seen a being a very important aspect in nurturing communities of practice (Wenger et al. 2002). One reason for this is that the personal relationships developed through the private spaces or face-to-face communication sustains the community through the periods of e-communication (Hildreth et al. 2000). In fact, Hildreth et al. suggested that it is only through personal contact and relationships that people will go the extra mile for someone. They also felt that strong personal relationships overcame issues of identity. In other words, "Who am I talking to?" and "Why should I share this information?".

As briefly touched upon above, the construction industry involves a wide range of participants who possess varied backgrounds and perceptions. These factors need to be considered and enhanced in establishing community spaces. Although technology is a key enabler of enhancing communities of practices, the traditional face-to-face communication process cannot and should not be underestimated as a means of establishing sustained trust and commitment within the community.

5.12.5 Focus on value

Focusing on value is the lifeblood of a community (Wenger et al. 2002). This was supported by Alavi and Haley (1999) who found that knowledge management systems need to be explicitly linked to high value. They also maintain that the quality and quantity of knowledge created is the key to long-term success. It was also found that value adding of information in terms of knowledge creation will not result from investment in technology itself, but from additional investment in specific people skills that can make best use of the information assisted by the technology (Pan & Scarbrough 1999).

We can apply this principle to a construction application by reflecting on past projects and history as a measure for value in the future. Knowledge embedded in a community of practice constitutes a form of corporate memory that can be brought to bear upon future problems or work scenarios, short-circuiting difficulties and providing a best-practice approach.

For example, certain locations with particular geological characteristics require greater investigation than would be normally be the case. This knowledge may not be readily available to the project construction firm. Where previous knowledge can be gathered through a community of practice, millions of dollars can be saved by taking the appropriate measures at the design stage, rather than through trial and error in construction. This is particularly true in construction, where the cost of rework is significant, and the contribution of a single piece of information can be the difference between success and failure.

Not all such contributions can be readily quantified, however. One option to assess value in this way is for managers to listen to members' stories. These stories are known in many circles as "war stories". They give members a shared framework for interpretation (Brown & Duguid 2000) and, when considered in the context of the situation, they can help clarify the sometimes complex relationship between knowledge creation and subsequent outcomes (Wenger & Snyder 2000). Communities of practice are the ideal forum for the exchange of such stories.

5.12.6 Combine familiarity and excitement

Wenger et al. describe this as a means of providing a neutral place separate from the every day work pressures of people's jobs. This is a medium where community members can offer advice on a project without getting entangled in it (2002, p. 61).

The litigious and contractually competitive nature of construction projects can be a key inhibiter to open and honest dialogue. Creating an environment outside the confines of specific projects allows for members to express their opinion and espouse their knowledge without fear. Management must consciously provide such opportunities. For a manager to obtain a return on the investment in time and place, longer-term relationships between suppliers and prime contractors are required. This is quite contrary to the usual form of relationships. Many examples exist, though, where suppliers and contractors align themselves over an extended period in order to capitalise on the knowledge gained in past successes. The deliberate encouragement of

communities of practice in this context would bring further benefits and increase the likelihood that lessons emerge to be used in new projects.

5.12.7 Create a rhythm for the community

The rhythm of the community is the strongest indicator of its vitality (Wenger et al. 2002, p. 63). Construction projects are typically one-off experiences where teams are brought together to design, construct and commission construction projects. Typically, the team will disperse immediately after these objectives are completed. This severs the cohesion and knowledge generating rhythm produced during the project's life. To overcome this, it is necessary for members to be bonded together for a greater purpose then the specific project on its own. Regular communication and opportunities to meet need, to be sustained by management to ensure that communities keep a rhythm and do not wither.

5.13 Operating Tools

With the recent explosion in communications technologies and collaborative work systems — such as intranets, the Internet, voice over Internet protocol (VOIP), forums, video-streaming and text chat — the possibilities for supporting sustained communication over geographical boundaries have increased greatly. Whilst the physical location of the members of a community of practice is not central to the definition, the members of communities of practice will generally be distributed and share some of the characteristics of a virtual team. They may also be culturally diverse.

The sustained operation of the community depends on collaborative technology that will facilitate communication, navigation and creation of knowledge (Gongla & Rizzuto 2001). The suitable choice of effective and useable collaboration tools for construction communities is an area requiring further research, although there are many such tools available (Alavi & Tiwana 2002). These tools will have to fit within the infrastructure constraints of the respective agencies where members of the community reside.

The construction industry is known for its reluctance to embrace new technologies. A lack of technical literacy, cost-consciousness and deeply embedded scepticism regarding the cost benefits hinders the deployment of technology. It is, therefore, unlikely that information technologies would, in the first instance, form a substantial component of communities of practice. However, as has been seen in other industries, it is a question of timing. Once technologies become perceived as low-risk commodity

items (such has a telephone might be now), there is likely to be a take-up of communication technologies such as chat rooms, expert forums and live web pages such as the Esprit "Cosmos" (available on-line at www.cordis.lu/esprit/src/27021.htm) project, which researches applications for the mobile or remote worker, collaborative working and the virtual enterprise.

5.14 Discussion

In an age where business has no bounds, communities of practice have a role to play for organisations that have employees in disparate geographic locations (Milstein & Coutts 2003). It is obvious though that a "one size fits all" philosophy is not a proposition for efficient and effective community development. Each community will have unique strengths and will be faced with different challenges (Gongla & Rizzuto 2001).

By isolating the three elements and seven principles recommended to cultivate communities of practice, this research attempts to highlight the relationships that exist between the recommended core elements and principles within a construction environment. Discussing each principle separately assists in explaining and describing specific characteristics and factors relevant to each and hopefully providing a better understanding of the interplay across each of the categories.

The three core elements and seven principles deemed necessary to develop and cultivate a community of practice are applicable to the construction environment. This is especially true where potential community members have a common purpose and perceive themselves to be part of a common network. Considering the number of potential networks that fall within this context, it is unlikely that construction organisations will be able to fund and facilitate the needs of all communities. Accordingly, managers need to be able to determine which communities will have the greatest impact on organisational goals (Lesser & Everest 2001).

The concept of a community of practice, exposes managers to a new management philosophy that can be used to enhance and complement existing management models. The initial framework presented provides a useful methodology that can be helpful in assisting managers operate in a dispersed environment. It also provides a way of spanning organisational and hierarchical boundaries and is, therefore, a powerful solution for harness knowledge.

5.15 Summary

This chapter presented the second case study – Lakeside Homes. The research conducted at Lakeside Homes provided a unique opportunity to observe and document the formation of a Community of Practice with case study one – ABC Homes. Furthermore, this second case study provided additional examples of knowledge management in action which enable thorough comparisons with the first case study. By viewing the knowledge management strategies employed at Lakeside Homes through the lens of Pan and Scarbrough's (1998) socio-technical framework, a greater understanding of both the theoretical and practical obstacles that need illuminating in order to succeed in designing and implementing effective knowledge management practices within the firm.

The following chapter presents an analysis and combined results of the two case studies.

Chapter 6: Analysis

6.1 Chapter aim and layout

Analysing data is at the heart of building a theory from case studies (Eisenhardt 1989). As such, the following chapter is considered the most important section of the study (Perry 1998, p.28). This chapter presents the combined results and analysis of the two case studies, addresses the conclusions about each research question, and presents the framework that was developed as a result of this research. The chapter layout is presented below in Figure 22.
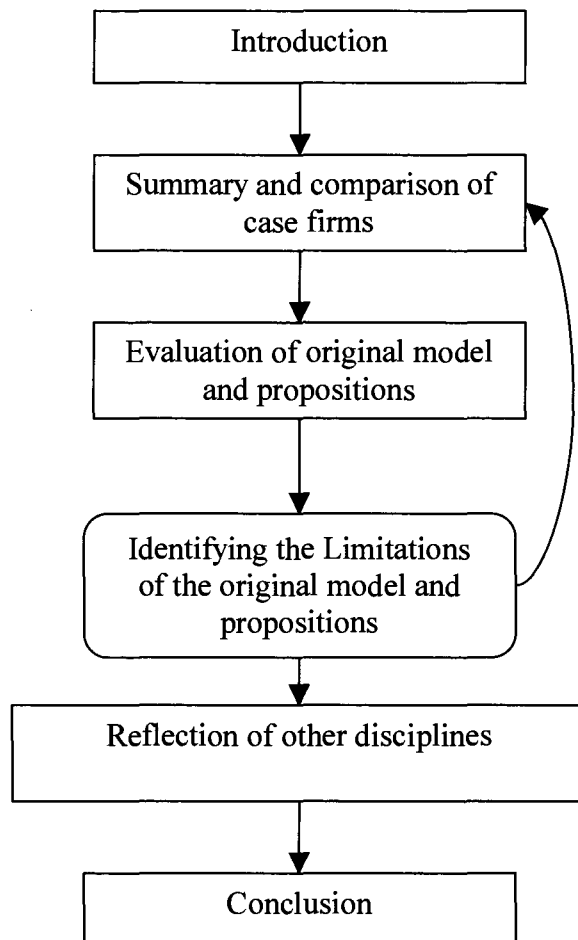
Figure 22:   Chapter 6 layout

6.2 Introduction

The primary aim of this study was to investigate and report on the potential relationship between how a knowledge management initiative arrives within a firm, how the initiative is further implemented and the types of knowledge created as a result.

I posed two research questions in order to increase our understanding of the knowledge management lifecycle within the firm:

1. How does the way in which a knowledge management strategy is approached in a Western Australian house-building firm affect the type of knowledge produced?

2. Does the way in which a knowledge management strategy is approached in a Western Australian house-building firm affect the sustained use and benefits of the knowledge management system within the firm?

There are many knowledge management theories presented in the literature, but we know little about how these theories relate to WA house-building firms. Guiding this study was the original research model and theoretical propositions as presented in Chapter 2. This model was used to form the structure for the initial analysis of the data collected from the two case studies together with a review and analysis of the original theoretical propositions.

The adoption of hermeneutics as a method for analysis meant that this study was not constrained by the rigid and prescriptive nature of testing propositions. Rather, it allowed me to explore alternative explanations and to expand the meaning of the original research model and theoretical propositions. This approach commenced with the introduction of the revised model, which considered the shortcomings of the original model by identifying the greater complexity and influences surrounding knowledge management within the firm than was originally considered.

The case studies of both ABC Homes and Lakeside Homes proved most suitable for this study as they were able to display clear examples of knowledge management in use. From these examples I was in a position to identify, describe and examine the lifecycles of a firm's knowledge management environment.

Having established the groundwork for the chapter, conclusions about each research questions will be addressed. A framework is then presented and discussed. This is followed by a summary of the chapter.

6.3 Summary analysis and comparison of the case firms

Both firms presented in this study were privately owned, medium-sized building companies that competed in the Western Australian residential building industry. A summary of operating comparisons is presented in Table 16.

Table 16: A summary of operating comparisons between Lakeside Homes and ABC Homes

	ABC Homes	Lakeside Homes
Years in operation:	40	10
Ownership:	Owner Manager	Board of Directors
Number of Staff:	40	25
Annual sales revenue:	$30,000,000	$15,000,000
Number of houses built per year:	200	25
Average price of houses:	$150,000	$600,000

6.3.1 Summary and comparison of the firms' infrastructure

Audits were conducted of the firms' physical infrastructure in order to assess their hardware, software and communicational tools. I found that ABC Homes presented a "no frills" policy to their front-end hardware, instead focusing on robust back-end proprietary systems such as their job tracking system. Lakeside Homes, on the other hand, displayed the latest in front-end technology (such as modern flat-screen PCs, 3-D imaging software and mobile technology) but had no structured or integrated project management software.

6.3.2 Summary and comparison of the firms' infostructure

On the surface, the overarching business models and modes of operation of both firms exhibited similarities. This assertion can be explained as both firms operate in an industry that is guided by strict regulatory requirements and source their labour and materials from an industry pool of independent subcontractors and suppliers. However, following the audits and interviews and having the opportunity to look deeper into the firms' infostructure I discovered that differences emerged between the firms in the way

they operated. These, in turn, would be seen to influence their knowledge management processes.

The most obvious of these differences was in the firms' espoused purposes and missions. For example, I found that ABC Homes were focused on low-cost high turnover products and services. As a consequence, management placed a priority on ensuring robust systems were in place to ensure conformity and control of procedures.

Lakeside Homes, on the other hand, relied more heavily on individual expertise to deliver their business strategy of differentiating in a niche market with unique product designs and personalised customer service. This was achieved through empowering their employees to take ownership of their individual areas of expertise.

6.3.3 Summary and comparison of the firms' infoculture

As we move along the continuum from technology to culture on Pan and Scarbrough's (1998) socio-technical model, attempting to draw comparisons and identify differences between the firms becomes more difficult and open to interpretation.

At a visible level, I found ABC Homes portrayed itself as a being a conservative hierarchical firm. This was reflected in its office facilities and professional atmosphere. Lakeside Homes, on the other hand, presented their office and surroundings as being fashionable and well resourced, with staff being encouraged to interact and display their individuality.

6.4 Analysing the original research model and theoretical propositions

According to Yin (2003, p. 109) "the analysis of case study evidence is one of the least developed and most difficult aspects of doing case studies". Yin explains that these difficulties are all too often exacerbated when researchers commence their investigation not knowing how the evidence is to be analysed.

Fortunately I had acknowledged the concerns raised by Yin early in this study and, following an extensive literature review, developed a set of theoretical propositions and research model. The theoretical propositions and research model proved beneficial in providing a basis for shaping my research questions and guiding the direction of data collection and investigation of the case firms.

It is also important to mention at this stage that both the model and the theoretical propositions proved inadequate in explaining the whole story that was eventually uncovered as a result of the case study. Nor did they predict the complexity that I would encounter in my attempt to have a better understanding of knowledge management within the firms. As such, a revised model emerged and is presented and discussed later in this chapter. Notwithstanding this, the model and theoretical propositions provided insights and confirming evidence sufficient to support their inclusion here.

6.5 What did the original model and theoretical propositions confirm?

The original theoretical propositions helped to trigger this study. They also shaped the research questions in such a way that I observed that there appeared to be a relationship between:

- the approach taken by a firm to initiate a knowledge management initiative (strategic or emergent);

- the kinds of knowledge most supported as a consequence of an initiative (tacit or explicit) and,

- the contribution made to the firm as a result of the knowledge management initiative (empowerment or control).

The original research model and theoretical propositions for the study are represented in Figures 23 and 24 respectively.

The Approach	

Strategy	Implementation
Emergent	Evolve from fragmented, incremental and largely intuitive processes
Strategic	Prediction made of the future (a big decision)

Observable influences affecting the strategy and knowledge outcome		

Role of Infostructure	Role of Infoculture	Role of IT Infrastructure
Formalised rules? Formalised roles? Clear definitions of information? Process driven?	Innovative, encouraging trusting Top down?	Value adding? Support tool of perceived value adding activities (i.e. marketing & production) High quality or error prone?

Knowledge outcome	

Knowledge creation	Contribution to organisation
Knowledge flows (tacit knowledge)	Empowerment/ innovation
Knowledge Stocks (Explicit knowledge)	Control

Figure 23:   The original research model

P 1   Strategic → Explicit → Control

Generates   Supports

P 2   Emergent → Tacit → Empowerment
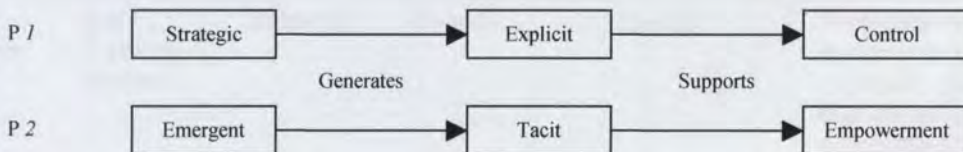
Figure 24:   Original theoretical propositions

In order to investigate these theoretical propositions, I adopted Pan and Scarbrough's (1999) socio-technical model to act as a theoretical lens to view the firms' knowledge management environment thorough the interweaving elements of infrastructure, infostructure and infoculture.

6.5.1 Outcomes observed following the implementation of a strategic KM initiative

The classification of a strategic knowledge management initiative within this study refers to an initiative that has been purposely determined and implemented by a firm That is to say, the firm made a formal decision to implement a knowledge management system rather than allow for a more fluid emergence of strategies. Interestingly, in both cases the decision making process toward a strategic knowledge management initiative was significantly influenced by the owner–manager of the firm who had a predetermined desire to improve operational efficiency and protect the firm against potential litigation through improved technology by controlling the processes and procedures.

As discussed in Chapter 2, Hansen et al. (1999 referred to this particular approach to knowledge management as a codification strategy. Consequently, the strategy centred on technology, as such: "Knowledge is carefully codified and stored in databases, where it can be accessed and used easily by anyone in the company" (p. 106).

Using the examples presented in the case studies, the following section (see also table 17) explores and analyses two examples of a strategic approach:

1. ABC Homes' job tracking systems; and

2. Lakeside Homes' job tracking systems.

Table 17:   Examples of strategic knowledge management initiatives

Case firm	KM Initiative	Approach	Stage of development	Knowledge creation	Espoused contribution to the firm
ABC Homes	Job Tracking System	Strategic	In-use	Explicit	Protection from litigation through improved control and standardised procedures
Lakeside Homes	Job Tacking System	Strategic	Planning	Explicit	Allow for greater control by standardising procedures

ABC Homes' job tracking system had been developed and implemented for some time (approximately 10 years). Lakeside Homes were in the process of developing and implementing a similar system.

The example of ABC Homes shows a clear attempt (through its job tracking system) to design and implement a technologically based tool that would assist with standardising and tracking the crucial procedures. The job tracking system excelled in the collection and storage of existing quantities of data. This allowed management to have access to progress reports, schedules and repositories of historical data (knowledge stocks).

In the second example, the Owner–Manager of Lakeside Homes made several references during the interviews to the importance of structure and control. Furthermore, he also expressed his concerns that, for his firm to grow, both commercially and operationally, he would need to be actively involved in the implementation of a job tracking system, one similar to that of ABC Homes.

Given these examples, it can be concluded that the proposed purpose and use of the initiatives within both firms would lead to similar outcomes. From this it can be interpreted that a significant driver for this tool would be to address his perception that there was an inverse relationship between growth within the firm and his ability to maintain control. That is to say, he expressed the view that as his business grew he and the other Directors of the firm would require a tool that could efficiently and effectively monitor, guide and capture the knowledge of his operations. Thus, a knowledge management tool would be required to better harness knowledge and control the way workers perform their tasks.

P1

| Strategic | → | Explicit | → | Control |

Support   Support

Strategic   =   a top-down management initiative;
Explicit   =   refers to the type of knowledge that is articulated and codified in symbolic form;
Control   =   the prescriptive nature of explicit knowledge allows for a more efficient means of tracking and measuring processes and procedures
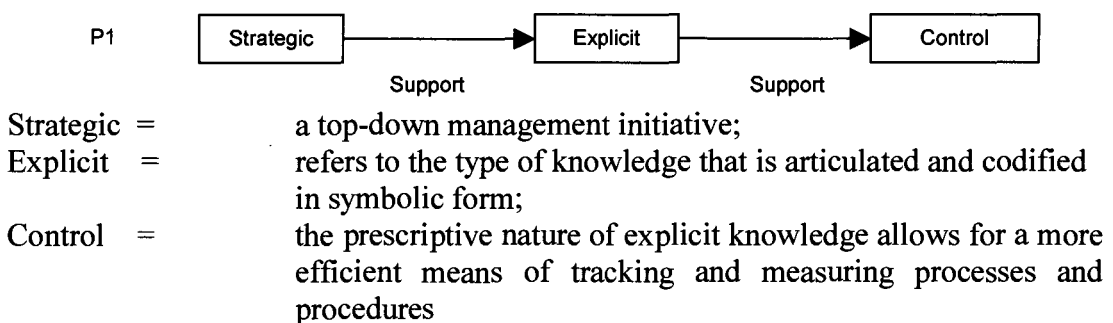
Figure 25:   Theoretical proposition one (P1)

In summary, it can be confirmed that following the analysis of these two examples, a strategic approach towards knowledge management has a propensity to create knowledge stocks and contribute to the firm in a way that enhances control. However, as will be demonstrated later in the chapter, the simple constructs of the model presented below do not adequately explain the whole story.

6.5.2 Outcomes observed following the implementation of emergent knowledge management initiatives

Unlike the strategic approach discussed above, emergent knowledge management initiatives appeared to evolve from relatively short-term decision making and/or socially determined experiences.

I witnessed more examples of knowledge management initiatives in use at both firms that adopted an emergent strategy than a strategically planned and implemented approach. Examples ranged from the ubiquitous usage of e-mail, mobile phones and Excel spreadsheets to unique initiatives such as the photo system and the community of practice. This mirrors the sentiments of Robson (1997), who argued:

> *While most organisations want to develop a more 'strategic' approach to managing IS/IT in the future, they have probably achieved their current situation through what is politely described as various short-term tactics (p. 1).*

Referring to the original theoretical propositions the following knowledge management initiatives will be analysed in more detail:

- the ABC Homes photo system; and

- the Lakeside Homes and ABC Homes community of practice.

Table 18:   Examples of Emergent knowledge management initiatives

Case firm	knowledge management Initiative	Approach	Stage of development	Knowledge creation	Espoused contribution to the firm
ABC Homes	Photo system	Emergent	In use	Flows	Improve a logistics need through access to new technological innovation
Lakeside Homes/ABC Homes	Community of practice	Emergent	In use	Flows	Support innovation and development through peer to peer contact and open sharing of experiences and knowledge

6.5.3 Example 1: the photo system

This first example of an emergent knowledge management initiative can be viewed as an employee (bottom-up) initiative that evolved from a combination of open access to new technology and a desire to improve a logistical need.

Hansen et al. (1999) referred to this particular approach to knowledge management as a personalisation strategy:

> *Knowledge is closely tied to the person who developed it and is shared mainly through direct person-to-person contacts. The chief purpose of computers at such companies is to help people communicate knowledge, not store it (p. 107).*

The bulk of both firms' resources are of an administrative nature; consequently, staff who are charged with the responsibility of designing, drawing, specifying, and liaising with customers rarely get the opportunity to visit sites and witness the construction of the house or the end product upon which they may have had a considerably influence. The photo system exploited new technology to reduce the barriers of time and space though instant and detailed imaging delivered directly to individuals' desktops. This simplification of communicating and the sharing of knowledge also enhanced enthusiasm among employees, which created a deeper sense of ownership and responsibility for the project.

In contrast to the prescriptive and codified nature of the job tracking system, the photo system could be seen as fluid and opportunistic in both its design and use. In summary, the photo system:

- emerged from a combination of staff attempting to fulfil a logistical need and the availability of new technology;

- was being used enthusiastically and was continually enhanced by users;

- facilitated a new form of relationship between different staff members and the object of their efforts (the house);

- enabled communication flows to carry more meaning than was previously possible; and

- was seen as a tool that serviced the needs of a community of practice.

6.5.4 Example 2: community of practice

Wenger and Snyder (2000) described communities of practice as groups of people that are typically bound together by their shared expertise and enthusiasm for a joint enterprise. Such communities rely less on technology than traditional knowledge management systems (data repositories, intranets etc.) and more upon the social and

cultural elements of the participants. This enhances usability, effectiveness and success.

This study identified the emergence of two communities of practice in use. The first was an intra-organisational community of practice that emerged between participating staff at ABC Homes using the photo system. The second was an inter-organisational community of practice that emerged between the two firms. Moreover, these examples confirmed communities of practice as being self-perpetuating in that as they generate knowledge they renew themselves.

It is widely recognised that communities of practice can be a valuable source of knowledge leveraging for organisations (Lesser & Storck 2001), in particular for those that want to emerge as knowledge generating organisations (Wenger & Snyder 2000). These examples identified an almost immediate payback to the participants in the way that new knowledge flowed between the participants. Moreover, the level of openness and trust displayed between the two competing firms runs opposed to the widely held view that this type of behaviour is not sustainable in the adversarial world of building and construction.

In summary, the photo system was introduced at ABC Homes through the availability of new technology in the firm and a desire by staff to fulfil a logistical need. The second example was the formation of a community of practice between Lakeside Homes and ABC Homes. This initiative was influenced more by social interaction than technological availability and access. Both knowledge management initiatives resulted in a predominance of knowledge flows rather than knowledge stocks. Thus, the socio-technical element of infoculture appeared to play a more influential role in this type of knowledge management than the more objective and technically determined infrastructure that was present in the strategically approached initiatives.

When comparing the two distinct approaches to knowledge management strategy as exhibited by ABC Homes, it can be seen that the job tracking initiative emphasised the desire to harness and control knowledge. It commenced with an explicit knowledge management strategy focusing on the organisation's business needs, resulting in knowledge stocks. By comparison, the photo system initiatives evolved and, as a consequence, had a propensity towards supporting knowledge flows.
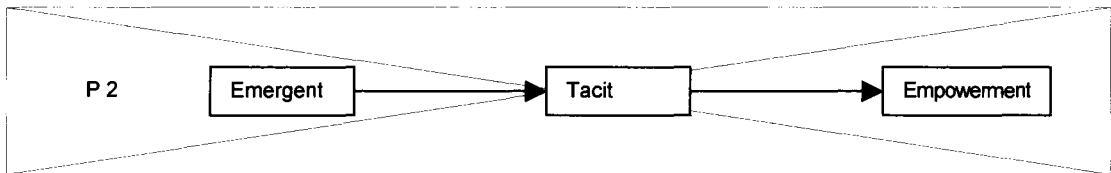
Emergent	=	initiatives that evolve from fragmented, incremental and largely intuitive processes;
Tacit	=	refers to the type of knowledge that is a composite of cognitive and technical components that reside in the human mind, behavior and perceptions;
Empowerment	=	access to technically simple and ubiquitous tools such as e-mail, internet, intranet and digital media enhance employees' ability to enhance their logistical needs.

Figure 26:   Theoretical proposition two (P2)

6.6 Limitations of the model and theoretical propositions

The first section of this analysis is positivist in orientation, but proved beneficial in helping me to establish clear guidelines on collecting my data and establishing a framework for analysis. But this approach, on its own, had shortcomings in the depth of investigation and analysis it allowed. By adopting the hermeneutic method of analysis, I did not rely solely on the transcripts and interviews of the participating firms alone, but took into account the wider environmental, social factors and my own experience and expertises concerning knowledge management within the case firms. Had I not adopted this method of analysis, I'm confident that the findings of this study would not have adequately explained the whole story.

Although sound arguments have been presented in this analysis to support the theoretical propositions I found that when I applied the principles of hermeneutic analysis, I encountered several limitations that required further examination and explanation. In particular, I isolated four elements that affect knowledge management within the firm outside those presented in the original model and theoretical propositions. The four elements of particular interest are:

1. the influence of environmental factors;

2. the influence of the firm's purpose and mission;

3. the alignment of the firm's socio-technical subsystems;

4. the cyclical nature of knowledge management. It was difficult to say where the initiative started and stops — if it did stop at all.

6.6.1 The influence of environmental factors

Both firms investigated for this study compete in the Western Australian house building industry. Within this industry, building firms, not unlike most organisations, need to constantly assess their strategy in order to maintain competitive and profitable in a market that is experiencing:

- increasing competition;

- an increasingly litigious environment;

- tight regulatory requirements; and

- changing disposition of employees.

Increasing competition

Managers of building firms are operating in a market where increased competition is placing a greater strain on profitability than previously experienced. This, combined with a well educated customer who demands transparency of products and their costs, means builders are having to work extra hard just to stay competitive.

Increasingly litigious environment

Managers and owners of building firms are also contending with a growing trend of having to defend their firms from a customer base that takes a keen interest in most aspects of their operation and are only too willing to resort to legal action if they are not totally satisfied with the process and product produced by the firm.

Tight regulatory requirements

The Housing Industry Association of Australia contends that its members operate in an industry that is the most regulated in the country (HIA 2001). In Western Australia, it is the *Home Building Contracts Act* that sets out the prescriptive guidelines for how builders operating in this region are to conduct their business. Other regulatory requirements exist, such as the Building Code of Australia; local shire planning and building regulations; environmental statues; and occupational health, safety and welfare to name but a few.

Changing profiles, preferences and predisposition of employees

According to Hall (2003, p. 1), new worker profiles are creating a "war for talent" as employers strive to attract and retain highly skilled, talented and in-demand employees. High demand employees, according to the author tend to be:

- more mobile;

- orientated to the acquisition of portable and marketable skill and competencies;

- more demanding of roles that are strategic within the firm;

- involved in decision making; and

- predisposed to engage in continuous learning

Each of the case study firms displayed a different organisational structure and disposition towards their employees that influenced their knowledge management strategies and practices in different ways. ABC Homes, for example, presented as a traditional and conservative firm, with a hierarchical structure. Employees' work was designed and monitored by management and with robust procedures. Lakeside Homes, on the other hand, displayed an open and flat structure that relied on individual expertise and creativity as a competitive strength. However, Lakeside Homes management were becoming concerned about their reliance on individuals and loose controls in a highly regulated and litigious market.

What can be drawn from this is that the Western Australian house-building environment is not only complex, but also demonstrates contradictions for managers to consider when designing and implementing knowledge management tools. For example, evidence presented in the case studies showed that both firms are grappling to contend with these conflicting conditions in different ways. For example, ABC Homes established a robust job tracking system that ensured conformity, but found staff did not embrace it. Lakeside Homes exploited their competitive strengths of being innovative and customer driven by employing highly skilled and creative employees where little control was exercised. Management was concerned about losing too much control and could foresee a time where tighter systems and controls would be needed in order to avoid litigation or non-compliance of regulatory demands.

6.6.2 The influence of the firm's purpose and mission

This stage of the analysis considers each firm's mission and purpose, its influence on knowledge management and how the original model and theoretical propositions were limited in taking this factor into account.

Research into the field in knowledge management conducted by Zack (1999) highlighted the role strategy plays in shaping a firm's knowledge management initiatives. "The most important context for guiding knowledge management is the firm's strategy" (p. 125).

The motivating force for this proposition, according to the author, is how the firm's strategic context assists in the identification of knowledge management initiatives. This is because the strategic context:

1. supports the firm's purpose or mission;

2. strengthens the firm's competitive position; and

3. creates shareholder value.

These sentiments are also echoed by Hansen et al. (1999) who argued:

> *A company's knowledge management strategy should reflect its competitive strategy: How it creates value for customers, how that value supports an economic model, and how the company's people deliver on the value and the economic (p. 108).*

Evidence of either firm conducting a formal strategic process for their business purpose or mission was limited. I did find, however, that management of both firms relied heavily on intuition and opportunity in shaping their knowledge management system approach. Table 19 below compares the strategic context of both case firms.

Table 19: Comparing the firms' strategic contexts

	ABC Homes	Lakeside Homes
Competitive strategy	Low cost	Niche
How does this strategy create value for its customers?	A no frills value for money house	Unique design and personalised service
How this strategy supports the firm's economic model?	Low margin high turnover-routine	High margin low turnover-non-routine
How do the people deliver the value?	Follow tight scripted procedures that are closely monitored	Employees are empowered to use their imagination and initiative in designing and building the home
Influence on Infrastructure	Robust and prescriptive project management tools	Access to the latest in front end 'sexy' technology
Influence on Infostructure	Closely monitored and controlled systems and procedures	Ad-hoc systems and procedures, rely heavily on individual expertise
Influence on Infoculture	A hierarchical structure that is risk averse	A flat structure that is customer focused

6.6.3 The alignment of the firms' socio-technical subsystems

What was beginning to emerge from the data was the importance of aligning the firms' socio-technical subsystems with the proposed knowledge management initiatives. I observed that in situations where there was symmetry between the knowledge management initiative and the firms' socio-technical subsystems there was a better chance of success and sustained use of the initiatives. Alternatively, where there was misalignment, one could assume that a change in management culture would be needed in order to maximise the benefits of the initiative. An example of such misalignment might involve implementing a knowledge management initiative that relies heavily on sharing knowledge and experiences in a firm where management is autocratic and focused on control and efficiency.

6.7 Knowledge management initiatives presented in the case studies

Below are five examples of knowledge management initiatives that were presented in the case studies. These examples are analysed from the perspective of the firms' socio-technical subsystems. The first two examples identify outcomes of knowledge management initiatives where there is little alignment. The remaining three examples analyse outcomes of knowledge management initiatives where the firms' socio-technical subsystems did align.

6.7.1 Example 1: ABC Homes' job tracking system

Table 20 provides a summary of the analysis of the first example of a knowledge management initiative where there was a misalignment between the initiative and the firm's socio-technical subsystem.

Table 20:   Socio-technical alignment versus misalignment: example 1

Case Firm	Example	Purpose of initiative	Results
ABC Homes	Job tracking system	A main feature of the system was considered a failure by management and staff	Technology did not meet users expectations; Procedures were not in place which was in contrast to a firm that relied heavily on prescriptive rules and regulations, Culture of control made staff feel uneasy about sharing knowledge

An integral component of the job tracking system was the note-taking function. This function was designed to allow employees to input notes and comments into the database. It was anticipated that this would:

- Add meaning to the data and reports generated from the system.

- Deter staff from using and relying on *ad hoc* message and note taking.

- Information collected and stored in the repository would serve as back-up evidence in case of future litigation.

The notes function on the job tracking system was considered a failure by management and staff.

Infrastructure: The technology was purely textual (MS-DOS) based, difficult to access and cumbersome.

Infostructure: The technology did not match the workflow, and there were no established rules or explicit expectations on who should use the function or when.

Infoculture: Staff felt uneasy about the job tracking system and its purpose. As a result, information entered into the notes function was typically very succinct and banal.

6.7.2 Example 2: Lakeside Homes' customer service policy change

Table 21 provides a summary of the analysis of the second example of a misalignment between a knowledge management initiative and the firm's socio-technical subsystem.

Table 21: Socio-technical alignment versus misalignment: example 2

Case Firm	Example	Purpose of initiative	Results
Lakeside Homes	Change in customer service policy	Improve efficiency by initiating a standard industry practice of collecting knowledge stocks from customer before commencement of construction	This process change was made in isolation to the firm's overall mission and purpose; Management failed to take into account the culture within the firm that the customer comes first. This policy change was seen by staff as compromising their ability to deliver the service they felt appropriate

A standard industry process in building a home is referred to as pre-start or colour selection. This is the process that allows the owner to choose and select items such as wall and floor tiles, colour schemes, appliances etc. For many building firms, it is standard practice that the owner finalises these selections prior to the final set of plans being drawn, this ensures there are no conflicts between the owner supplied items and the construction details. Accuracy of this process prior to the commencement of construction can also minimise any potential delays during construction.

The established process at Lakeside Homes was to allow customers to hold off on making these selections until the construction of the house had progressed to a point closer to when the items were needed. Management were becoming concerned that the process of allowing the owner to delay their selection making was causing unnecessary delays in construction and fragmenting the flow of information from design, administration and production. A change of policy was introduced that would see the selection process being mandatory prior to construction commencement.

Not long after the change of policy, management agreed to revert to their existing process as a result of:

- Complaints were received from staff that the new policy was not in the best interest of the customer.

- Greater delays were experienced in the commencement of the projects.

- The distribution of the information was not perceived to have improved.

Infrastructure: Technology was a small player in this initiative, and no adjustments to existing technology were made to enhance the change.

Infostructure: The process change was made in isolation to the overall building process employed by the firm.

Infoculture: There was a strong sense of customer loyalty held by the employees. This change appear to erode this perception.

6.7.3 Example 3: ABC Homes' photo system

Table 22 provides a summary of the analysis of the third example of a knowledge management initiative. Unlike the previous two examples, this example is represents an outcome where there was alignment between the initiative and the firm's socio-technical subsystem.

Table 22:   Socio-technical alignment versus misalignment: example 3

Case Firm	Example	Purpose of initiative	Results
ABC Homes	Photo system	An emergent knowledge management that evolved from a combination of access to new technology and a desire to fulfil a logistical need	Staff took advantage of new technology that was widely accessible and easy to use; Existing rules and procedures were not compromised, rather, they were enhanced; Management felt that the benefits of the initiative outweighed their desire for control and subsequently supported the initiative

The photo system was first introduced at ABC Home by employees (bottom-up) and evolved from the combination of open access to new technology and a desire to improve a logistical need. The photo system was seen as a success for the following reasons:

- It was being used enthusiastically and continually enhanced by the users.

- The relationship between different staff members and the object of their efforts (the house) had been personalised.

- The flow of knowledge carried more meaning than was previously possible.

- It was seen as a tool that serviced the needs of a community of practice, as the experiences of the initiative were reciprocated between the two case firms.

Infrastructure: The availability of new, relatively inexpensive and easy-to-use technologies in the form of digital imaging, intranets and e-mail were exploited.

Infostructure: The existing rules and procedures of the firm were not compromised, but enhanced with better knowledge and understanding.

Infoculture: Management eased their dominance as the main source of knowledge between the different functions.

6.7.4   Example 4: ABC Homes and Lakeside Homes in a community of practice

Table 23 provides a summary of the analysis of the fourth example of a knowledge management initiative.

Table 23: Socio-technical alignment versus misalignment: example 4

Case Firm	Example	Purpose of initiative	Results
ABC Homes and Lakeside Homes	Community of practice	Participation of this study; Enhance the effectiveness of both firms through increased knowledge	Technology enhanced communication through e-mail and mobile phones Existing processes were enhanced with increased knowledge Culture changed from one of hoarding knowledge to one of sharing knowledge

The community of practice between ABC Homes and Lakeside Homes emerged as a direct consequence of this study. To recap what was discussed previously, a potential dilemma I faced when establishing my methodology for this study was obtaining open access to more than one building firm. This point was also raised as a concern by the ethics committee during the thesis proposal.

With this in mind, I had chosen to meet in neutral territory (a café). With the permission of the Managing Director of ABC Homes, I shared knowledge and experiences from our firm that I felt would be of interest to Lakeside Homes. After several meetings the level of detail and discussion grew as follows:

- Meeting outcomes were beneficial to both the study and the firms.

- The community of practice expanded to include employees of each firm.

- There was an implied understanding that respected the privacy of each firm's commercial and client interests.

Infrastructure: Technology played the role of communication facilitator. For example, mobile phones, e-mail etc.

Infostructure: This was similar to that of the photo systems example, in that the rules and procedures of each firm were not compromised but enhanced through broader knowledge and shared experiences;

Infoculture: The culture of the two firms changed as a result of the community of practice. Previously there was an espoused view within the firms that their knowledge was a critical source of competitive advantage and, as such, should be closely guarded from competitors. What emerged

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from this experience was that neither firm was disadvantaged from sharing knowledge. Rather, both firms benefited and strengthened their competitive standing.

6.7.5 Example 5: ABC Homes: Intervention by the researcher to the job tracking system

Table 24 provides a summary of the analysis of the fifth example of a knowledge management initiative.

Table 24:   Socio-technical alignment versus misalignment: example 5

Case Firm	Example	Purpose of initiative	Results
ABC Homes	Intervention by researcher to the Job Tracking System	Capture and store events and notes of interest that combined with the prescriptive reports generated by the tool would add more meaning to each project	Technology that was previously considered 'cumbersome' was changed to MS Windows;
			Staff and management agreed that there were certain stages within a project where note entries would be most beneficial;
			A change in culture was necessary, in which staff were not intimidated (perceived or otherwise) by the use and purpose of the tool.

As was indicated in the first example, the job tracking system was not considered a successful knowledge management tool by management or staff of ABC Homes. In particular, it was found that the note-taking function was being under utilised and not considered useful by staff or management.

Infrastructure: Upgraded to Windows-based software. This made access and usability more simple and user friendly.

Infostructure: Staff determined that comments were more critical at particular stages of the building process than at other stages. As such, the firm modified its current procedure to include automatic updates of projects.

Infoculture: Data generated from the note-taking function of the original job tracking system were not made available to all employees. This created a climate of uncertainly as to the use of the notes and comments made. In the revised system, access was given to all employees. Participation in the early stages was minimal. However, as

management began to champion the tool through active participation and sharing of knowledge, staff no longer felt the tool was simply another method of control but a sound contributor to their day-to-day logistical needs.

In summary, these five examples showed that successful knowledge management does not operate in isolation from any part or function of the firm. Rather, it must be considered from a systems perspective if the full potential of the initiative is to be realised.

6.8 Analysing the data through the socio-technical lens of infrastructure, infostructure and infoculture.

As discussed in Chapter 3, Pan et al. (1999) argued that knowledge management activities within a firm can be seen as a series of multi-layered systems that have a loose association with technological, informational and social elements, each of which interact over time to determine their practical outcomes. The following sections of this chapter address those influences through the socio-technical lens of infrastructure, infostructure and infoculture.

6.8.1 The role of infrastructure in mediating the influence of strategy upon knowledge outcomes

This section of analysis commences with infrastructure, as opposed to the other more subjective and tacit socio-technical sub-systems, because technology has been dominant in much of the literature and the focus to date of knowledge management. Swan et al. (1999) clamed that "IS/IT was the focus of nearly 70 per cent of all KM articles in 1998". Furthermore, the authors went on to say "people do feature but only in as much as they need to be willing and able to use KM tools" (p. 265).

Nevertheless, technology does play a critical role in managing knowledge by virtue of its ability to act as a key enabler of knowledge management. From the data collected in the two case studies, it was seen that a range of IS and IT tools were adopted and in use. This allowed both firms to collect, store and disseminate their knowledge. Strategies adopted by both firms in adopting these tools ranged from quite prescriptive approaches to opportunist emergent strategies as can be seen in Table 25.

Table 25:   Combined observations made on the role of infrastructure in
influencing the strategy and knowledge outcome within the firms

	Job tracking systems	Photo system	Community of practice
Observed technological enablers	Data base, purpose designed software, desktop computers, intranet	Digital camera, e-mail, MS Word, intranet	Phone, e-mail
Observed strategy when adopting technology	Strategic-prediction made of the future	Emergent-opportunistically Evolved and fragmented	Emergent-opportunistically Evolved and largely intuitive
Observed knowledge outcome	Knowledge Stocks, control with an emphasis on explicit knowledge	Knowledge flows, with an emphasis on tacit knowledge	Knowledge flows, with an emphasis on tacit knowledge
Relationship between technology type and knowledge management initiative	Ability to codify, collect, store, and disseminate structured data and support programmed rules	Ability to personalise knowledge through ubiquitous and mobile tools that require little prescription and programming	Enhance the social experience through rich interactive media available as the user wants it!

The clearest observation that can be drawn from the above is that, within the two firms, technology plays a dominant role in generating knowledge stocks. It does this through its ability to capture and store data and information, thus building expansive knowledge repositories well beyond the capabilities of human memory or comprehension. Knowledge flows and tacit knowledge on the other hand, by the nature of their subjectivity, rely less on technology and more on human interaction. Notwithstanding this, recent developments in technology such as the World Wide Web, digital imaging and e-mail have reduced the rigidity of technological interaction. This has made the tools somewhat ubiquitous, allowing all levels of staff access to new ways of conducting their work and communicating.

During the investigation of both firms, it became apparent that technology played an increasingly important role within the firms. This observation was supported by both owner–managers. For example, as was seen earlier in the case study of ABC Homes the owner–manager espoused his concerns regarding his reliance on the job tracking system. It was critical in controlling how work was performed and in protecting the firm against potential litigation. In the case of Lakeside Homes, the owner–manager held the perception that, in order to grow, a greater emphasis should be placed on

technology and its ability to control and store knowledge, rather than supporting and nurturing individuals and collective knowledge flows.

> *Great claims are made, then, in the literature for the use of sophisticated IT-based tools (such as intranets, e-mail, groupware, data warehousing) for knowledge capture, storage and sharing. However, these typically overestimate the utility of new IT for delivering organizational performance improvements (Swan et al. 1999, p. 265).*

From this point my focus shifts from the more objective and technically determined characterises of knowledge management to a subjective and tacit view that is influenced more by managerial and social environments than by technical tools.

6.8.2 The role of infostructure in mediating the influence of strategy upon knowledge outcomes

As discussed in Chapter 2, much of the recent literature on knowledge management presented organisations as aggregations of knowledge stocks and knowledge flows (Gray 2001). Expanding this view, the literature (Gray 2000, 2001; Hansen et al. 1999) also makes the claim that firms with routine outputs are best advised to pursue a codification knowledge strategy; that is, one that focuses on building repositories and thus emphasising technology and knowledge stocks.

Alternatively, organisations with non-routine outputs should pursue a personalised knowledge strategy and person-to-person contact thus emphasising human interaction and knowledge flows. But, as seen in this study, firms rely heavily on both routine and non-routine outputs. Therefore undesirable outcomes could be expected if balance (i.e. linking routine and non-routine outputs) is not considered within the framework of the firm's knowledge management strategy.

To put this into perspective, both firms operated in an environment that required both routine and non-routine outputs. We can see by the demands of regulation and the need for staff to confirm to these formalised rules and roles that a distinct desire to focus on routine outputs is desirable for both firms in order to conform and to mitigate their exposure to litigious clients and regulators. At the same time, management were faced with dealing with an environment in which staff and clients were becoming more knowledgeable and were demanding greater input and influence on the building process. Ignoring this situation was not an option for either firm as competition demanded they keep pace by offering more flexible and open systems. This resulted in non-routine outputs.

Much has been written about the undesirable ways in which the building and construction industry operates. It is an industry that has been characterised as a one-of-a-kind production (Wilson, Jackson & Hughes 2005). Because of the individuality of each project, attempts to standardise work methods and procedures are made difficult. The case firms provided examples of how knowledge management needs to be integrated into the mission, purpose and practices of the firms. For example, ABC Homes is clear on its intent to standardise its work through the implementation of robust knowledge management tools like their job tracking system. In contrast, Lakeside Homes' purpose and mission is focused on differentiating their products and service. This may account for their reluctance to date to formalise and be overly prescriptive with their knowledge management tools.

6.8.3 The role of infoculture in mediating the influence of strategy upon knowledge outcomes

As discussed previously, organisational culture played a critical role in shaping the knowledge management environment for both firms. According to Janz and Prasarnphanich (2003, in Alavi et al. 2006):

> *Organizational culture is believed to be the most significant input to effective KM and organizational learning in that corporate culture determines values, beliefs, and work systems that could encourage or impede knowledge creation and sharing (p. 192).*

Equally significant was the role played by the owner–managers of each case firm in shaping the firms' knowledge management environment. This, in turn, had the tendency to support a hierarchical atmosphere, whereby top down or vertical silos were created with the firms' knowledge flows. However, it was also discovered that when staff gained access to new technologies (e.g. digital mobile imaging and the intranet) this allowed the facilitation of more open knowledge flows. However, the sustainability of such initiatives remains questionable. To embed them within the firms' daily practice and procedures would still require the acceptance of the owner–manager.

These observations are inline with the literature. This considers firms of a similar size and structure to the case firms (in particular small-to-medium enterprises), where it is seen that these firms possess unique psycho-sociological characteristics (Fink 1998; Swartz et al. 1997).

6.9 Observed 'knowledge' outcomes as a result of the knowledge management initiatives

This study observed that firms adopt knowledge management strategies that, at the extremes, can be viewed as sitting along a continuum from emergent to strategic. Both approaches were viewed as providing differing levels of competitive advantage to the firm.

The job tracking system was considered a success in the way it contributed to improving ABC Homes' procedural and operational efficiency via the tool's ability to increase the use and distribution of codified knowledge in the form of knowledge stocks.

The photo system and communities of practice, on the other hand, placed a greater emphasis on improving the firm's tacit knowledge or know-how by allowing participants to share their knowledge through mutual interactions (knowledge flows). According to Shulze and Jobe (2001, in Keskin 2005):

> *Firms using this strategy protect themselves against being imitated by their rivals through keeping their strategic knowledge such as 'know-how' in tacit form (p. 170).*

In summary, both approaches toward knowledge management (strategic and emergent) make positive contributions to the sustainable competitive advantage. But it must be understood that a strategic approach will typically enhance a firm's explicit knowledge whereeases that emergent approach excels in enhancing the firm's tacit knowledge. What is also becoming clearer from this study is both firms' knowledge management environment evolved through a series of knowledge epochs. The following section presents a summary discussion on the evolution of both firms knowledge management evolution.

6.10 Knowledge management as an evolution not revolution

It can be seen from the case studies and the analysis that the knowledge management environment in both firms has evolved through a series of knowledge epochs. For clarity I have chosen to categorise these epochs into five headings: start-up, transition, professionalism, knowledge management and the future. Brief explanations of each of these heading are presented below:

1. Start-up takes a snap shot of the firm's knowledge management environment at the start of trading. The difference between both firms was most noticeable during this epoch. This could be explained by the different era in which each firm began trading and the subsequent views of technology held by the owner–managers (infoculture).

2. Transition for both firms was mostly influenced by external forces. In particular, increased regulation, increased competition and the increasingly litigious nature of customers.

3. Professionalism emerged from the transition epoch, with both firms identifying the need for improved business processes (infostructure) in an effort to remain competitive.

4. Knowledge management is the central theme of this study. The results of the case studies confirm that firms operating in the Western Australian house-building industry require unique consideration with the adoption and implementation of their knowledge management system.

5. The future is impossible to predict. However, by having a better understanding of how knowledge management is influenced within the local industry, firms that make use of this knowledge will be better placed to exploit opportunities for sustainable competitive advantage.

Figures 27 and 28 present a summary of both firms' knowledge management evolution.

ABC Home's knowledge management evolution

	Start-up	Transition	Professionalism	Knowledge Management	Future
Infoculture	Early stages of developing a cultural direction of the firm-based on owner/manager lived experiences and ideology	Technology is viewed as a necessary cost to the business and is reluctantly embraced by the owner/manager	Management view technology as a necessary business expense to improve control. However, staff initiate a change in the firms' attitude towards technology	Management and staff view technology as a capable 'facilitator' of both tacit and explicit knowledge	Culture of sharing knowledge is enhanced throughout the firm (intra and inter). Management lead by example
Infostructure	Ad-hoc processes and systems begin to take shape from observation and experience-Tacit knowledge is emphsised	As the firm and industry grows, business processes become more complex and the need for more prescription in processes is acknowledge as-is the need to harness and store explicit knowledge	Processes tightened but staff become dissatisfied with the job tracking system and create individual systems and processes in order to personalize their logistical needs	Systems modified and enhanced to deal with both routine and non-routine processes/procedures (tacit and explicit knowledge). However, key knowledge sharing initiatives are still ad-hoc	A strategic approach to managing knowledge is adopted (allowing explicit and emergent strategies to co-exist and interact) with appropriate initiatives being incorporated into the business processes
Infrastructure	Technology is not seen as adding competitive advantage-success is based on individual know-how, communiactions are limited to two-way radio, facsimile and telephone	Job tracking system designed and implemented which operates alongside limited accounts package, basic telecommunication tools and CAD	Proprietary job tracking system and ERP tools operate alongside ad-hoc staff initiated software and tools ie: MS Word and MS Excel	Job tracking system upgraded to incorporate generic software to allow planned individualization and mutual meaning. WWW, Intranet, digital mobile imaging being exploited by both management and staff	Core IS/IT is continually reviewed and upgraded Flexibility is given to try new technology as and when it becomes available
	The WAHBI is predominantly a stable 'cottage industry' espousing little business professionalism	Market fluctuations, adversarial customers and increased competition have a negative impact on profitability	Industry experiences greater consolidation as un-professional and un-profitable firms fail	Industry consolidation increases which add additional pressure to profitability and sustainability of traditional smaller firms	Firm is well positioned to exploit the opportunities presented in an emerging knowledge economy
External events	Regulators concerns about lack of industry professionalism and increase surveillance and prosecutions for un-professional practices	Industry becomes prone to cyclical economic conditions leading to a 'boom-to-bust' lifecycle	Industry acknowledges concerns about its ageing workforce and inability to attract suitable younger participants to the industry	Impact of the emerging knowledge economy take effect, ie: knowledge workers, changing social attitudes etc...	

1964-2000	Focus of study 2001-2005

Figure 27: ABC Home's knowledge management evolution

Lakeside Home's knowledge management evolution

	Start-up	Transition	Professionalism	Knowledge Management	Future
Infoculture	Early stages of developing a cultural direction of the firm-based on owner/manager lived experiences and ideology	Owner manager is an avid supporter of IS/IT	Management view technology as a excellent tool for personalising customer service	Management and staff view technology as a capable 'facilitator' of both tacit and explicit knowledge	Culture of sharing knowledge is enhanced throughout the firm (intra and inter). Management lead by example
Infostructure	Ad-hoc processes and systems begin to take shape from observation and experience-Tacit knowledge is emphsised	Established business processes become embedded with new IT	Management rely on the individual expertise of each employee supported by generic industry based practices	Routine processes are standardised. Sufficient empowerment given to employees to shape non-routine processes	A strategic approach to managing knowledge is adopted (allowing explicit and emergent strategies to co-exist and interact) with appropriate initiatives being incorporated into the business processes
Infrastructure	Technology is not seen as adding competitive advantage-success is based on individual know-how, communiactions are limited to two-way radio, facsimile and telephone	Off-the shelf job tracking system working alongside management initiated software and tools	Job tracking system and ERP tools operate alongside ad-hoc staff initiated software and tools	Job tracking system upgraded to incorporate generic software to allow planned individualization and mutual meaning. WWW, Intranet, digital mobile imaging being exploited by both management and staff	Core IS/IT is continually reviewed and upgraded Flexibility is given to try new technology as and when it becomes available
	The WAHBI is predominantly a stable 'cottage industry' espousing little business professionalism	Market fluctuations, adversarial customers and increased competition have a negative impact on profitability	Industry experiences greater consolidation as un-professional and un-profitable firms fail	Industry consolidation increases which add additional pressure to profitability and sustainability of traditional smaller firms	Firm is well positioned to exploit the opportunities presented in an emerging knowledge economy
External events	Regulators concerns about lack of industry professionalism and increase surveillance and prosecutions for un-professional practices	Industry becomes prone to cyclical economic conditions leading to a 'boom-to-bust' lifecycle	Industry acknowledges concerns about its ageing workforce and inability to attract suitable younger participants to the industry	Impact of the emerging knowledge economy take effect, ie: knowledge workers, changing social attitudes etc...	

1995-2003	Focus of study 2004-2006

Figure 28:   Lakeside Home's knowledge management evolution

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6.11 The extended research model

Figure 29 shows the extended model that has been developed to take into account the findings of this research.
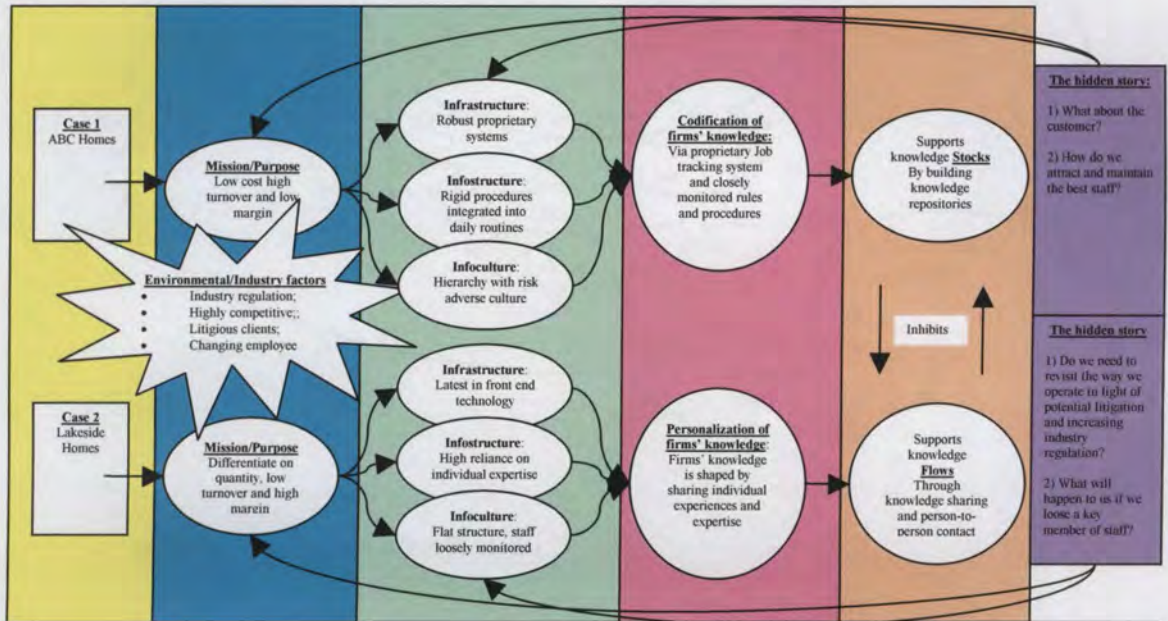

Figure 29:   The extended research model

Figure 30 presents the revised framework adopted by this study for gaining a better understanding of how a firm's strategy and socio-technical subsystems influence managing the firm's knowledge.
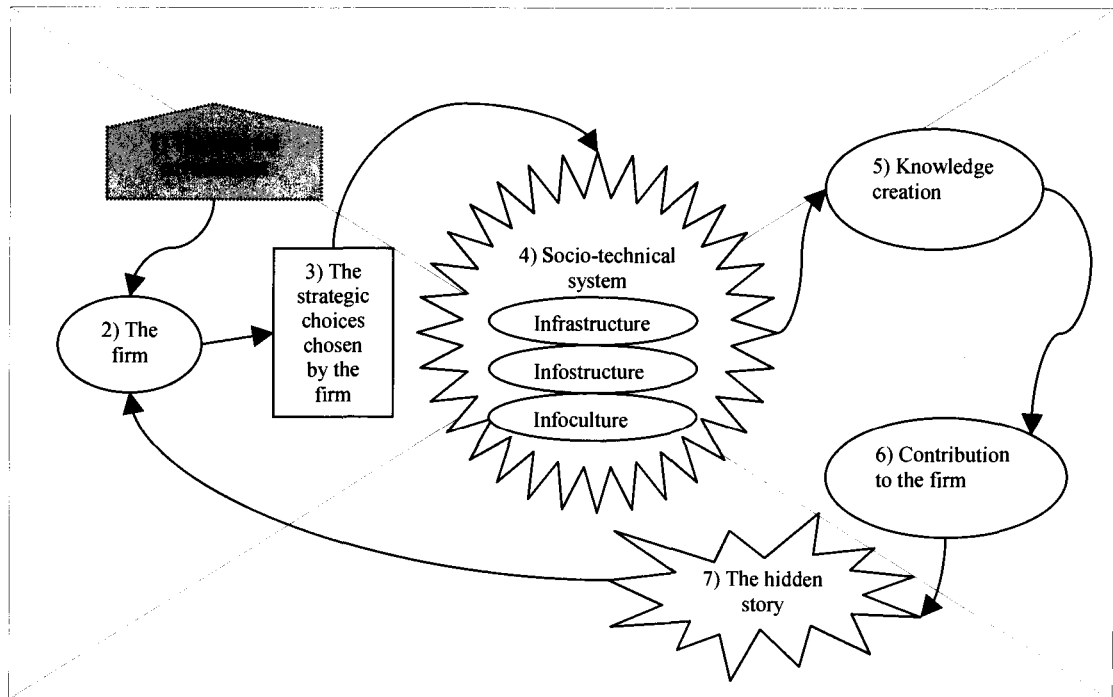
Figure 30:   The revised research model

The core elements of this model are discussed below:

1. The external environment is concerned with the Western Australian house-building industry's external influences and how they affect the strategic direction of the firm. For example, the influence of the litigious nature of the industry was prominent in both case studies. It was thus necessary for both firms to suitably adjust their knowledge management environment or risk exposure and possible failure from this external influence.

2. Apart from representing the commercial entity, the firm also represents the employees, owners, managers and all other internal stakeholders.

3. Strategic options adopted by the firm when considering a knowledge management initiative appeared along a continuum from strategic to emergent. A strategic approach was carefully planned and implemented by management. An emergent approach, as the name suggests, was a result of emerging ideas and initiatives adopted by the firm. An example of a strategic knowledge management system was presented in the form of the job tracking system at ABC Homes. An example of an emergent system was seen in the emergence of a community of practise between ABC Homes and Lakeside Homes;

4. The socio-technical subsystems of the firm were interactive. Furthermore, this study has shown that where there is misalignment between these socio-technical

elements, success of a knowledge management system is less likely. That is to say, the technology employed by a firm needs to compliment the firm's processes, procedures and its culture.

5. The type of knowledge created and supported by the knowledge management initiative can be influenced by the knowledge management system adopted by the firm. This study has shown that a strategic approach will have a tendency to focus on the codification of a firm's knowledge (explicit knowledge); whereas, an emergent knowledge management system will generally personalise the firm's knowledge (tacit knowledge).

6. The contribution to the firm made by the knowledge management system is also influenced by the knowledge produced and supported by the system. For example, the job tracking system at ABC Homes helped the firm control a complex environment through the codification and structuring of rules, processes and procedures (knowledge stocks). Alternatively, the photo system enhanced knowledge flows by facilitating meaningful interaction between employees.

7. The "hidden story" is in place to remind us of the potential for hidden truths to be embedded in a knowledge management system.

6.12 A reflection of other disciplines

The following section offers a review and reflection on other fields of literature that can help explain what I have observed following the analysis. For example, I observed that the owner–manager played a leading role in determining the IS and IT landscape of the organisation. When I looked deeper into this, I observed that the management literature on traditional themes (Taylor etc.) helped to explain what was going on. In particular, I found emerging relationships that bore much resemblance to the literature presented on the wider small-to-medium enterprise community.

6.12.1 Relationship with the case firms and the unique characteristics of small-to-medium enterprises

As discussed earlier, most of the literature presented on knowledge management has a tendency to focus on larger firms. Little research has been conducted to date on knowledge management in small-to-medium enterprises. Even less research effort has been directed at knowledge management and small-to-medium-sized building firms. The Western Australian house-building industry, and most construction industries, consists of small-to-medium enterprises. These operate differently from larger

organisations and possess unique characteristics that are often overlooked in the literature, which has a propensity to concentrate on larger firms (Fink 1998; Swartz et al. 1997)

The two case studies have shown examples of these unique characteristics; in particular, their environmental, organisational decisional and psycho-sociological characteristics. The following section of this chapter considers these characteristics and how they have played a pivotal role in shaping both firms' knowledge management approaches.

6.12.2 Unique environmental characteristics

ABC Homes and Lakeside Homes have inherently designed their knowledge management tools to be mindful about the high level of uncertainty and fluctuations in the industry. Ironically, though, these same tools potentially limit flexibility and openness. For example, ABC Homes have concentrated a large percentage of resources on their job tracking system, which is rigid by design and allows little in the way of flexibility of users. Similarly, Lakeside Homes is now in the process of implementing a similar tool based on the premise that a tighter control of work process and employees could be a key success factor for growth and competitive advantage in their firm.

Chapters 3 and 4 presented clear examples of this were made by both owner–managers. In the case of ABC Homes the Managing Director espoused his concern about losing control in a litigious and highly regulated market. The Managing Director of Lakeside Homes linked the potential for successful expansion with tighter organisational procedure and systems. Within this scenario, less reliance would be required on intuition and individual problem solving. Both Managing Directors regarded the potentially prescriptive and constraining nature of information technology as a key tool for facilitating this objective. Table 26 provides a summary and comparison of both case firms' unique environmental characteristics with SMEs in general.

Table 26: Unique environmental characteristics

Characteristic	SMEs in general	ABC Homes and Lakeside Homes
Environmental	Small-to-medium enterprises (SMEs) are usually characterised by a high level of environmental uncertainty (e.g. fluctuations in interest rates), including the IT environment.	The WA house-building industry and indeed the construction industry in general is well known for its cyclical nature in terms of Political, Environmental, Sociological and Technological. These environmental factors affect both firms.

6.12.3 Unique organisational characteristics

Small-to-medium enterprises are regarded as "poor" in human, financial and material resources (Fink 1998). This has caused both firms to rely more extensively than larger organisations on outside help in designing and implementing their knowledge management tools, in particular, their codification approaches. The nature of this approach required a higher level of technological expertise. Both firms' personalised approach toward knowledge management was more opportunistic. They used and exploited new developments that were widely available such as e-mail, digital imaging etc.

The level of external support required by the firms did differ depending on the level of competence and knowledge about IS and IT by the owner–manager. For example, the owner–manager of ABC Homes was open about his limited knowledge of technology; whereas, the owner–manager of Lakeside Homes was obviously familiar with technology. As such, I observed that there appeared to be a relationship between the reliance on external support and the level of competence towards IS and IT of the owner–manager.

ABC Homes' core knowledge management tool, the job tracking system, was designed, implemented and maintained by external consultants with the implementation being driven by the Managing Director. Lakeside Homes on the other hand, relied on internal expertise and off-the shelf products. It was indicated, however, that in time the firm would have to rely on external expertise should it adopt a formal job tracking systems similar to that of ABC Homes. Table 27 provides a summary and comparison of both case firm's unique organisational characteristics with SMEs in general.

Table 27:   Unique organisational characteristics

Characteristic	SMEs in general	ABC Homes	Lakeside Homes
Organisational	Small-to-medium enterprises (SMEs) are regarded 'poor' in human, financial and material resources. This has caused them to rely more extensively than larger organisations on outside help;	IS/IT planning and implantation driven by owner manager with a need for a high level of external advice and support, due to the owner manager's limited technical knowledge of IS/IT	IS/IT planning and implementation driven by owner manager relying more on proprietary (off-the-shelf) systems than that of the slightly larger ABC Homes

6.13 Unique decisional characteristics

There is a well known view in the small-to-medium-enterprise literature that decision-making tends to be short-term and intuitive, focusing on reaction rather than anticipation and that IT suitable in such situations needs to be robust and available quickly, preferably as packages (Fink, 1998). This appears to be more relevant to small organisations than to medium-sized firms, the classification of the two firms investigated for this study. That is to say, the size of the firms appears to influence the knowledge management strategies adopted. ABC Homes, for example, implemented their job tracking systems in anticipation of an increase in the litigious nature of consumers. Lakeside Homes intend to implement a job tracking system to support their long-term growth strategy.

Both firms contained within their "kit" of knowledge management tools examples where intuition and reaction were a key influencer in implementing knowledge management. For example, ABC Homes adopted their photo system from intuitive staff members taking an opportunistic advantage of changes in the technological advances in IS and IT. This was a similar situation for Lakeside Homes, who adopted the same knowledge management tool through casual discussion with other industry participants (the community of practice).   Table 28 provides a summary and comparison of both case firms' unique decisional characteristics with SMEs in general.

Table 28: Unique decisional characteristics

Characteristic	Small-to-medium enterprises in general	ABC Homes	Lakeside Homes
Decisional	Decision-making tends to be short-term and intuitive, focusing on reaction rather than anticipation. IT suitable in such situations needs to be robust and available quickly, preferably as packages;	The key influences for knowledge management initiatives for ABC Homes were driven by the owner/managers concerns about litigious clients and complex regulatory requirements. Staff on the other hand embraced knowledge management tools that enhanced their day-to-day logistical need	The key influences for knowledge management initiatives at Lakeside Homes were driven by the owner/managers perception that tighter controls were needed to support growth for the organisation. Staff on the other hand embraced knowledge management tools that enhanced their day-to-day logistical need)

6.14 Unique psycho-sociological characteristics

Arguably, the most salient characteristic I identified during the collection of data for the case studies was the dominant role played by the owner–manager in shaping a firm's IS and IT environment.

In both cases the owner–manager took full accountability for the firm's IS and IT infrastructure and infostructure. The main influencer on these socio-technical elements, however, was the third socio-technical element of infoculture.

The owner–manager of ABC Homes played a pivotal role in planning and implementing the firms IS and IT. The job tracking system was developed to "keep an eye on things". As the case study uncovered, the staff saw this as a negative, and participation needed to be constantly enforced by management. On the other hand, the photo system was openly embraced by the staff, but reluctantly by management, who felt the job tracking system should contain sufficient information and knowledge for staff to perform their tasks. Table 29 provides a summary and comparison of both case firms' unique psycho-sociological characteristics with SMEs in general.

Table 29:   Unique psycho-sociological characteristics

Characteristic	Small-to-medium enterprises in general	ABC Homes	Lakeside Homes
Psycho-sociological	From a psycho-sociological perspective, the owner-manager plays a dominant role in the organisation, thereby shaping the organisational culture with respect to the use of IT (Fink 1998).	Evidence was shown that little support was given to knowledge management initiatives that were implemented without the owner-manager's explicit backing.	The owner-manager's open acceptance towards IS/IT flowed through to all levels of the firm.

What can be gleaned from the above is confirmation that there is consistency between the established literature on small-to-medium enterprises and Western Australian house-building firms, in that their unique characteristics affect the way knowledge management is planned, implemented and used within these firms.

This important factor also goes a long way to supporting this study's initial view that a different approach to designing and implementing knowledge management systems is required for local firms than that of the extant literature on knowledge management, which is focused on larger firms.

6.15 Summary of the main findings

Table 30 presents a typology of the findings of the study when related to the unique traits exhibited within the WA house-building industry. What can be reasonably assumed from this is that:

- Both firms have approached their knowledge management challenges in similar ways.

- The outcomes following the implementation of a knowledge management initiative are, in many ways, dependent on how the firm approaches the initiative.

Table 30:   The cycle of KM choice, strategy, outcome and benefits

	KM Choice	KM Strategy	KM Outcome	KM Benefit
WA house-building industry Trait	Codify or Personalise	Strategic or Emergent	Stocks or Flows	Control or empowerment
High degree of industry regulation	Codify	Strategic	Stocks	Control
Highly competitive	Codify	Strategic	Stocks	Control
Continuous changes of IS/IT	Personalise	Emergent	Flows	Empowerment
Changing attitudes in workforce	Personalise	Emergent	Flows	Empowerment
Changing face of client: demanding and knowledgeable	Personalise	Emergent	Flows	Empowerment
Changing face of client: more likely to seek legal interference	Codify	Strategic	Stocks	Control

6.16 Summary

In summary, this chapter has analysed the theoretical propositions that argued that the way a firm approached its knowledge management initiative would affect the subsequent knowledge produced. As such, the success of the initiative would be manifested in the stocks and flows of knowledge created. This must be evaluated against the strategy, but a knowledge management system can be a failure and a success at the same time. For example, the job tracking system is a stocks success but a flow failure. The origin of a knowledge management initiative was seen as either emergent or imposed, and the form it took depended upon existing (or utilised) infrastructure, infostructure and infoculture.

Chapter 7: Conclusions, limitations and further research

This final chapter presents a summary of the study and its limitations. Included in this chapter are recommendations for further research, practical implications that emerged from the study and a brief epilogue by the researcher.

The focus of this study was to conduct an interpretive case study of two Western Australian house-building firms. This was done to expand our knowledge of current practices for designing and implementing knowledge management systems within a WA building-industry setting. An extensive literature review conducted at the beginning of this study helped to establish a set of theoretical propositions that would act as guideposts throughout the journey of this study. From this foundation two specific research questions were addressed:

1. How does the way in which a knowledge management strategy is approached in a Western Australian house-building firm affect the type of knowledge produced?

2. Does the way in which a knowledge management strategy is approached in a Western Australian house-building firm affect the sustained use and benefit of the knowledge management system within the firm?

To answer these questions an interpretive case study of two WA house-building firms was conducted during the period May 2004 to January 2006. Data collected from the case studies was analysed in conjunction with the relevant literature. To ensure an appropriate level of relevance and rigour was maintained, data was further analysed using the principles of the hermeneutic circle as presented by Klein and Myers (1999).

The following sections of this chapter review and discuss each question in detail. They also discuss the extent to which the initial research objectives were met.

7.1 Research question 1

How does the way in which a knowledge management strategy is approached in a Western Australian house-building firm affect the type of knowledge produced?

This first question evolved from my observations made as a practitioner that there appeared to be a relationship between the approach taken toward a knowledge management initiative and the knowledge subsequently produced. I was observing that, at the two extremes, firms were approaching their knowledge management in two

very different ways. Also, the ways in which firms approached their knowledge management initiative appeared to support a particular type of knowledge. On the one hand, I was observing that some initiatives were approached in a strategic way, with a focus on technology and structure. On the other hand, some knowledge management initiatives emerged from a set of opportunist behaviours and/or the availability of new technologies.

The literature suggests that effective knowledge management starts with strategy (Gropeal & Gagon 1995; Zack 1999; Valli 2002). The term "strategy" can be approached in many different ways, though. On the one hand, strategy can be viewed in its traditional form as, predominantly, a management responsibility of preparing broad-based formulas for how firms can best compete. Within this paradigm, strategy is typically approached in a rational-analytical way. However, it has been known for some time now that firms rarely use this approach (Quinn 1978). It is more likely for strategies within the firm to evolve from fragmented, incremental and largely intuitive processes (Beinhocker 1999) or in way that can be seen as being emergent.

The results of this study concur with the literature in that very few examples of a "strategic" approach towards knowledge management could be observed. I was thus able to observe several examples of emergent knowledge management initiatives. Also, as a result of this study, I was able to actively participate in two of the initiatives.

- The job tracking systems in use at ABC Homes was highlighted as a clear example of a strategic approached toward knowledge management. Lakeside Homes supplemented this example as it was shown that they were in the processes of planning for an initiative similar to the job tracking systems in use at ABC Homes.

- Both firms presented examples of emergent approaches toward knowledge management within their photo systems. A second emergent initiative evolved between both firms in the form of a community of practice.

Having established the two approaches a firm adopts, the next section addresses the influence a particular approach will have on the outcomes of a knowledge management initiative.

Question one sought to discover and discuss if there was a propensity for a particular type of knowledge to be produced as a result of the firm subscribing to a particular approach toward a knowledge management initiative.

Below is a brief summary of three examples presented in the case studies where I observed a relationship between the knowledge management system and its subsequent support of a particular type of knowledge.

7.1.1 The job tracking system

This example was classified as strategic as it was seen that management had made a predetermined decision to embark on the initiative for tactical and competitive reasons.

The primary aim of the job tracking system was to assist the firm (management in particular) with standardising the procedures and tracking the progress and status of each project. As a tool for collecting and storing extant levels of data, the job tracking system excelled, but its usefulness for supporting tacit knowledge (knowledge flows) was low. The knowledge that was produced as a result of the strategic approaches was explicit, as the knowledge was embedded within the firm's systems, processes, tools and routines (De Long & Fahey 2000). Table 31 presents a summary of example one.

Table 31:   A summary of example one: the job tracking system

Knowledge management tool	Approach	Knowledge produced
Job tracking system	Strategic	Explicit

7.1.2 The photo system

This example emerged from a staff initiative at ABC Homes and, during this study, it was shared with Lakeside Homes. The photo system was classified as an emergent initiative as there was no obvious attempt by management to plan and/or implement the system based on either a strategic need or desire. In contrast, the photo system emerged from a combination of employees attempting to fulfil a logistical need and the availability of new technology.

From this example, employees were seen to engage in a process of sharing information and knowledge to deal with non-routine issues such as unusual construction details and site works etc. Table 32 presents a summary of example two.

Table 32:   Summary of example two: the photo system

Knowledge management tool	Approach	Knowledge produced
Photo system	Emergent	Tacit

7.1.3 The community of practice

In this example, structure and technology played only a minor role. Instead, what was significant was the social relationships that existed between the members of the community, their common purpose and their perception that they found themselves to be part of a common network. Table 33 presents a summary of example three.

Table 33:   Summary of example three: the community of practice

Knowledge management tool	Approach	Knowledge supported
Community of practice	Emergent	Tacit

In summary, I have presented supporting evidence that demonstrates that the type of knowledge produced from knowledge management initiatives can be influenced by the approach adopted in designing an implementing the initiative.

In particular, I observed that a strategic approach to knowledge management had a tendency to support explicit knowledge. On the other hand, an emergent approach had a tendency to support tacit knowledge.

Extending this observation and conclusions drawn from question one, the second question considered the relationship between a particular approach toward knowledge management and its effect on the firm.

7.2 Research question 2

Does the way in which a knowledge management strategy is approached in a Western Australian house-building firm affect the sustained use and benefit of the knowledge management system within the firm?

During this study, I observed that Western Australian house-building firms intuitively adopt a range of knowledge management initiatives to operate and maintain their competitive positioning and performance. This study also identified that knowledge management initiatives could be classified as operating along a continuum from

strategic to emergent. In addition, the type of knowledge produced was also found to be operating at corresponding ends of a continuum of tacit to explicit.

As demonstrated in the previous question, strategic knowledge management initiatives had a tendency to produce knowledge stocks; whereas, emergent knowledge management initiatives tended to support flows. This second question sought to discuss how these initiatives might benefit the firm.

In Chapter 2, the point was raised that much of the recent literature presents firms as aggregations of knowledge stocks and knowledge flows (Gray 2001). The literature also suggests that firms with routine outputs are advised to pursue a codification strategy that focuses on building and enhancing knowledge repositories (knowledge stocks). Alternatively, firms with non-routine outputs are advised to pursue a knowledge strategy with the aim of enhancing tacit knowledge through person-to-person contact and communication (knowledge flows) (Hansen et al. 1999).

What follows is evidence that concurs with the established literature, in that firms are aggregations of stocks and flows. However, this study brings into question the viability of a firm that relies solely on a single approach to knowledge management for its sustainable competitive advantage.

When assessing the strategic and emergent examples presented above, I found the job tracking system in use at ABC Homes to be an unequivocally strategic approach, and the photo system was clearly an emergent approach toward knowledge management.

The focus of the strategic approach was to systematically manage, use and store the firm's explicit knowledge. This approach to knowledge management allows the firm to achieve scales of economy and improved organisational efficiency via the re-use of codified knowledge (Markus 2001; O'Dell & Grayson 1998, in Keskin 2005).

Within the context of an emergent approach to knowledge management systems, the emphasis was on sharing tacit knowledge through mutual interactions and dialogue (Keskin 2005). This was achieved by establishing social networks and communities. The advantages of this approach was its ability to develop core processes, obtain new understandings and combine enhanced abilities and experiences to increase the speed at which decisions were made and new ideas generated in order to take advantage of dynamic environments (Nonaka & Takeuchi 1995; Spender & Grant 1996, in Keskin 2005).

These examples provide evidence that illustrates that firms require knowledge management initiatives that produce and support both tacit and explicit knowledge in order to sustain their competitive advantage. A firm that relies solely upon strategic knowledge management and explicit knowledge will potentially reduce its ability to generate new knowledge. Similarly, a firm that relies solely on emergent knowledge management and tacit knowledge risks exposure to a loss of control.

The extent to which a firm relies on or focuses on either knowledge management system will be manifested in many attenuating factors. Three attenuating factors were seen to influence the way in which Western Australian house-building firms adopted knowledge management initiatives. These were:

1. the influences of the external environment in which the firm operates;

2. the firm's purpose and mission; and

3. the alignment or misalignment of the firm's socio-technical subsystems.

7.2.1 The influence of the firm's external environment

The first of the attenuating factors to influence the way in which a firm adopted a knowledge management system was its environment. Evidence was presented in the study that showed that the WA house-building industry operated in an environment that was highly competitive, had tight regulatory requirements and had increasingly litigious customers. These factors were the major influences driving ABC Homes' desire to implement their job tracking system. Similarly, Lakeside Homes felt it necessary to establish a similar system for the same reasons.

The importance of conforming to routine procedures within a highly litigious and regulated environment cannot be underestimated. As such, it was seen that the job tracking system was an effective knowledge management tool that was strategically designed and implemented to deal with these environmental factors.

7.2.2 The influence of the firm's purpose and mission

The second attenuating factor was the firm's purpose and mission. The strategic context of a firm plays a leading role in shaping its knowledge management approach (Zack 1999; Hansen et al. 1999). Evidence produced by the case firms confirmed their particular mission or purpose. I observed that both firms exhibited a different mission and purpose in order to carry out their competitive strategy. I also observed how their mission and purpose influenced their approach toward knowledge management. While

ABC Homes adopted a low-cost strategy, Lakeside Homes had established themselves as a niche builder.

7.2.3 The influence of the firm's socio-technical alignment

The third attenuating factor to affect not only the approach but also the success of a knowledge management system was the alignment of the firm's socio-technical subsystems. This study identified and discussed five examples where a firm's alignment and/or misalignment influenced knowledge management's effectiveness and use. In the examples presented where little alignment existed, the success and suitability of the knowledge management systems were less obvious. These examples also illustrated how the socio-technical subsystems of a firm could be realigned to support a knowledge management system.

7.3 Summary

Evidence presented in this study has shown that much consideration is needed by a firm to achieve better results from a knowledge management initiative. It can be shown that the way in which a firm approaches its knowledge management will influence the knowledge produced. In particular, a strategic approach has a tendency to produce knowledge stocks, and an emergent approach has a tendency to produce knowledge flows. Management need to be mindful of three attenuating factors, though: the external environment, their mission and purpose, and the alignment of socio-technical subsystems.

The success of an initiative will be manifest in the stocks and flows of knowledge created. This must be evaluated against the environment in which the firm operates, and its purpose and mission. A knowledge management system can be a failure and a success at the same time. For example, the job tracking system was a stocks success but a flow failure.

This paradox of simultaneous success and failure was brought about through the different perspectives held by stakeholders of the knowledge management initiative. For example, management found that the job tracking system fulfilled its objective of providing vast amount of knowledge stocks; however, employees felt the initiative was a failure as it did little to improve their ability to share knowledge flows.

A significant attenuating variable in determining the success or failure of a knowledge management initiative was thus its relationship with the firm's socio-technical

subsystems. The alignment or misalignment of these subsystems in relation to the knowledge management initiative will affect the benefits experienced by the firm.

7.4 What are the practical implications that flow from this study?

As discussed in Chapter 1, my early views and perceptions of knowledge management within the Western Australian house-building industry have evolved considerably. I began with a set of theoretical propositions. These acted as guideposts during the study and helped to increase the viability and reliability of my analysis. This approach proved most beneficial in achieving my initial objective of producing practical outcomes that would assist the building and construction community in WA.

Table 34 presents a summary of the practical implications of this study.

Table 34:   The practical implications of this study

Study conclusion	Practical implications
The owner-managers of small-to-medium building firms play a leading role in determining the knowledge management (KM) landscape of the firm.	When all is said and done, it will be the owner-manager who determines the success or failure of knowledge management.
	A firm relies heavily on the owner-manager to provide not only economic support for the purchase of new technology and tools, but for guiding the firm's rules, procedures and culture.
The approach a firm adopts when considering a KM initiative moves along a continuum from strategic to emergent.	A strategic approach to KM occurs when management explicitly attempts to determine the future.
	An emergent approach to KM evolves from intuitive and opportunistic behaviour.
A strategic approach will typically produce knowledge stocks.	Knowledge stocks are most suited to storing and retrieving knowledge in the shape of standard and procedures.
	Knowledge repositories are an example of strategic KM initiatives that produce knowledge stocks
An emergent approach will typically produce knowledge flows.	Knowledge flows emphasise the sharing of knowledge and experiences through mutual interactions and dialogues;
	Examples of emergent KM initiatives that produce knowledge flows can be seen in communities of practice.
KM can be a success and failure simultaneously.	A KM initiative may excel in generating knowledge stocks but not knowledge flows.
KM strategies are influenced by the firm's external environment.	KM initiatives need to take into account the building and construction industry's unique characteristics:
	• high regulation;
	• the changing disposition of workers; and
	• increasingly litigious clients.
KM strategies need to be aligned with the firm's purpose and mission.	A KM initiative cannot be implemented without consideration of the firm's overall business strategy.
	A low-cost, high-turnover strategy will require different KM tools and initiatives than a differentiation strategy.
Possibly the most salient discovery of this study was understanding how the alignment of a firm's socio-technical elements (infrastructure, infostructure and Infoculture) increase a KM initiative's chance of success	Effective KM is not just about technology. It requires managers to be constantly aware of their ever-changing socio-technical environment.
	A socio-technical view will help managers to improve their awareness of the KM environment.

7.5 Research limitations

Qualitative research of the type adopted for this study is inevitably restrictive and bound by limitations. By making these restrictions and limitations explicit, future research approaches can address them and build upon the results contained in this study.

In my view, there were three significant areas of limitations within this study. These are as follows:

7.5.1 Sample size

My initial preference was to extend the sample size of this study to gain a wider perspective of knowledge management approaches within the Western Australian house-building industry. Indeed, my initial proposal suggested that four firms be investigated. However, taking the advice of my proposal examiners and the ethics committee, this sample size was reduced to two firms as:

- The original sample size was beyond the limit of a Doctor of Business Administration Degree.

- A sample size of two enabled this study to go into greater detail.

7.5.2 Bias

The second significant limitation of this study was the extent to which my personal bias, from my role as General Manager of one of the firms, may have influenced the data and results of this study. This may have influenced the participants' responses to my interviews and my observations as General Manager and researcher.

7.5.3 Unbalanced access to data

The third and possibly most significant limitation of this study was the unbalanced weighting of data collected between the case firms. I had open access to ABC Homes; thus, the level of data collected from Lakeside Homes was not of the same level of detail. In order to mitigate this potential limitation, I established a process within my data collection and analysis where new insights obtained at either case firm would be presented to the other case participants for their comments and views. I found this process most suitable. Walsham (1993) posited:

In the interpretive tradition, there are no correct and incorrect theories but there are interesting and less interesting ways to view the world. One uses the phenomenological approach to discover lived experience and hermeneutics as the process of uncovering and interpreting the meanings behind action (p. 6).

7.6 Recommendations for further research

The limitations and outcomes of this study suggest a number of areas where further research on this topic is necessary:

- Extend the research to include the wider value chain of the construction industry. This study was focused on intra-organisational knowledge management. However, it was made clear to me that both firms relied heavily on external interactions and influences.

- Explore the relevance between the size of a firm and the type of technology used and desired

- The relationship between organisational structure and innovation needs to be investigated further to consider the unique context of the building and construction industry. The small sample investigated in this study presented two examples where the structure of a firm appeared to be an important moderator on the level of innovation sought and produced by the firm.

- Having identified the importance of aligning a firm's socio-technical subsystems, more research is needed to study the role these elements play in improving the effectiveness and efficiency of knowledge management within a firm.

- Further explore the role and influence that an owner–manager plays in shaping the knowledge management environment within a firm.

7.7 Concluding comments

To conclude this study, it is appropriate that the following points be clarified:

1. What were the delineations of this study?

2. What were the main objectives of this study?

3. Did the research approach compliment the study's questions and objectives?

7.7.1 Study delineations

The delineations of the study were set around two medium sized Western Australian, privately owned house-building enterprises. The study focused on their approaches

towards the development and implementation of IS using the perspective of knowledge management.

7.7.2 The study's objectives

This study set out to illuminate the importance of strategically initiated knowledge management in achieving and sustaining competitive advantage within organisations. A paucity of research into the Western Australian house-building industry using the perspective of knowledge management has left this sector exposed as there is little assistance available to managers of local house-building enterprises to guide them in the implementation of effective knowledge management systems.

The results of this study have shown that there is no silver bullet. There are, however, sound guidelines that, when considered, will increase the chance of gaining sustainable competitive advantage from the implementation of knowledge management systems.

7.7.3 Reflections on the research approach adopted for this study

The nature of the research questions, my worldview and my access to rich data guided this study towards an interpretive case-study approach. This approach proved most beneficial as it allowed a depth of research into the machinations of knowledge management within two medium-sized firms. In particular, the Western Australian house-building industry may have been overlooked had a more structured research methodology been undertaken.

To ensure the quality of this study, particularly the interpretation of data, a decision was made to adopt the principles of the hermeneutic cycle as presented in Klein and Myers (1999). This supported the interpretive approach and acted as a guide to ensure that rigor and relevance was maintained throughout the study.

7.8 Conclusion

This study was conducted on a part-time basis as I was a full-time employee at ABC Homes for the duration. This degree commenced in March 2002 with the coursework component of the degree lasting 12 months. This time allowed me to shape my ideas and future direction for conducting the study. My research proposal was submitted and approved in April 2004. Following receipt of my ethics clearance shortly thereafter, I commenced data collection and the writing of this thesis. The thesis was submitted for examination in September 2006.

Appendix 1: Invitation to participate in the study

(Name of company)

Invitation to participate in research: knowledge management practices in the Western Australian Housing Industry

We would like to invite you and your company an opportunity to participate in a research project as part of my Doctor of Business Administration degree being conducted at the faculty of Business and Public Management, Edith Cowan University.

The core objective of the study is to better understand how Western Australian Project Builders utilize information systems and technology to manage their firm's knowledge. The exponential rise in information communication technologies, such as Internet, Intranet and mobile digital imaging is rapidly changing the environment in which WA Project Builders operate. These emerging technologies are reducing the necessity of firms to rely on sophisticated proprietary systems to collect store and disseminate the firm's knowledge. However, we know little about how firms implement their information systems and technology strategies and the benefits produced from such strategies. To address this gap this study will seek to answer the following questions:

How does the way a knowledge management strategy is approached in a Western Australian House Building Firm affect the type of knowledge produced?

Does the way the way a knowledge management strategy is approached in a Western Australian House Building Firms affect the sustained use and benefits to the firm?

Should you wish to participate, your involvement would require a series of brief interviews at a place and time convenient to you and your staff. Please be assured that any information collected will be held in the strictest of confidence and will stringently abide to all ethical standards set by the Edith Cowan University ethics committee. This research will be conducted under the guidance of Dr Paul Jackson and Professor Craig Standing of Edith Cowan University

In return for your participation, you will receive a summarized report on the major findings of the thesis.

Thank you for considering my request and please feel free to contact me at any time on my mobile phone (0411698400).

Yours sincerely

Geoff Wilson

Doctoral Candidate-Edith Cowan University
Faculty of Business and Public Management

Appendix 2: IS and IT audit template

Components of the physical infrastructure (Ward and Griffiths, 1988 p. 491):

> *A physical infrastructure, which consists of a broad assortment of products and services, deployed to reflect the current technology architecture. A component is considered as being part of the infrastructure if it is used by more than one application. The physical infrastructure consists of hardware and software, which can be brought "off-the-shelf".*

Computer hardware

1.1	Mainframe			
1.2	Midrange			
1.3	Desktop machines			
1.4	Open systems			
1.5	Supercomputer			
1.6	I/O devises (multimedia, printers, plotters and storage devices)			
1.7	Disk tape			
1.8	Distributed computing and client/server architectures			
1.9	Other			

Systems software

2.1	Operating systems (multi-user and desktop),			
2.2	Teleprocessing monitors			
2.3	Database management systems			
2.4	Language compliers			
2.5	Other			

Communication and networking systems

3.1	Hardware			
3.2	Software and services			

Development tools

4.1	CASE			
4.2	Rapid application development tools			
4.3	Prototyping			

Office systems and desktop environments

Application software

6.1	Bought-in products that are used as delivered, such as general purpose packages for e-mail or electronic conferencing			
6.2	Bought-in products that are configured and possibly tailored, such as major application packages, e.g. MRPII			
6.3	Bought-in tailored software, for common usage			
6.4	Bought-in parts, stored for assembly into applications, e.g. classes of objects			
6.5	In-house developed parts for common usage			

Special purpose tools

7.1	Electronic commerce (EDI)			
7.2	Artificial intelligence (expert systems, neural systems, knowledge based systems, recognition technology)			
7.3	Computer aided design and manufacturing systems			
7.4	Executive support systems			
7.5	Executive information systems (EIS)			
7.6	Management information systems			
7.7	Decision support systems			
7.8	Information retrieval, electronic publishing and document management			
7.9	Workflow management tools			

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