1 Introduction

This chapter provides a summary of the research process and research findings. It is laid out as follows. Section 1.1 starts with a brief description of the research background. Section 1.2 presents the research questions, outlines the development of theories, research models, and hypotheses, and summarizes the contributions made by the research. Section 1.3 justifies the research and discusses the significance of the research. Section 1.4 addresses the methodology which is used to conduct the research. Section 1.5 presents a brief description of the content of this thesis, chapter by chapter. Key terms are articulated and defined in Section 1.6. Section 1.7 discusses the key assumptions which apply to this research, the limitations of the research and the research findings. A conclusion is presented in Section 1.8.

1.1 Background to the KMS Research

Modern knowledge management (KM) is believed to have been introduced as a discipline in the 1990s. According to Prusak (2001), the first public conference dedicated to knowledge management was held in Boston in 1994. Since then the discipline has greatly expanded; in 2000 alone, there were more than fifty KM conferences (Davenport, Prusak et al. 2003).

In a review of modern knowledge management development, Davenport, Prusak et al. (2003) suggest that the launch of the modern KM movement was mainly based on the emergence of knowledge-oriented technologies, such as Lotus Notes, World Wide Web, and other collaboration tools. In fact, knowledge-oriented technologies have played a vital role in driving the modern knowledge management movement. For instance, a study of 431 USA and European organizations, conducted in 1997 by the Ernst & Young Centre for Business Innovation, showed that the majority of the investments in KM projects were on IT systems such as intranets, data warehouses and knowledge repositories, decision-support tools and groupware to support collaboration (Ruggles 1998). It was estimated by the Gartner Group that knowledge management software and consulting services was a US$1.5 billion market in 1998 and was expected to be a US$5 billion market by 2002 (cf. Lucier and Torsilieri (2001)). Another forecast suggested the corporate investment on KMS would grow to US$13 billion annually by 2007

(Anonymous 2004).

Given the increasing investment in KMS, concerns have been expressed about the actual role of KMS in organizational knowledge management, and the real value that investments in KMS bring to the organizations (Lucier and Torsilieri 2001). For instance, Alavi and Leidner (2001) called for more research on the role of KMS in organizational knowledge management. Similarly, Gallupe (2001) observed that

> *"We do not know much about how KMS fits into the larger context of organizations" (p. 72),*

While knowledge management is becoming pervasive in today's organizations, the value of knowledge and of knowledge management systems are still two of the biggest concerns for most organizations (Smith and McKeen 2003). Consequently, it is argued that the issues of KMS success in terms of its use and its effects on organizational knowledge management deserve further study.

1.2 Research question, Hypotheses and Contributions

1.2.1 Research Questions

The above-mentioned issues related to KMS and its effects on organizations can be operationalized into research questions concerning the user's acceptance and use of KMS, and the success of KMS (Alavi and Leidner 2001). KMS usage, in this context, does not necessarily imply KMS success. However, use of KMS will influence the adoption of individual or organizational knowledge management.

Nahapiet and Ghoshal (1998) define social capital as relationship networks embedded with the available resources possessed by people or social units. Nahapiet and Ghoshal (1998) suggest that social capital leads to knowledge sharing. Similarly, Lesser (2000) argues that social capital would enhance knowledge sharing within organization. Tsai and Ghoshal (1998) provide empirical evidence for the theoretical propositions made by Nahapiet and Ghoshal (1998).

Social capital emphasises the trust-based relationships between people, and the networks and communities through which they create and share knowledge by engaging

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in collaborative and cooperative action (Cohen and Prusak 2001). Social capital is thus the most valuable asset possessed by organizations (Lesser 2000). Instead of examining the direct impact of KMS on knowledge management processes (eg. knowledge creation, transfer and sharing), this research investigates the effects of KMS on individual social capital, because social capital is a rich indicator of crucial organizational social resources (Yli-Renko, Autio et al. 2001) .

The research problems addressed in this study are concerned with the acceptance and use of KMS and the impacts of KMS use on end-users' (i.e., knowledge workers) social capital. The two research questions are as follows:

Q1: Why do end-users accept and use KMS? What are the fundamental determinants to users' acceptance and use of KMS? And

Q2: What are the impacts of KMS use on the end-user's (i.e., knowledge worker's) social capital?

1.2.2 Theories and Hypotheses

In the following section, a brief description of the development of theory and research models is presented, followed by a summary of the hypotheses derived from the research model. More details on the development of theory, research models, and hypotheses are presented in Chapter 3.

The knowledge-based theories of the firm see an organization as a distributed knowledge system (e.g., Grant 1996; Tsoukas 1996; Sveiby 2001), and/or knowledge-based activity system (e.g., Spender 1996; Spender 1996; Nonaka, Toyama et al. 2000) in which individuals, tasks, technology (KMS), organizational structures and procedures are interwoven together. As a result, KMS should be investigated from a systematic and integrated perspective. Organizational knowledge is socially constructed, emerging, and dynamic in nature (Tsoukas 2000; Brown and Duguid 2001). Accordingly, a dynamic and evolutionary perspective is essential for interpreting KMS in organizations. Spender (1996) suggests that socio-technical systems theory (Fox 1995; Coakes 2002) and

structuration theory (Spender 1996; Orlikowski 2000) may be required to examine knowledge management (including KMS) from a systematic, dynamic, and longitudinal perspective. While socio-technical systems theory provide a systematic framework to represent the main system components (e.g., KMS, people, tasks, organizational structures, and environment) and the interrelations between these components (Coakes 2003), structuration theory or adaptive structuration theory (AST) describes the evolution and dynamics of the socio-technical system from a longitudinal perspective (DeSanctis and Poole 1994; Orlikowski 2000). As a result, two KMS research models (frameworks) have been developed: a socio-technical system framework of KMS and an AST-based KMS success model.

The socio-technical framework of KMS was developed for modelling KMS in organizations based on the five-components socio-technical model proposed by Coakes (2002). The socio-technical framework sets out the main KMS components, namely

- The technical components.
- Knowledge workers as end-users and as individual knowledge resources.
- Tasks performed by knowledge workers.
- Networks as channels for knowledge sharing, and
- Organizational environment and interrelations (see Chapter 3 for more details).

The AST-based KMS success model represents dynamic and evolutionary KMS in organizations, based on the adaptive structuration theory suggested by DeSanctis and Poole (1994). The AST-based KMS success model focuses on the appropriation of KMS, and includes the determinants to a user's appropriation of KMS and the impacts of KMS appropriation on an individual's social capital. The AST-based KMS success model represents the socio-technical model of KMS in a longitudinal way, and reflects a system-to-value chain of KMS.

Following the suggestions by Alavi and Leidner (2001), the major determinants to user acceptance and use of KMS come from a review of the IS success models, which include:

- The DeLone and McLean IS success model (DeLone and McLean 1992;

DeLone and McLean 2003).

- The Technology Acceptance Model (TAM) (Davis 1986; Davis 1989).
- The Task-Technology-Fit (TTF) model (Goodhue and Thompson 1995), and
- The System-to-Value chain (Doll and Torkzadeh 1991).

As a result, information quality (DeLone and McLean 2003), task-technology fit (Goodhue and Thompson 1995), perceived usefulness (Davis 1989), perceived ease of use (Davis 1989), and social norms (Lucas and Spitler 1999) are chosen as determinants of user acceptance and use of KMS. Performance-related use (Doll and Torkzadeh 1991; Doll and Torkzadeh 1998) is designed as a multidimensional construct for representing the richness of the use of KMS in organizations (DeLone and McLean 2003). Given that knowledge-sharing in organizations is mainly through communities (Mertins, Heisig et al. 2003; Nielsen and Ciabuschi 2003), KMS usage is oriented to support the learning processes in communities, i.e., a process of " *negotiation of meaning*" by participation and reification (Wenger 1998; Wenger, McDermott et al. 2002). As a result, the performance-related use of KMS is operationalized into two sub-constructs: interaction-related use of KMS and information-related use of KMS.

Apart from the user acceptance and use of KMS, the second research question addresses the effect of KMS use on the user's social capital. This research uses Nahapiet and Ghoshal (1998)'s definition of social capital, which is operationalized into three sub-constructs, personal networks, trust level, and shared vision (Tsai and Ghoshal 1998).

A set of hypotheses was developed based on the literature review and the AST-based KMS success model. The major hypotheses are listed in Table 1.1, each of them being developed into a number of subsidiary hypotheses.

Number	Hypothesis
H1	Performance-related use of KMS will have a significant positive impact on the user's social capital development.
H1a	Information-related use of KMS will have a significant positive impact on interaction-related use of KMS.
H1b	Interaction-related use will have a significant positive impact on users' personal networks expansion.
H1c	Interaction-related use will have a significant positive impact on the development of trust between colleagues.
H1d	Interaction-related use will have a significant positive impact on shared vision between colleagues.
H1e	Users' personal networks expansion will have a significant positive impact on the development of trust between colleagues.
H1f	Users' personal networks expansion will have a significant positive impact on the shared vision between colleagues.
H1g	Shared vision will have a significant positive impact on the development of trust between colleagues.
H2	Perceived usefulness of KMS will have a significant positive impact on performance-related use of KMS.
H2a	Perceived usefulness of KMS will have a significant positive impact on information-related use of KMS.
H2b	Perceived usefulness of KMS will have a significant positive impact on interaction-related use.
H3	Social Norms will have a significant positive impact on performance-related use of KMS.
H3a	Support from management and peers in using KMS will have a significant positive impact on information-related use of KMS.
H3b	Support from management and peers in using KMS will have a significant positive impact on interaction-related use of KMS.
H3c	User's desire to please management and peers by using KMS will have a significant positive impact on information-related use of KMS.
H3d	User's desire to please management and peers by using KMS will have a significant positive impact on interaction-related use of KMS.
H4	Information Quality will have a significant positive impact on performance-related use of KMS.
H4a	Information content quality will have a significant positive impact on information-related use of KMS.
H4b	Information services quality will have a significant positive impact on information-related use of KMS.
H5	Information Quality will have a significant positive impact on perceived usefulness of KMS.
H5a	Information content quality will have a significant positive impact on perceived usefulness of KMS.
H5b	Information services quality will have a significant positive impact on perceived usefulness of KMS.
H6	Perceived ease of use of KMS will have a significant positive impact on perceived usefulness of KMS.

Table 1.1 Summary of Hypotheses

1.2.3 Contributions

This research makes several contributions to the knowledge management and knowledge management systems research that will be presented in section 6.2. The contributions can be summarized as follows:

- A socio-technical system framework of KMS and a comprehensive KMS success model have been developed. The KMS success model has been tested across a variety of organizations and KMS; the framework of KMS and the KMS success research model provide a basis for further study.
- A set of survey instruments for KMS has been developed and validated across a variety of organizations and KMS. These would help organizations to investigate and diagnose their KMS and to improve their decision-making on investment in-and operation of KMS.
- A set of potential critical determinants to users' acceptance and use of KMS has been identified and studied across a variety of organizations and KMS. The results have demonstrated the different levels of impacts of these factors on the users acceptance and use of KMS.

The study has confirmed that knowledge management technology systems (KMS) do have the expected significant effects on social capital development, a critical social infrastructure for knowledge management. The significant positive impacts of KMS use on three dimensions of social capital development - structural, relational, and cognitive dimension - has been assessed, and significant findings have been made.

Methodologically, two main complementary structural equation modelling methods - PLS and Covariance-based (LISREL) - were applied to the instrument development, data analysis and hypothesis testing, which enhanced the accuracy and reliability of the findings.

1.3 Justification for the Research

The research problems in this research are considered significant and important both in a theoretical sense and in a practical sense. Firstly, more and more organizations have been seeking improved performance by investing large sums of money in knowledge

management systems (Davenport and Prusak 1998; Nielsen and Ciabuschi 2003). In order to introduce KMS, the costs and benefits of KMS need to be justified. Secondly, knowledge is fundamentally different from information, and leveraging knowledge involves a unique combination of human systems and information technologies (McDermott 1999). The application of information technology to support knowledge management raises new research and practitioner challenges. Although KMS has been extensively applied to support knowledge management in organizations, little relevant IT research on the design, use, and success of KMS is found in the literature (Alavi and Leidner 2001). Therefore, it is important to examine how KMS is used by knowledge workers within organizations, answering such questions as

- What are the key determinants to the users' acceptance and use of KMS in their daily work?
- How does the use of KMS affect organizational knowledge management?
- What is the actual role of KMS in the support of knowledge management?

In addition, identifying and choosing the suitable significant dependant variable for evaluating IT systems (e.g., KMS) success (DeLone and McLean 1992), is a crucial and significant issue in research on KMS, as the choice of dependant variables needs to reflect the definition and interpretation of what is the KMS designed and used for.

Thirdly, research on the measurement and evaluation of KMS success has significant implications for organizations and KM practitioners. As knowledge is recognized as the most important resource for business development and competitive advantage in the current turbulent and dynamic business environment, organizations who have implemented KMS need to be able to measure their use and effectiveness. Organizations and KM practitioners need to clearly understand what the valid criteria of KMS success are, and how to measure KMS success; this is in order to make better decisions in KM projects, and improve the management and operation of KMS. Accordingly, empirical research into the measurement and evaluation of KMS success should provide prescriptive guidelines and valid, reliable measures for organizations and KM practitioners.

In sum, there exist an obvious need for empirical research into the use and success of KMS in an organizational context. Knowledge management is becoming pervasive in

organizations, and organizational performance and competitive advantage rely heavily upon successful knowledge management systems. Organizations and KM practitioners need prescriptive guideline, and valid and reliable measures for evaluating KMS.

1.4 Methodology

According to Gallupe (2001), quantitative KMS study, such as surveys or field experiments, is required to energise the field. A Delphi study on the future of knowledge management conducted in the (Northern) winter 2001/2002 suggests that empirical study design, including survey study, is the most promising theoretical approach for KM (Mertins, Heisig et al. 2003).

This research follows the tradition of normative discourse, which is the dominant perspective in IS-based knowledge management research (Schultze and Leidner 2002). Normative discourse seeks to establish cause-effect relationships through hypothesis testing, and the research findings are assumed to be both generalisable and cumulative (Schultze and Leidner 2002). Nomothetic methods are found to be the dominant methods used in the normative discourse. In addition, the positivist perspective is also the dominant methodology for the study of information systems success measurement (Kraemer 1991; Garrity and Sanders 1998). Given the nature of the research in this thesis (e.g., research model and hypotheses), a survey is considered to be the most suitable methodology to tackle the research questions.

As the main research design associated with the normative discourse, surveys are used as the data collection method for this research. An Internet self-administered survey (web-based survey) was considered to be a suitable data collection method, and was used for two time-cross-sectional data collections, one for pre-testing the survey instruments and one for validation of the survey instruments and for hypothesis testing. Internet self-administered surveys have unique strengths compared with other, more conventional survey methods. Internet surveys can rapidly reach a large group of people, regardless of their location. Hence their use provides access to a wide population (Zikmund 2000; Simsek and Veiga 2001). An Internet survey process is easy to manage. More importantly, the target population of this research, the knowledge workers, is considered to be dispersed and have the opportunity to access and use the Internet in their daily work, which makes them well suited to a Web-based survey.

Structural Equation Modeling (SEM) techniques are used to analyze data, including the validation of survey instruments and hypothesis testing (Gefen, Straub et al. 2000). SEM is recommended as an important second generation statistical technique for high quality information systems research (Gefen, Straub et al. 2000; Boudreau, Gefen et al. 2001; Chin, Marcolin et al. 2003). Two main complementary structural equation modelling methods - partial-least-squares (PLS)-based and Covariance-based (LISREL) - are used in this research. More details on SEM methods can be found in Chapter 4.

Survey instruments were adapted from previous validated questionnaires whenever possible. All instruments have been strictly validated so as to make them suitable for this specific research context. The application of both LISREL and PLS in the development of questionnaires, model testing and hypothesis testing enhanced the accuracy and reliability of the findings (Gefen, Straub et al. 2000; Chin, Marcolin et al. 2003).

1.5 Outline of This Thesis

The thesis presents the whole research process and findings, and is organized as follows. Chapter 1 provides an executive summary of the research process and contributions, including the background to the research, the research problems, the research hypotheses, the methodology, the justification for the research, definitions of key terms, and key research assumptions. Chapter 2 discusses the research issues, presents a literature review of knowledge, knowledge management, and knowledge-based theories of the firm, and sets out the research questions.

Chapter 3 focuses on developing the knowledge management systems (KMS) research models and deriving the research hypotheses. A socio-technical system framework of KMS and an AST–based KMS research model are established. The AST-based KMS research model is operationalised into an AST-based KMS success model. Chapter 4 presents a detailed discussion of the research methodology, including the choice of research approaches and assumptions, the survey data collection methods, Structural Equation Modeling (SEM) techniques, sampling design and unit of analysis, initial survey questionnaire development, data collections, and pre-test of the survey instruments.

Chapter 5 focuses on data analysis, including a strict validation of the survey

instruments, following by model and hypothesis testing. Chapter 6 presents the research conclusions and implications, summarises the main findings of the research, explores the implications for theory, methodology and practice of the findings, addresses the research limitations and highlights the potential areas for the future study.

1.6 Definitions

As an emerging area of knowledge management systems research, the definitions adopted by researchers are often not uniform for many key and controversial terms, so key terms used in this thesis are defined below. The definitions are further elaborated in the literature review.

Community of practice is defined by Wenger, McDermott et al. (2002) as follows:

"Groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (p. 4).

Knowledge is defined by Davenport and Prusak (1998) as:

"A fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information" (p.5)

Knowledge management is defined as systematic and explicit ways to build knowledge infrastructures, e.g., KMS, social networks, procedures, culture, and policies, to enable and enhance knowledge creation and sharing by providing time, space, and tools for interaction and collaboration (Davenport and Prusak 1998; Wenger, McDermott et al. 2002).

A knowledge management system is defined as a technology system implemented and used to integrate organizational knowledge resource in order to help people in organizations efficiently and effectively to obtain the knowledge they need to perform their tasks.

Knowledge workers are professionals, technicians and management staff who have

high levels of formal education, are more empowered and able to use his/her intellective and social skills in more autonomous and creative ways, and whose work is the production and reproduction of information and knowledge (Schultze 2003).

Structuration Theory is defined by Orlikowski (1992) as a framework to embrace both objective and subjective conceptions of information systems in organizations, which has been used to study the organizational adoption of information technologies.

Adaptive Structuration Theory (AST) is defined by DeSanctis and Poole (1994) as a framework for studying variations in organizational change that occur as advanced information technologies are used. Advanced information technologies trigger adaptive structurational processes which, over time, can lead to changes in the rules and resources that organizations use in social interactions, which, in turn, are the key determinants of social outcomes (e.g., decision outcomes, new social structures and relationships).

A **Socio-Technical system** (STS) is defined as a set of principles and systematic methods for organizational design to achieve the joint optimization of the social and technological subsystems of an organization (Ryan and Harrison 2000).

Internet surveys are an important means of data collection in organizational studies due to the universal use of Internet (Zikmund 2000). Generally speaking, there exist two types of Internet surveys, email-based surveys and Web-based surveys (Simsek and Veiga 2001).

Social capital is defined by Nahapiet and Ghoshal (1998) as:

> *"The sum of the actual and potential resources embedded within, available through, and derived from the network of relationship possessed by an individual or social unit. Social capital thus comprises both the network and the assets that may be mobilized through that network" (p. 243).*

Task-Technology Fit (TTF) is defined by Goodhue and Thompson (1995) as

> *"The degree to which a technology assists an individual in performing his or her portfolio of tasks" (p. 216).*

1.7 Key Assumptions and Delimitations of Scope

This research makes a number of assumptions, which are expressed briefly as follows.

Knowledge lives in the human act of knowing, and thus is socially constructed and a capacity to act (Wenger 1998; Orlikowski 2002).

Knowledge remains mainly tacit or tacit-based, thus there are limits to its codification (Sveiby 1999; Tsoukas 2000; Tsoukas and Vladimirou 2001).

Tacit knowledge and explicit knowledge are inseparably related and mutually constituted, and the understanding and sharing of explicit knowledge relies upon sharing the relevant tacit knowledge (Tsoukas 2003).

The main purpose of KM is to promote knowledge creation and sharing, which is mainly achieved through social networks and communities (Cohen and Prusak 2001; Wenger, McDermott at el. 2002).

KMS enables KM (e.g., knowledge sharing and learning) by connecting people, enabling people interactions, and fostering trusted social networks among knowledge workers (Alavi and Leidner 2001).

Knowledge management is closely linked to the development of social capital, and communities of practice (Wenger, McDermott et al. 2002; Swan 2003).

The target population for the surveys in this thesis is restricted to the knowledge workers who are able to, and have the resources to access the Internet. The sampling frame can only be established through available public Internet resources, such as listservs, professional discussion groups, and university academic staff directories (Simsek and Veiga 2001). The organizational contexts of the target population are assumed to be knowledge-intensive organizations, such as educational institutions, government agencies and high-tech firms.

These assumptions may impose limitations to this research, which may in turn add limitations to the applicable scope of research findings.

1.8 Conclusion

This chapter provided an executive summary of the research, and laid the foundations for the thesis. It briefly reviewed the background to the research, and introduced the research problems and hypotheses. The research was then justified, the methodology was briefly addressed and justified, the definitions of key terms were presented, the thesis was outlined, and followed by brief articulations of the key assumptions and the limitations. On these foundations, the thesis can proceed with a detailed description of the research.

2 Knowledge and knowledge management systems

2.1 Introduction

This chapter discusses the theoretical background of the research undertaken in this thesis. It starts with a review of the application of IT systems to knowledge management, followed by a review of existing research on KMS. It then examines the literature of knowledge, knowledge processes, the knowledge-based theories of the firm, and knowledge management practice. However, the review focuses only on relevant aspects of the literature, and is not, by any means, a comprehensive literature review of the whole emerging and evolving knowledge management area. The literature review leads to definitions of the terms "knowledge", "knowledge management", and "knowledge management systems" in a specific context. The review also discusses the research questions.

This chapter is organized as follows. Section 2.2 addresses the status of KMS in modern knowledge management, Section 2.3 reviews existing relevant research on this issue. Section 2.4 focuses on the fundamental concepts and nature of knowledge, and the details of knowledge processes of creation and sharing. Section 2.5 discusses knowledge-based theories of the firm, providing a broader context for understanding organizational knowledge management activities and highlighting viable research approaches for tackle the KMS issues. Section 2.6 reviews knowledge management practice in organizations, resulting in a definition of KMS and the specific research questions. Finally, a summary of the chapter is presented in Section 2.7.

2.2 The Issues

According to Davenport, Prusak et al. (2003), the modern knowledge management movement originated from early 1990s, signalled by the first formal conference on knowledge management, which was held in Boston in early 1994. Since then, increasing numbers of organizations have been seeking improved performance by investing in knowledge management projects (Davenport and Prusak 1998; Davenport, Prusak et al. 2003).

Prusak (2001) suggested three critical factors that might account for the emergence of

modern knowledge management. One of the three is ubiquitous computing (Prusak 1997). In fact, modern information technologies have played an active role in organizational knowledge management. For instance, a study of 431 USA and European organizations, conducted in 1997 by the Ernst & Young Center for Business Innovation, showed that the majority of investments for KM projects surveyed were in IT systems such as intranets, data warehousing, knowledge repositories, decision-support tools, and groupware to support collaboration (Ruggles 1998). It was estimated by the Gartner Group that knowledge management software and consulting services was a US$1.5 billion market in 1998 and was expected to be a US$5 billion market by 2002 (cf. Lucier and Torsilieri 2001). Recently, a forecast suggests the corporate investment on KMS might grow to US$13 billion annually by 2007 (Anonymous 2004).

The IT systems designed and used for KM purposes are referred to knowledge management systems (KMS) (Gallupe 2001). While KMS has been widely used in organizational knowledge management initiatives and knowledge management is becoming pervasive in today's organizations, the actual value of KMS in knowledge management still remains one of the biggest concerns for most organizations (Smith and McKeen 2003).

Although KMS has been extensively applied to support knowledge management in organizations, relevant IT research on the design, use, and success of KMS is still sought (Alavi and Leidner 2001). Like Information Technology, the successful design and implementation of KMS does not ensure the appropriate and effective use of that KMS. Therefore, it is important and significant for research to empirically investigate a number of questions on the use of KMS in organizations. These include:

- Is KMS accepted and used by knowledge workers within organizations?
- What are the key determinants to the users' acceptance and use of KMS in their daily work?
- How does the use of KMS affect organizational knowledge management?

In summary, the concerns can be summarised in two research questions:

Q1: Do people accept and use KMS in organizations?

Q2: What value does KMS bring to organizations?

2.3 Existing Relevant Research

According to a comprehensive literature review and analysis conducted by Gallupe (2001), most KMS-related research was in knowledge codification and storage (e.g., Poston and Speier 2005): relatively little research was found to be focused on using KMS for knowledge creation and sharing, for identifying and solving new problems, or for training. Furthermore, most research was descriptive, with anecdotal case studies or conceptual arguments; very few studies that investigate KMS use quantitative techniques. As a result, Gallupe (2001) called for more rigorous studies of KMS, using survey studies, field studies, and experimental study methods to assess the effects of KMS on organization and on people.

Similarly, as indicated in a comprehensive literature review by Alavi and Leidner (2001), little research exists on the use and success of KMS. As a result, there are large gaps in the body of knowledge, in terms of knowledge management theory and corresponding empirical work. In other words, there is still a lack of substantial empirical study on how KMS is used in organizations and the impact of KMS on organizational knowledge management (Alavi and Leidner 2001; Schultze and Leidner 2002).

Recently, however, some relevant empirical research has been published. Desouza (2003) examined the use of KMS in software engineering. He identified three major hurdles which prevented the effective use of KMS:

- Firstly, people resisted being known as an expert due to a perceived disadvantage in advancing their careers.

- Secondly, knowledge is highly tacit in nature, very hard to codify into explicit knowledge, and the cost of codification on average usually outweighs the perceived benefits.

- Thirdly, the alternatives to using KMS, such as dialogue with peers, are more effective and efficient than KMS. (Desouza 2003).

As the majority of KMS in the study were designed for managing explicit knowledge through codification (Hansen, Nohria et al. 1999), these barriers highlight the serious limitations to the usefulness of codification-based KMS (Desouza 2003). Moreover, a significant result drawn from the research is that KMS should encourage dialogue between individuals, and enable tacit knowledge sharing by fostering communication

and collaboration (Wagner 2004).

Moffett, McAdam et al. (2003) examined the relationships between information, culture, people, and technical aspects of KM within organizations using survey research. Their study was based on a conceptual model of KM, the MeCTIP model, which consists of five key factors which affect adoption of knowledge management within organizations (Moffett, McAdam et al. 2003). These are:

- The macro environment.
- Culture.
- Technology.
- Information.
- People.

The research revealed that 43% of the surveyed organizations had adopted a technical approach to KM, i.e., their KM was technology orientated, and a strong relationship was found to exist between the key factors (Moffett, McAdam et al. 2003). This research emphasizes the necessity of studying KM from a balanced perspective of people, culture, and technology.

Feng, Chen et al. (2005) empirically investigated the impacts of adopting KMS on organization performance. The analyses were conducted using secondary data which came from the financial data extracted from the COMPUSTAT database for a set of selected organizations taken from the clients bases of KMS vendors. The KMS vendors were chosen from a list which appeared in KM World Magazine (March 2003 issue) (Feng, Chen et al. 2005). The results of these analyses revealed that the firms that had adopted KMS gained a competitive advantage over non-adopters in terms of ROA (Return on Assets), ROS (Return on Sales) and ATO (Asset Turnover) (Feng, Chen et al. 2005). These results may not be rigorous or reliable because of the research method and design, and the use of secondary data. However, the research represents an attempt to assess the contribution of KMS to firm performance across industry sectors. Similarly, Tanriverdi (2005) empirically examined the impacts of IT systems on firm performance by associating IT relatedness of business unit and cross-unit KM capability in the multi-business context. The research revealed that IT relatedness (defined and measured by shared IT infrastructure, IT strategy-making processes, IT human resource management processes, and IT vendor management processes (Tanriverdi 2005) enhances cross-unit

knowledge management capability defined as

> *"The firm's ability to create, transfer, integrate, and leverage related knowledge*
> *across its business units" (p314),*

which in turn results in increased financial performance for the firm in terms of ROA (Tanriverdi 2005).

In sum, although the lack of rigorous studies investigating KMS using quantitative techniques has been partly remedied, according to the literature the systematic assessment of KMS success still remains to be investigated.

In order to explore the research issues raised above, it is necessary to start by reviewing relevant studies of knowledge and knowledge management, to help to understand the issues from a broader perspective.

2.4 Knowledge in Organizations

Knowledge is a complex, multi-layered, and multifaceted phenomena (Blackler 1995; Swan 2003). Accordingly, it is essential to approach knowledge from multiple perspectives.

The perspectives of knowledge are the key to understanding and analysing personal and organizational knowledge, knowledge strategies and knowledge management systems, since different views of knowledge will lead to different principles for managing knowledge, formulating knowledge strategy, and designing and implementing knowledge management systems (Alavi and Leidner 2001; Yoo and Ifvarsson 2001).

In knowledge management literature, there exist multiple perspectives on knowledge (von Krogh 1998; Holsapple 2003). They all have had an impact on knowledge management theory and practice. Of these, two major perspectives are discussed, namely the knowledge vis-à-vis information perspective, and the constructionist perspective.

2.4.1 Knowledge vis-à-vis Information

The knowledge vis-à-vis information perspective is referred as the hierarchical view of

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data, information, and knowledge (Davenport and Prusak 1998; Holsapple 2003). In the knowledge vis-à-vis information perspective, information is the key to the understanding of knowledge, which can be interpreted from different perspectives.

From an knowledge vis-à-vis information perspective, knowledge can be interpreted from a view of usability and value (Holsapple 2003), a view of information and information processing (Beckman 1999), and a view of action-oriented information (Sveiby 1997). These are discussed in the following paragraphs.

Knowledge can be differentiated from information in terms of its usability and value (Holsapple 2003). Knowledge is viewed as more usable and valuable than information; meaning and relevance are the keys to understanding the difference between information and knowledge. The state of usability and value is dependent on context, and the dividing line between knowledge and information is relative to such factors as the processor, the current task and timing (Holsapple 2003). This means that knowledge may change into information if any of the factors of context, actor, task and timing has been changed (Holsapple 2003).

Knowledge can be interpreted from an information and information-processing viewpoint. For instance, Beckman (1999) views knowledge as organized information applicable to problem solving. Similarly, Turban (1992) sees knowledge as information that has been organized and analysed as being understandable and applicable to problem-solving, and Beckman (1999) emphases that knowledge is reasoning about information and data. Gillette (2002) views that knowledge is the ability to recognize, to comprehend, and to select information, and (Wang and Plaskoff 2002) see knowledge as information with personal or organizational insights and experiences. Dretske (1981) treats knowledge as authenticated information and personalized information related to facts, ideas, concepts, interpretations, procedures, models, observations, and judgments (Davenport and Prusak 1998; Alavi and Leidner 2001).

In addition, knowledge is also considered as information processed in the minds of individuals (Alavi and Leidner 2001). This view assumes that information and knowledge can be changed mutually via human cognitive processes, that is, information is converted to knowledge when it is processed in the mind of individuals, and human knowledge turns to information once it is articulated and presented in the form of

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symbolic systems (e.g., text, graphics, and words). Thus, a significant implication of this view of knowledge is that for individuals to reach the same understanding of data and information, they must share a certain knowledge background (Davenport and Prusak 1998; Alavi and Leidner 2001).

Knowledge can be viewed as relevant, actionable, and experience-based information, which is subjective (e.g., relevant to personal experience), and linked to meaningful behaviour (e.g., actionable) (Leonard and Sensiper 1998). Apart from viewing knowledge as an outcome from information, knowledge is also considered as a condition for access to information and a capacity to utilize information. For instance, Watson (1999) argues that knowledge is the capacity of utilizing information rather than taking action.

In summary, it is clear from the KM literature that the relationship between knowledge and information can be thought of in many ways (e.g., Nonaka and Takeuchi 1995; Leonard and Sensiper 1998; Miller 2002; Wilson 2002). Callaghan (2002) notes that

> *"...perhaps the greatest confusion lies in distinguishing between information and knowledge" (p32).*

Having drawn a clear distinction between knowledge and information, Nonaka and Takeuchi (1995) argue that knowledge is different from information, because knowledge is concerned with beliefs and commitment, and is action-oriented. Unlike knowledge, information is not necessarily related to perspective and intention or to action. According to Nonaka and Takeuchi (1995):

> *"Information is a flow of messages, while knowledge is created by that very flow of information, anchored in the beliefs and commitment of the holder" (p. 58).*

However, the knowledge vis-à-vis information perspective suffers from a number of problems. In particular, it equates information to knowledge (e.g., codified knowledge) (Davenport and Prusak 1998; Alavi and Leidner 2001). This leads to the misuse of the terms "knowledge" and "information" and a disproportionate emphasis on information

processing and information technology in knowledge management (Nonaka and Takeuchi 1995; Sveiby 1997). Therefore, this view of knowledge is appropriate for IT professionals, because knowledge management systems designed to support knowledge management in organizations may not be radically different from other forms of information systems, except for having functions which enable users to assign meaning to information and to extract knowledge from information and/or data (Alavi and Leidner 2001).

In summary, the knowledge vis-à-vis information perspective can not represent the rich nature of knowledge, such as emergence, dynamics, and evolution (Nonaka and Takeuchi 1995; Tsoukas 2000).

2.4.2 The Constructionist Perspective

The constructionist perspective views knowledge as an act of construction or creation instead of an act of representation (von Krogh 1998). Knowledge has to be recreated, rather than copied and memorized (Kogut and Zander 1992; von Krogh 1998). Knowledge constructionists believe that knowledge is embedded in humans, and is closely tied to a human's senses and to previous experience, so knowledge is unique to each individual (Polanyi 1967; Polanyi 1969; Sveiby 1999).

Thus, knowledge is seen as subjective and closely related to human action (Nonaka and Takeuchi 1995). Sveiby (1997) views knowledge as a capacity to act. According to him, knowledge is a process of simultaneously knowing and acting (Sveiby 1997). Similar opinions are held by a number of other authorities (e.g., Polanyi 1967; Nonaka and Takeuchi 1995; Spender 1996; Zack 1998; Tsoukas 2000). Consequently, knowledge can be regarded as both the capacity for human action and the results of human action (Nonaka and Takeuchi 1995; Sveiby 1997). The knowledge process relies heavily on the understanding of the context around the focused object or phenomenon, and the use of methods and tools to handle what is being focused on (Sveiby 1997).

The constructionist perspective emphasizes the social nature of knowledge (Brown and Duguid 1991). Given that humans are social beings, knowledge should be seen as socially constructed under a given social context (Sveiby 1997; Wenger 1998; Swan 2003). Knowledge is created and shared through social interactions, which are anchored

in a social context and are for specific purposes (Nonaka and Takeuchi 1995; Wenger 1998; Huang and Pan 2001; Wenger, McDermott et al. 2002; Swan 2003).

The constructionist perspective suggests that knowledge lives in the human act of knowing (Orlikowski 2002). Wenger (1998) suggests that knowledge, as the accumulation of experience, is the capacity to act (e.g., singing in tune). According to the social theory of learning proposed by Wenger (1998), knowledge is generated or obtained from the process of *"negotiation of meaning"* (p.52), which takes place in a context that combines a vast array of factors, such as environment, background, participants, time and space (Wenger 1998). Therefore, knowledge lacks meaning if separated from the context in which the knowledge has been created. The users of knowledge must understand the context in which it is generated and used, for the knowledge to have meaning to them. From the constructionist perspective, knowledge is socially constructed, not static, but emerging, dynamic, and evolutionary. It is always in a process of change.

In summary, the following comparative results regarding knowledge vis-à-vis information can be drawn from the discussion in Section 2.3.1 and 2.3.2:

- Knowledge is more valuable than information. Information comes from a process of adding value to data (Davenport and Prusak 1998). The meaning and value of information depends upon its receiver. Thus, the meaning and value of information is uncertain (Nonaka and Takeuchi 1995; Sveiby 1997).
- Knowledge is personal, emerging, dynamic, evolutionary, and actionable. Information, however, is not necessary relevant to perspective and intention, and action. Knowledge is a process of simultaneously knowing and acting, and organizational knowledge is created and transferred by social interaction among people (Brown and Duguid 1991; Brown and Duguid 1998).
- Information will lead to new meaning, and information is a necessary medium or material (trigger) to provoke and construct meaning (Davenport and Prusak 1998; Miller 2002). Thus, information will lead to knowledge creation (Nonaka and Takeuchi 1995; Sveiby 1997; Walsham 2001).

2.4.3 Working Definitions of Knowledge

As a multi-dimensions complex concept, there are numerous definitions of knowledge in the literature. As discussed above, these different definitions reflect different perspectives on knowledge. The following section reviews several broadly recognized working definitions of knowledge in the knowledge management literature.

As one of the pioneers of knowledge management, Wiig (2000) defines knowledge as:

> *"...truths and beliefs, perspectives and concepts, judgments and expectations,*
> *and methodologies and know-how processed by humans or inanimate agents"*
> *(p. 26).*

For him, knowledge consists of two parts: understanding, and information and rudimentary knowledge (Wiig 2000). Understanding is people based, and information and rudimentary knowledge may exist outside of a person's mind.

Davenport and Prusak (1998) define knowledge as

> *"...a fluid mix of framed experience, values, contextual information, and expert*
> *insight that provides a framework for evaluating and incorporating new*
> *experiences and information" (p.5).*

In their definition, knowledge is personal, fluid, and intuitive. Knowledge originates and is applied in the mind of the knower. Information is part of knowledge, and new knowledge derives from both practice (e.g. new experience) and information. This definition suggests viewing knowledge as both process and stock.

Nonaka and Takeuchi (1995) emphasize a process view of knowledge. They define knowledge as *"a dynamic human process of justifying personal belief toward the truth"* (p. 58). In their definition, knowledge is a dynamic process which resides within people. Personal belief, as the input of knowledge process, may come from practice and/or information. Thus, knowledge is an action-oriented process of knowing (Nonaka 1994).

Knowledge is defined as the individual capability to draw distinctions, within a domain of action, based on an appreciation of context or theory, or both (Tsoukas and Vladimirou 2001; Swan 2003). According to this definition, knowledge lacks meaning if divorced from the context of action in which it has been produced and accepted.

Knowledge, thus, is contextual, highly situated, subjective/inter-subjective and constructed through social relationships in particular contexts.

The above-mentioned definitions clearly distinguish knowledge from information. New knowledge is created from received information and new practice and experience. Knowledge cannot be copied, but can only be recreated. Knowledge is a complex and multi-facet notion with a mixture of intellectual elements. This thesis sees knowledge as both a dynamic process (i.e., knowledge as being socially constructed) and as stock (i.e., knowledge as the results of social construction), and views information as a trigger to knowledge creation. As a result, knowledge is considered to be fundamentally different from information in nature, and there is a discontinuity from information to knowledge (Davenport and Prusak 1998).

2.4.4 Knowledge Mode

Knowledge mode is used to describe and distinguish different types of knowledge. One widely recognized categorization is to see knowledge as duality, i.e., tacit knowledge vs. explicit knowledge (Polanyi 1967; Nonaka and Takeuchi 1995). While explicit knowledge is that which is articulated, codified, and written, tacit knowledge refers to knowledge that is highly personal and hard to express in symbolic systems (Nonaka and Takeuchi 1995; Davenport and Prusak 1998). Considerable research has been based on the mode attribute of knowledge (e.g., Nonaka 1994; Nonaka and Takeuchi 1995; Sveiby 1997; Sveiby 1999).

All knowledge originates from tacit knowledge (Polanyi 1967; Sveiby 1999; Tsoukas 2003). Tacit knowledge is acquired primarily through experience. It is personal, subjective, context-specific, and comes from an individual's purposeful endeavours in dealing with the world (Sveiby 1999; Tsoukas 2003). Tacit knowledge can be viewed as a construct with three elements, a cognitive element, an emotional element, and a technical element (Nonaka and Takeuchi 1995).

According to Nonaka and Takeuchi (1995), the cognitive element consists of an individual's mental models, such as paradigms, perspectives, schemata, beliefs, and worldviews, which help the individual to perceive and define their world. It refers to an individual's images of reality and visions for the future (Nonaka and Takeuchi 1995).

Human beings create, update, and modify their working model of the world by making and manipulating analogies in their minds and forming mental models (Nonaka and Takeuchi 1995). The cognitive part of tacit knowledge is always in the process of development (Nonaka and Takeuchi 1995). The emotional element includes an individual's emotions, feelings, and motivations, and is a vital component of that person's knowledge (Sveiby 1999). The technical element includes concrete tacit knowledge, such as know-how and skills which help individuals deal with the tasks they face (Nonaka and Takeuchi 1995). These three elements interact with each other to create new knowledge (Nonaka and Takeuchi 1995).

Tacit knowledge relies on human beings, is practice-oriented, and has strong subjective features (Tsoukas 2003). Human beings' emotions, feelings and their specific mental model have major impacts on the creation of tacit knowledge. However, although tacit knowledge is individual-specific, the outcome that is derived from the use of tacit knowledge may be objective (Sveiby 1999). For example, if an individual watches, say, a gymnastic competition, he might believe that the judges give different scores to a participant based on their own specific tacit knowledge, but in fact the judgments are not arbitrary, but close to a potential standard (the mean). That means their understanding about the activity is not subjective (Sveiby 1999).

The relationship between the cognitive element, the emotional element and the technical element may have a significant influence on the features of the technical element of tacit knowledge (Nonaka and Takeuchi 1995). This may lead to some tacit knowledge relying on its creators' specific mental models and emotions. A significant implication of this relationship is that some tacit knowledge may be easy to articulate, and some may be difficult to articulate depending on the relationship among the three elements. Another implication of this relationship is that the mutual trust among individuals may be the most important precondition for effective and efficient knowledge sharing, because individuals' emotions, feelings, and mental models have to be shared to build mutual trust (Nonaka and Takeuchi 1995). Since tacit knowledge is context-specific, experience-based, and includes cognitive and emotion elements, it is specific and thus is difficult to copy. As a result, organizational tacit knowledge-based core competence may create real competitive capability (Kayworth and Leidner 2003).

Some tacit knowledge can be articulated and codified by people using formal symbolic systems such as words, numbers, diagrams and tables, into, for example, text, scientific formulas, computer programs or product specifications (Nonaka and Takeuchi 1995; Davenport and Prusak 1998; Nickols 2000). Consequently, explicit knowledge is rooted in tacit knowledge, but this represents only a very small amount of entire body of knowledge (Polanyi 1967; Nonaka 1994; Nonaka and Takeuchi 1995; Sveiby 1997). Explicit knowledge is produced by a process of restructuring knowledge, representing knowledge in logic, context-free and objective ways (Davenport and Prusak 1998). Since explicit knowledge can exist independently, it is feasible to communicate explicit knowledge by information technology (Sveiby 1997). However, the effectiveness of sharing explicit knowledge through information technologies may be problematic (Walsham 2001). While the production of explicit knowledge is the result of a sense-giving process, and depends on the producer's tacit knowledge, the interpretation and absorption of explicit knowledge, as a process of sense reading, also relies on the receiver's tacit knowledge (Polanyi 1969; Walsham 2001). Thus, the effective and efficient transfer and sharing of explicit knowledge is similar to the transfer and sharing of tacit knowledge, and relies heavily on shared mental models and other common knowledge between people (Polanyi 1969; Sveiby 1997; Walsham 2001).

Explicit knowledge and tacit knowledge are not totally separate, but mutually complementary entities (Tsoukas 1996). On the one hand, it is very hard to elicit knowledge from an individual without distortion, because the individual's knowledge is a mix of cognitive, emotion and technical elements; on the another hand, any piece of explicit knowledge needs the relevant tacit knowledge to enable understanding and utilization of the explicit knowledge (Brown and Duguid 1998; Hildreth and Kimble 2002).

Apart from the tacit-explicit classification scheme, some researchers suggest classifying knowledge based on purpose and usage, such as know-what, know-how, know-where, know-why and care-why (Quinn 1996). Knowledge could also be categorized according to conceptual levels of knowledge, such as goal-setting or idealistic knowledge, systematic knowledge, pragmatic knowledge, and automatic knowledge (Brooking 1996). Furthermore, Collins (1997) classifies knowledge according to accessibility, as symbol-type knowledge, embodied knowledge, embrained knowledge, and encultured

knowledge. De Long and Fahey (2000) suggest that there are at least three distinct types of knowledge, i.e., human knowledge which is manifested in individuals' skill or expertise, social knowledge which exists only in relationships between individuals or within groups, and structured knowledge which is embedded in an organization's systems, processes, tools and routines. From the view of cognitive psychology, knowledge can be divided into two categories: declarative knowledge (know-what) and procedural knowledge (know-how) (Anderson 1976; Anderson 1993; Nickols 2000). These include causal (know-why) knowledge, conditional (know-when) knowledge, and relational (know-with) knowledge (Zack and Serino 2000; Alavi and Leidner 2001).

2.4.5 Organizational Knowledge

Organizational knowledge can also be approached from various perspectives. Grant (2001) views organizational knowledge as *"the result of aggregating and integrating individuals' knowledge"* (p.149), while assuming that all knowledge resides in human heads.

In addition to the knowledge embedded in an individual, a great deal of organizational knowledge is produced and held collectively (Brown and Duguid 2001). Collective knowledge originates from a group of people who work together in tightly knit groups (Brown and Duguid 1998; Boer, van Baalen et al. 2002). Such groups, which include formal working teams and informal communities of practice, are usually practice-oriented (Brown and Duguid 1991; Wenger and Snyder 2000; Brown and Duguid 2001). As the results of interactions, collective knowledge is heavily social in nature (Brown and Duguid 1998; Huang and Pan 2001). It is aligned to the collective work practice of employees in the specific organizational context. Thus, the social origins of collective knowledge make it very difficult to organize and propagate locally developed knowledge throughout an organization (Davenport and Prusak 1998; O'Dell and Grayson 1998). However, organizations exist as a mechanism to structure fragmented practices (Grant 1996). Thus, organizational knowledge can be viewed as a constellation of fragmented collections of locally developed collective knowledge and individual knowledge (Tsoukas and Vladimirou 2001).

Some authors consider organizational knowledge as a corporate asset (Sveiby 1997; Teece 1998). Organizational knowledge is readily generated through the purposeful

activities of organizations and their staff (Spender 1996). Organizational knowledge consists of employees' individual knowledge, collective knowledge (i.e., knowledge generated from collective work practice) and the knowledge embedded in the organizational structure, such as business routines, processes, technology, products and services, and customer relationships (Sveiby 1997; Teece 1998; De Long and Fahey 2000).

Organizational memory is one approach to the modelling and representation of organizational knowledge (Walsh and Ungson 1991; Stein and Zwass 1995). According to Stein and Zwass (1995), organizational memory can be viewed as a means by which knowledge from the past, experience, and events influence present organizational activities. Organizational memory consists of the general, explicit and articulated knowledge owned by an organization (e.g., information stored in electronic databases, codified knowledge stored in expert systems and documented organizational procedures and processes), and tacit knowledge residing in individuals and in networks of individuals (Skyrme 1999; De Long and Fahey 2000). Thus, organizational memory models an organization as a distributed knowledge system, emphasising the importance of establishing connections among distributed knowledge components (Tsoukas 1996; Skyrme 1999; Alavi and Leidner 2001).

2.4.6 Knowledge Creation

All functioning organizations create and use knowledge. All innovation is based on new knowledge (Leonard-Barton 1995), which is created within organization or acquired from outside (Davenport and Prusak 1998).

In the knowledge management literature, the theory of organization knowledge-creating is well accepted and widely recognized as the most significant perspective to understand knowledge-creating process (Nonaka 1994; Nonaka and Takeuchi 1995). Nonaka and Takeuchi (1995) see knowledge as a duality, i.e., tacit knowledge vs. explicit knowledge, and assume that new knowledge comes from an individual's cognitive processes and social and collaborative processes. They suggest that the organizational knowledge creation process can be understood from two dimensions, i.e. the ontological and epistemological dimensions (Nonaka 1994). From the ontological dimension, the process of transforming individual's knowledge to organizational knowledge is seen as

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a dynamic spiral (Nonaka, Toyama et al. 2001). As the individual is the source of new knowledge, organizational knowledge creation involves a process of integrating and amplifying the knowledge created by individuals (Nonaka, Toyama et al. 2000). Organizations not only provide support and context for individuals to create knowledge, but also organizationally amplify and crystallize individual's knowledge through the individual, group to organizational level (Brown and Duguid 1998; Nonaka, Toyama et al. 2000).

From the epistemological dimension, organizational knowledge creation involves a continual interplay between tacit and explicit knowledge (Nonaka 1994). According to Nonaka and Takeuchi (1995), the knowledge creation process involves four modes of knowledge conversion, namely socialization, externalization, combination, and internalization (SECI), and the four modes are called SECI processes (Nonaka 1994).

A model of organizational knowledge creation process consists of three elements (Nonaka, Toyama et al. 2001):

- The SECI process.
- Ba.
- Knowledge assets.

According to Nonaka, Toyama et al. (2001), the SECI process refers to a process of knowledge creation via interactions and conversions between tacit and explicit knowledge (Nonaka and Takeuchi 1995). The 'Ba' provides organizational shared contexts for creating and integrating knowledge (Nonaka, Toyama et al. 2001). The knowledge assets represent the inputs, outputs and moderators of the organizational knowledge creating process (Nonaka, Toyama et al. 2000).

Figure 2.1 depicts that how the three are related. A dynamic knowledge spiral that creates knowledge is formed via their interactions.

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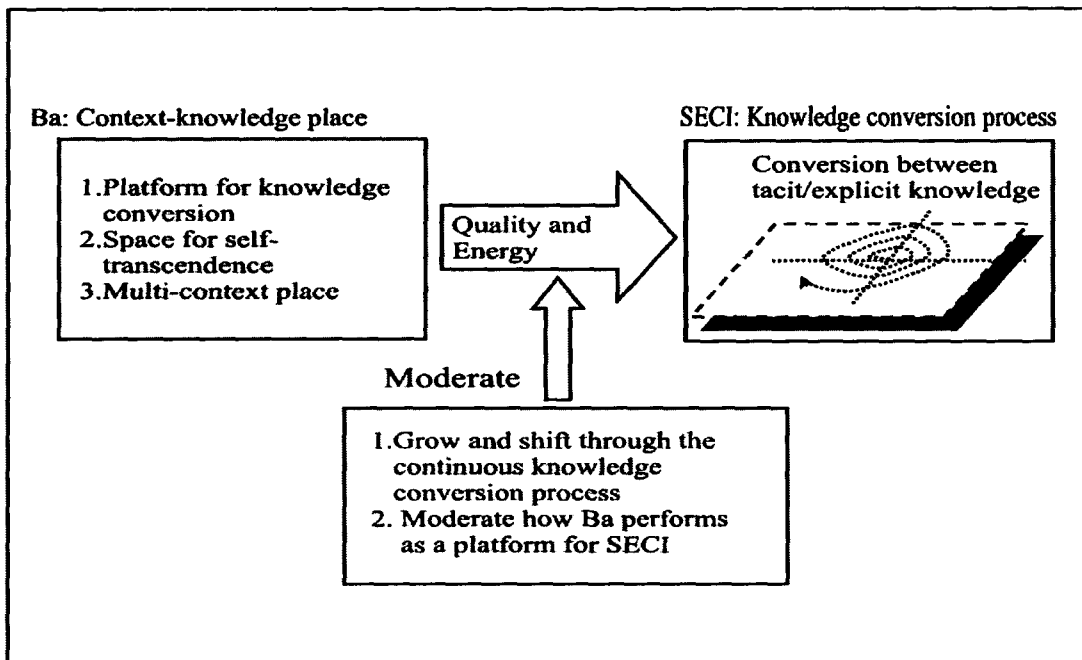
Source: (Nonaka, Toyama et al. 2001)

Figure 2.1 Three elements of knowledge creating process

The model of knowledge creation is centred on the SECI process, which consists of the socialization mode, the externalization mode, the combination mode, and the internalization mode (Nonaka 1994; Nonaka and Takeuchi 1995).

According to Nonaka and Takeuchi (1995), the socialization mode, from tacit knowledge to tacit knowledge, refers to the creation of new tacit knowledge such as technical skills and shared mental models, through the process of sharing experience, such as mentor relationships. The externalization mode, from tacit knowledge to explicit knowledge, refers to the process of articulating, formalizing, and codifying tacit knowledge, e.g., documenting insights. The combination mode, from explicit knowledge to explicit knowledge, refers to a process of creating new explicit knowledge by reorganizing, reclassifying, and synthesizing existing different bodies of explicit knowledge, such as writing a technical report or a product specification. The internalization mode, from explicit knowledge to tacit knowledge, refers to a process of making sense out of, and obtaining new insights from explicit knowledge and information, such as learning from a book.

The four knowledge creation processes are highly interdependent and intertwined (Nonaka and Takeuchi 1995). For instance, the socialization mode may rely on and benefit from the externalization and combination modes for completion, i.e., the tacit

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knowledge creation (e.g., new insight) and transfer (e.g. new technical skills training) can be facilitated by purpose-specific artefacts (e.g., documents, tools), which may be the results of the externalisation and combination processes (Nonaka and Takeuchi 1995). To complete the externalization process may need new insight and skills provided by the socialization process (Nonaka, Toyama et al. 2001). The internalisation process also benefits from new insights and skills obtained from the socialization process (Nonaka, Toyama et al. 2001). Finally, the internalization and externalization processes may provide the necessary intermediate steps for completion of the combination process, i.e., an individual makes sense out of existing explicit knowledge (i.e., internalization), and then codifies the new tacit knowledge into new explicit form (i.e., externalization) (Nonaka, Toyama et al. 2001).

According to Davenport and Prusak (1998), organization knowledge creation refers to following five explicit modes:

Acquisition: an organization inputs knowledge, which is new to the organization, from outside. The inputting behaviour usually involves purchases (e.g., buying an organization with the required knowledge or hiring individuals who have the required expertise), and rental (e.g., hiring a consultant).

Dedicated resources: an organization develops knowledge using the organization's dedicated units or groups (e.g. an R&D department within an organization).

Fusion: A process to bring together people with different perspectives and experience to work on a problem or project, and asking them to come up with a joint answer (e.g., brainstorming meeting, cross-divisional teams).

Adaptation: knowledge generation/creation driven by the intention and actions of an organizational change in response to changing outside environments (e.g., a competitor's challenges).

Networks: knowledge generation/creation through informal, self-organizing networks (e.g. communities of interests, communities of practice).

Adequate time and space devoted to people interaction and networking, and recognition of the importance of knowledge creation by managers are suggested to be the critical

factors for all of the four organizational knowledge creation modes (Davenport and Prusak 1998; Nonaka, Toyama et al. 2001).

2.4.7 Knowledge Transfer and Sharing

As an organization is considered to be a distributed cognitive system (Grant 1996; Tsoukas 1996), knowledge transfer and sharing are a critical issue for organizational knowledge management and performance (Davenport and Prusak 1998; Tanriverdi 2005). Knowledge-based strategies also view knowledge transfer as a vital part of the strategy (Sveiby 2001). In fact, knowledge transfer is part of everyday organizational life, and spontaneous and unstructured knowledge exchange could happen anywhere and at any time within an organization (Davenport and Prusak 1998).

Knowledge transfer refers to a process of knowledge transmission, absorption and utilization (Davenport and Prusak 1998; O'Dell and Grayson 1998). Thus it involves three actions: transmission (sending or presenting knowledge to a recipient), absorption, and utilization by that person or group. A successful knowledge transfer means that knowledge is transmitted to the recipient with reasonable speed and accuracy, the knowledge is absorbed properly and is put into action, leading to changes in behaviour or improvement of individual or organizational performance(Davenport and Prusak 1998). According to this definition, part success does not mean any success of knowledge transfer. If knowledge is not absorbed, recreated, and used effectively, it has not been transferred (Davenport and Prusak 1998).

Two indicators are suggested to measure the quality of knowledge transfer: velocity and viscosity (Davenport and Prusak 1998). According to Davenport and Prusak (1998), the velocity of knowledge transfer refers to the speed with which knowledge moves through an organization. It measures how quickly and widely knowledge is disseminated, and how quickly the people who need the knowledge become aware of it and get access to it. Viscosity refers to the richness of knowledge transferred. It measures the effect of absorption and utilization of the knowledge, i.e., how much of that which is being communicated is actually absorbed and used. According to Davenport and Prusak (1998), velocity and viscosity are often at odds, i.e., what enhances velocity may damage viscosity, and vice versa.

The quality of knowledge transfer is influenced by a number of factors (Davenport and Prusak 1998). Among them, five key factors are

- The perceived value of the source's knowledge.

- The motivational disposition of the knower (i.e., his/her willingness to share knowledge),

- The existence and richness of transmission channels,

- The motivational disposition of recipient (i.e., his/her willingness to acquire knowledge from outside), and

- The absorptive capacity of the recipient, defined as the ability not only to acquire and assimilate but also to use knowledge (Gupta and Govindarajan 2000).

According to Davenport and Prusak (1998), the first factor requires that people judge the information and knowledge accessed. People tend to judge the value of knowledge and information according to the status of the knower or provider. For instance, knowledge and information from a senior manager may be considered more important than that from a junior manager because of differences in status. The availability of more background information about the knower or provider will help knowledge seekers to make the right judgment.

The motivational dispositions of provider and recipient are closely related to organizational culture (Davenport and Prusak 1998; Liebowitz 1999; De Long and Fahey 2000; Kayworth and Leidner 2003). People tend to share their knowledge in an organization where cooperation and collaboration is encouraged and rewarded; people are unwilling to share their knowledge in a competition-intensive environment where people are evaluated and rewarded based on their individual performance. Moreover, trust is also a critical factor in determining people's willingness to share their knowledge (Ford 2003). People tend to help friends, or seek advice from somebody trusted by them (Nielsen and Ciabuschi 2003).

The existence of rich transmission channels is a necessary condition for transferring knowledge within an organization (Hansen 2002; Hayes and Walsham 2003). Two main channels for knowledge transfer are technology infrastructure (e.g., computer-based

information and communication networks) (Hayes and Walsham 2003) and human networks (e.g., formal and informal personal networks) (Cross, Borgatti et al. 2002). Technology networks and personal networks have different roles in knowledge transfer and sharing, and they can be complementary. Technology networks enable the fast transmission of information or knowledge, whereas personal networks improve the viscosity of knowledge transfer (Davenport and Prusak 1998). For instance, while technology provides a fast channel for explicit knowledge dissemination (e.g., structured knowledge), face to face communication provides the richest channel for tacit knowledge sharing (O'Dell and Grayson 1998).

The absorptive capacity of the recipient is the key to effective knowledge transfer. According to Davenport and Prusak (1998), trust and common ground (e.g., shared common language, shared context, and shared mental models) between the sender and recipient play key roles in the absorptive capacity of the recipient. For instance, if a recipient does not trust the sender, he or she may be reluctant to put the new knowledge into use, even he or she has understood and absorbed the knowledge. Effective knowledge transfer is far easier when participants use the same or similar languages (e.g., professional terms). The trust and common ground is called the bandwidth of the knowledge transfer channels (Sveiby 1997).

There are various kinds of knowledge transfer which happen within organizations (Davenport and Prusak 1998). Some knowledge transfers appear to be formal because of purposeful arrangements by the organizations (O'Dell and Grayson 1998). For instance, some organizations hold knowledge fairs to bring people together for knowledge sharing, and move people in order to replicate best practice (Cohen 1998; Davenport and Prusak 1998). Formal mentoring programs are set up for transferring tacit knowledge between seniors and newcomers (Sveiby 1997). However, knowledge transfer via informal channels is more common in organizations (Brown and Duguid 1991; Wenger and Snyder 2000; Cohen and Prusak 2001; Prusak and Cohen 2001; Cross and Prusak 2002). These channels include conversations at the water cooler, discussions by telephone or online forums, and other forms of sporadic information exchanges between individuals (Davenport and Prusak 1998).

The relative ease of knowledge transfer depends on the type of knowledge involved

(Sveiby 1997; Davenport and Prusak 1998; O'Dell and Grayson 1998). While explicit knowledge can be easily transferred via tools (e.g. Intranet, databases, documents, procedures) with reasonable accuracy and velocity, tacit knowledge and ambiguous knowledge are especially difficult to transfer from the source to the other parts of the organization; transfer generally requires extensive personal contact (Davenport and Prusak 1998). For instance, an effective way to transfer tacit knowledge is by means of working relationships, such as friendships (Cross, Parker et al. 2001), partnerships, mentorships or apprenticeships (Cohen and Prusak 2001).

2.4.8 Summary

From the review of literature, the following key points can be drawn:
- Knowledge is socially constructed, action-oriented, and human-related.

All knowledge originates from tacit knowledge, and any piece of explicit knowledge needs relevant tacit knowledge to enable understanding and utilization of the explicit knowledge.

- Knowledge creation is centred on the mutual conversion of tacit knowledge and explicit knowledge, and a process of new knowledge being socially constructed through human beings participating in social interactions.
- Knowledge transfer and sharing refers to a process of knowledge transmission, absorption and utilization, which relies closely on channels (i.e., computer networks and people networks), trust relationships between people, and common ground (e.g., shared common language, shared context, and shared mental models) between sender and receiver.

As a result, KMS can play an active role in organizational knowledge creation by enabling people networks and interaction, providing virtual spaces and opportunities for virtual collaboration (Majchrzak, Rice et al. 2000), and providing access to valuable information and explicit knowledge.

KMS can also play an important role in organizational knowledge transfer and sharing. Firstly, KMS can not only provides the necessary channels (e.g., computer networks)

for explicit knowledge transfer and sharing, but also create or enhance social networks among people (Wellman 1996), which may benefit tacit knowledge transfer and sharing within organizations. Secondly, KMS helps identify individual knowledge sources, and enables access to these knowledge sources (e.g., knowledge yellow pages and expert locators (Davenport and Prusak 1998)). Thirdly, KMS facilitates and supports online communities and online discussion forum for people interaction, which may foster shared mental models and trust among people (Wellman 2001).

2.5 Knowledge-based Theories of the Firm

As knowledge becomes the most important resource of organizational competitive advantage, a new theory of the firm is required in order to assist in the interpretation of firms and their activities, and to predict their structure and behaviours from a knowledge perspective (Kogut and Zander 1992; Spender and Grant 1996). In this section, three knowledge-based theories of the firm are addressed. These are the firm as a distributed knowledge system (Tsoukas 1996), the knowledge-flowing view of the firm (Sveiby 2001), and the dynamic knowledge-based view of the firm (Spender 1996; Spender 1996).

The review provides a systematic view for interpreting both organizations as knowledge systems and the role of information technology in organizational knowledge management.

### 2.5.1 The Firm as a Distributed Knowledge System

Tsoukas (1996) suggests a knowledge connectionist and distributionist view of the firm. According to Tsoukas (1996, 2000), a firm can be seen as a distributed and decentralised knowledge system. The firm's knowledge is continually constituted through the social practices undertaken by individual agents within a firm. These social practices are a combination of role-related social expectations, depositions, and interactive situations, and are continual-discrete events which happen when the practitioners confront local circumstances. Thus a firm's knowledge is emergent, distributed, and never complete at any point (Tsoukas 1996; Tsoukas 2000).

Tsoukas (1996) argues that tacit knowledge and explicit knowledge should not be viewed and treated as two separate types of knowledge. Instead, they are inseparably related and mutually constituted; explicit knowledge is always grounded on a tacit component and all knowledge has a necessary tacit component. Tsoukas (1996) further suggests that organizational knowledge, constituted with articulated knowledge and unarticulated background, is carried by a firm's routines and a firm's members. Organizational knowledge, also called the collective mind (Brown and Duguid 1998), is continually constituted and manifested, and it is organizational knowledge through which individuals dynamically interrelate their actions (Tsoukas and Vladimirou 2001). Individuals' actions make contributions to the collective mind, and vice versa (Tsoukas 1996). The collective mind provides a social context, an unarticulated background, for effective and efficient individual actions (Tsoukas 2000). As individuals' contributions to the collective mind come from the individuals' social practices which in turn involve the knowledge that individuals receive from previous learning and practices, part of their individual knowledge and of the organizational knowledge may originate from outside of the organization (Davenport and Prusak 1998; Tsoukas and Vladimirou 2001). Viewing knowledge as socially constructed and the firm as a distributed and decentralised knowledge system, Tsoukas (1996) suggests that the major organizational problem that firms face is the utilization of knowledge which is distributed, decentred, emergent, and is not, and cannot be, known and processed by a single agent. The key to utilizing knowledge effectively and efficiently depends on effectively and efficiently coordinating purposeful individuals and their actions (Tsoukas 2000). He argues that the key to achieving coordinated actions depends on integrating organizational knowledge, finding more and more effective ways of connecting and interrelating the knowledge each individual has, rather than collecting more and more knowledge (Tsoukas 1996). In addition to the connections and interrelation among individuals, the specific organizational structure and norms, such as intra-organizational communities and the organizational culture, are critical conditions for achieving the coordination of and integration of distributed knowledge (Grant 1996; Tsoukas 1996). Tsoukas' theory has significant implications for the design, implementation, and use of KMS in organizations. Instead of centralizing organizational knowledge into knowledge repositories, Tsoukas' theory suggests that the KMS has to be designed and used in such a way as to

- Efficiently and effectively connect people.
- Be adaptable and flexible to the emerging knowledge, and
- Integrate and coordinate organizational knowledge through supporting and facilitating the cooperation and interaction of the knowledgeable individuals.

2.5.2 An Knowledge-flowing View of the Firm

From the perspective of intangible assets, Sveiby (2001) suggests a knowledge-based theory for strategy formulation. He defines knowledge as capacity-to-act, which emphases the action element; he claims that " *capacity-to-act can only be shown in action*" (Sveiby 1997). According to Sveiby (1997), organizational knowledge, that is the intangible assets of organizations, consists of three types of soft structures, namely internal structures, external structures, and individual competences which interplay with each other and construct a dynamic and organic system (see Figure 2.2) (Sveiby 2001). According to Sveiby (1997), these structures are not tangible things but sequences of events linked together, and which are the outcomes of purposeful activities of employees (Sveiby 2001). According to Sveiby (1997), the internal structures, including internal networks, cultures, norms, concepts, models, processes, and computer and administrative systems are the outcomes of people working within the organization. The work of people outside the organization creates the external structure, which includes customers and/or suppliers relationships and the image of the firm (Sveiby 1997). Individual competence consists of the competence of the staff that who have direct contact with customers and suppliers (Sveiby 1997).
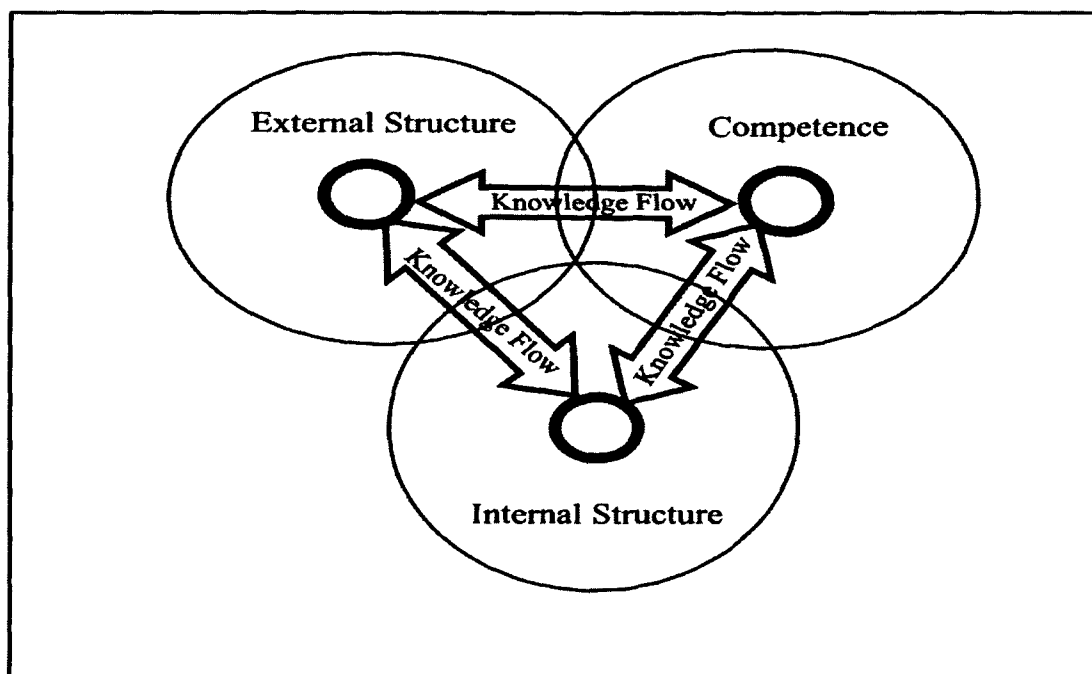
(Source: adapted from Sveiby 2001)

Figure 2.2 Three-circles knowledge model of the firm

Assuming that knowledge is doubled when it has been effectively shared by two people,

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Sveiby (2001) argues that it is the flow and sharing of knowledge that create value for organizations, and that the flow and conversion of knowledge enhances organizational knowledge in terms of internal structure, external structure and employee's competence (Sveiby 1997). While the various networks provide the necessary infrastructure for the flow of knowledge within and between different structures, organizational elements such as culture, structure, reward systems and company policies play a critical role in enhancing or blocking knowledge sharing (Sveiby and Simons 2002). From a socio-technical perspective, Sveiby's knowledge-based firm model can be reconfigured into the composition of two subsystems, the technical subsystem, which is formed by the connections within and between structures, and the social subsystem, which consists of norms, culture and policies (Coakes 2002). Connections refer to the variety of communication systems, such as computer system, personal networks, organizational structures, products, documents and processes, which provide the necessary infrastructure for enabling communications and cooperation (Yoo and Ifvarsson 2001). The organizational norms, culture, and policies play a role in controlling and coordinating communications and cooperation, and enhancing or blocking knowledge sharing within or across the organization. There exists a tension between these two subsystems, and they are mutually constructed (Tsoukas 1996).

2.5.3 A Dynamic Knowledge-based View of the Firm

Spender (1996) assumes that the firm is a socially constructed object with complex heterogeneous internal epistemological processes, and accordingly proposed a view of the firm as a dynamic, evolving, quasi-autonomous network system of knowledge production and application (Spender 1996). According to Spender (1996), the firm can be viewed as a complex and dynamic network in which the individuals, organizational structures, rules and routines, technological systems, markets and environments, infrastructures and norms are identifiable actors (Spender 1996). The firm exists and evolves through the "*underdetermined co-evolutionary interplay*" (Spender 1996, p55) of these system components (referred to as 'quasi-objects') (Spender 1996).

Having adopted a pluralist epistemology, Spender (1996) proposed categorizing organizational knowledge into four types. These are:

- Conscious knowledge, the explicit knowledge held by individuals, an abstraction of personal tacit knowledge.

- Automatic knowledge, which is personal tacit knowledge, embedded in personal experience.
- Objectified knowledge, which is articulated organizational knowledge in documents or other coding systems.
- Collective knowledge, the knowledge embedded in organizational processes, routines, culture and norms.

According to Spender (1996), collective knowledge, as the most secure and strategically significant kind of organizational knowledge, provides a common context for human action and sense-making (meaning) of individuals. Spender (1996) claims that every real firm will be a mixture of the four types of knowledge and that the firm's knowledge mix may change over time.

Since knowledge is essentially related to the process of knowing and knowing entities, it is related to human action (Nonaka and Takeuchi 1995; Orlikowski 2002). Knowledge is tacit or based on tacit knowledge (Tsoukas 2003). Tacit knowledge is itself in action (Sveiby 1999). Emphasizing knowledge relevant to human action suggests that a firm is a body of activity-based knowledge about the interaction of quasi-objects, such as individuals and their practices, rules and routines, norms, social subsystems and technology subsystems. Spender (1996) argues that the firm needs to be understood as an activity system, a system of knowing rather than a system of applied abstract knowledge. Based on systems theory, organization systems consist of two levels, the functioning system and its components (Spender 1996); organizational knowledge exists as systemic and componential types of knowledge respectively (Spender 1996). Thus there are essentially two types of knowledge-related activities existing within a firm which produce individual knowledge and collective knowledge respectively. It is the dynamic interaction of background collective knowledge (such as organizational culture and norms) and individual creativity that gives meaning and identity to the firms and which holds the components of the firm (quasi-objects) together (Spender 1996).

As the firm is defined as a quasi-object, Spender (1996) claims that his theory is not a theory in the positivist sense. Instead, Spender (1996) argues that it is a method of unpacking the complexity of the evolved quasi-objects which constitute our world. Thus, the purpose of Spender's theory is to help people to see, analyst and interpret the firm from systemic, dynamic, and evolutionary knowledge-based perspectives (Spender

1996).

Based on Spender's argument, KMS and its roles within organization are not either technologically determined, or socially determined, but outcomes from the underdetermined co-evolutionary interplay of KMS technical systems and organizational systems (e.g., people, organizational structure, norms, culture and production systems) (Spender 1996). As a result, the dynamic knowledge-based view of the firm provides a strong theoretical rationale for applying socio-technical theory (Coakes 2003) and structuration theory (Orlikowski 1992) to analyze and interpret the behaviours and effects of KMS within organizations.

As an emerging field, knowledge management research falls behind knowledge management practice. As a result, an examination of knowledge management practice provides valuable guiding insights into knowledge management systems research.

2.5.4 Summary

From the review of knowledge-based theories of the firm, the following key points can be drawn:

- Organizations can be viewed as distributed and decentred knowledge systems.
- Organizational knowledge comprises individuals' knowledge (personal experience and expertise), social knowledge (embedded in personal networks and relationships), and institutionalised knowledge (e.g., embedded in routines, procedures, and tools and processes, cultures and norms).
- Knowledge-based theories of the firm highlight the systematic, networking and evolutionary perspectives of organizational knowledge management. Any knowledge management initiative (including KMS) needs to be studied from systematic, dynamic, and networking views, thus providing strong theoretical rational for applying socio-technical system theory and structuration theory to investigate KMS in organizational systems.

In terms of the role of KMS in organizational knowledge management, KMS can:

- Efficiently and effectively connect people.
- Be adaptable and flexible to the emerging knowledge, and

- Integrate and coordinate organizational knowledge through supporting and facilitating the cooperation and interaction of the knowledgeable individuals through communities.

2.6 Knowledge Management in Organizations

As indicated by many authors (e.g., Davenport, De Long et al. 1998; Ruggles 1998; Mertins, Heisig et al. 2001; Mertins, Heisig et al. 2003), knowledge management in practice has many different faces. For instance, some organizations focus on knowledge sharing among individuals or across internal divisions and units through non-technical means (e.g., best-practice transfer across departments) (Davenport and Prusak 1998; O'Dell and Grayson 1998), while some emphasize the use of technology to capture, locate, store, and disseminate knowledge throughout the whole organization (Pan and Scarbrough 1998; Nielsen and Ciabuschi 2003).

Organizational knowledge management practices usually involve three major issues, strategy choice, knowledge-related activities or processes, and infrastructures enabling and facilitating knowledge management activities (Hansen, Nohria et al. 1999).

2.6.1 Definitions of Knowledge Management

There are a variety of definitions of knowledge management in the KM literature. Wiig (2000) defines knowledge management as systematic and explicit ways to manage knowledge-related activities, practices, programs, and policies within the enterprise. De Long and Fahey (2000) define knowledge management as the enhancing of organizational performance by explicitly designing and implementing tools, processes, systems, structures, and cultures to improve the creation, sharing, and use of all three types of knowledge (human knowledge, social knowledge and structured knowledge) that are critical for decision making and problem solving. Liebowitz (1999) views knowledge management as the process of creating value from an organization's intangible assets (Sveiby 1997). Skyrme (1999) offers a practice-focused definition of knowledge management as

"The explicit and systematic management of vital knowledge and its associated processes of creating, gathering, organizing, diffusion, use and exploitation, in pursuit of organizational objectives" (p. 59).

Knowledge management is seen broadly as any process or practice for creating, acquiring, capturing, sharing and using knowledge, wherever it resides, so as to enhance learning and performance in organizations (Swan 2003). In this thesis, however, organizational knowledge management is defined as 'systematic and explicit ways to build knowledge infrastructures, e.g., KMS, social networks, procedures, culture, and policies, so as to enable and enhance knowledge creation and sharing by providing the time, space, and tools for interacting and cooperating (collaborating)' (Davenport and Prusak 1998; Wenger, McDermott et al. 2002).

2.6.2 Two Fundamental Knowledge Management Strategies

Based on a study of knowledge management practices of companies in several industries, Hansen, Nohria et al. (1999) suggest that, in practice, there exist two main knowledge management strategies. They argue that all knowledge management projects are based on a knowledge management strategy (Hansen, Nohria et al. 1999). The right strategy decision is one of the key factors affecting knowledge management project success, and failed projects may be the results of a wrong strategy choice (Davenport, De Long et al. 1998).

Hansen, Nohria et al. (1999) refers to the two major knowledge management strategies in practice as codification strategy and personalization strategy. Codification strategy centres on the IT systems (O'Dell and Grayson 1998). Knowledge is carefully codified and stored in databases, where it can be accessed and used easily by anyone in the firm or its clients. Codification strategy enables knowledge sharing through emphasizing the production, storage, and utilization of explicit knowledge (Zack 1998; Zack 1999). Personalization strategy, in contrast, supports knowledge sharing mainly by relying on person-to-person contacts (Hansen, Nohria et al. 1999). Personalization strategy emphasizes tacit knowledge transfer, sharing and communication (Sveiby 2001).

Hansen, Nohria et al. (1999) identify three factors that affect firms' knowledge

management strategy choice, namely their business strategy, their profit model and their human resource strategy. They suggest that codification strategy may be relevant to a firm focusing on standardized products/solutions/services, whilst personalization strategy may work well in a firm specializing in customized products/solutions/services. According to Hansen, Nohria et al. (1999), in firms delivering standardized products, solutions or services, their profit model relies mainly on cost control, and the scale and efficiency of production. Production knowledge can be articulated and explicated into knowledge objects, such as manuals, procedures and standard solutions (Zack 1998). Hence the knowledge objects can be accessed and reused easily by anyone in the company, which may improve employees' productivity (Zack 1999). On the other hand, for firms delivering customized products, solutions or services, the profit model mainly relies on innovative and problem-solving capabilities (Hansen, Nohria et al. 1999). Most of their knowledge is hard if not impossible to be articulated and explicated into knowledge objects (Mertins, Heisig et al. 2001). Therefore, knowledge transfer through people-to-people connections may become the most effective way to enlarge the utilization of the knowledge (sarvary 1999). However, in practice, these two knowledge management strategies are not mutually exclusive; organizations often choose to use them together (Hansen, Nohria et al. 1999).

KMS plays an important role in knowledge management strategy as they offer not just tools for codifying and storing information/knowledge, but also allow people to communicate and collaborate more easily and efficiently, no matter where they work (Gordon 2000). While codification strategy is called IT-oriented strategy because of its heavily reliance on computer systems, personalization strategy, which is rooted in social communications among people, is called people-oriented strategy (Sveiby 2001).

It becomes clear that knowledge sharing is the first objective in most knowledge management initiatives in organizations, no matter what major KM strategy they have chosen (Mertins, Heisig et al. 2001; Mertins, Heisig et al. 2003).

According to a survey on a number of organizations across Europe conducted by CIBIT (CIBIT Consultants)& EFQM (European Foundation for Quality Management) between November 2001 and January 2002 (Mertins, Heisig et al. 2003), the majority of surveyed organizations (74%) use communities of practice to create and share

knowledge. Communities of practice are shown in the survey to be the single most popular enabling tool for knowledge creation and sharing (Mertins, Heisig et al. 2003). From the perspective of community of practice (Wenger and Snyder 2000), knowledge creation and sharing involve the process of *"negotiation of meaning"* (Lave and Wenger 1991; Wenger 1998). According to Wenger (1998), negotiation of meaning involves a fundamental duality: participation and reification. Participation suggests both action and connection, i.e., a process of taking part and the relations with others that reflects this process (Wenger 1998). Through participation, people can shape their experience and mental models, update their existing knowledge and obtain new knowledge (McDermott 2000). Participation can be direct or indirect, physical or virtual, explicit or implicit (Wenger 1998).

Reification refers to the process of giving form to knowledge, and the products yielded by the process (Wenger 1998). Reification can be considered as sense-giving (Polanyi 1969; Walsham 2001), involving a process of articulating the participant's ideas and/or understanding, and presenting a participant's knowledge in concrete form, such as text, books, tools or procedures.

Participation and reification form a unity in their duality, and cannot be considered in isolation (Wenger 1998). They work together to enable knowledge creation and sharing. They also make up for their respective limitations (Wenger 1998). On the one hand, people produce, interpret, and use reification through participation(Wenger 1998). On the other hand, people's participation requires interaction and thus generate shortcuts to coordinated meanings which reflect people's enterprise and views of the world (Wenger 1998). For instance, people can deepen their understanding about what they read through discussion. Reification can help people who participate in a meeting (or miss the meeting) by the keeping of records of the meeting as a reminder for later reference. It is through reification that innovative ideas on production can be transformed into procedures or computer programs so as to improve employees' productivity (Wenger 1998).

Information technologies can play a critical role in knowledge creation and sharing through the enabling of people networks, participation in communities of practice (participation), and accessing of relevant information and knowledge repositories (reification) (Goodman and Darr 1998; Wenger 2001).

2.6.3 Knowledge Management Systems (KMS) in Organizations

Information technology (IT) has been widely used by organizations as an important enabler for knowledge management initiatives (Borghoff and Pareschi 1998; Davenport and Prusak 1998; Alavi and Leidner 2001; Ericsson and Avdic 2002; Mertins, Heisig et al. 2003).

Alavi and Leidner (2001) define knowledge management systems (KMS) as a class of IT-based systems developed and implemented to integrate, support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application to solve one or more business problems. Gallupe (2001) defined KMS as:

> "...systems designed and developed to give decision makers/users in organizations the knowledge they need to make their decisions and perform their tasks" (p.63).

Although IT-based knowledge systems were implemented to enable and enhance organizational knowledge processes, the ultimate aim of introducing IT-based knowledge systems is to help people to perform their tasks (e.g., decision making and problem-solving) efficiently and effectively. In this thesis, based on Gallupe's definition, KMS is defined as technology systems implemented and used to integrate organizational knowledge resources in order to help people in organizations efficiently and effectively to get the knowledge they need to perform their tasks (Gallupe 2001).

In the definition, organizational knowledge resources include a range of available knowledge resources, including organizational knowledge (Brown and Duguid 1998), individual knowledge, expertise and experience (Grant 1996), and external knowledge available to the organization members (Davenport and Prusak 1998). Knowledge integration addresses the centralization of knowledge into knowledge bases/repositories (O'Dell and Grayson 1998), and connection to knowledge held by individuals using knowledge yellow pages (Davenport and Prusak 1998), expert locators (Davenport and Prusak 1998), or computerized personal social networks (Wellman 2001). While centralized knowledge supports the creation and reuse of explicit knowledge (codified knowledge), connected knowledge benefits tacit knowledge creation and sharing.

KMS are crucial to knowledge management within organizations for the following four reasons (Pan and Scarbrough 1998; Pan and Scarbrough 1999; DeTienne and Jensen 2001; Wenger 2001; Wagner 2004).

- KMS spans barriers of geography and time.
- KMS provides organizations with the ability to disseminate information and knowledge in a timely fashion.
- KMS can facilitate efficient and effective communication and cooperation, and
- KMS can facilitate virtual collaborative work and communities.

The objectives of developing and deploying KMS for organizational knowledge management initiatives include (Davenport and Prusak 1998; O'Dell and Grayson 1998; Skyrme 1999; Alavi and Leidner 2001; Alavi and Tiwana 2003; Tsui 2003; Wagner 2004):

- Facilitation of the creation, capture and sharing of knowledge.
- Location of relevant information and knowledge (e.g. knowledgeable individuals).
- Provision of an environment for knowledge exchange (e.g. a KM platform).
- Connection of people with relevant interest and/or skills (e.g. a community of practice).
- Facilitation and/or support of intelligent problem solving, and
- Creation of knowledge networks.

There are a variety of KMS in practice. Tsui (2003) suggests that there exist two dominant approaches to deploying KMS, namely the codification approach and the personalisation approach, and that these approaches lead to different implementations and use of KMS.

The codification approach emphasizes explicit knowledge codification, storage, retrieval and reuse (Hansen, Nohria et al. 1999; Zack 1999). Therefore KMS for codification strategy is characterized by knowledge repositories, knowledge distribution and sophisticated search engines (Tsui 2003).

On the other hand, the personalization approach focuses on people and networks of

people (Hansen, Nohria et al. 1999). In such cases, KMS is deployed to support organizational soft infrastructure for knowledge management, e.g., social networks and knowledge communities (Goodman and Darr 1998; Ogata, Yano et al. 2001).

The codification approach is thought more suitable to the situation where exploitation tasks are dominant, which mainly involve reusing existing knowledge and providing quasi-standard solutions for clients (Zack 1999). In contrast, the personalization approach is appropriate for the situation where exploration tasks (e.g. ad-hoc tasks) are dominant and where existing knowledge is difficult to apply directly without significant knowledge creation (Hansen, Podolny et al. 2001). In practice, however, some organizations also adopt a combination of the two approaches to guide their development of KMS (Nielsen and Ciabuschi 2003; Tsui 2003).

Wagner (2004) viewed KMS having two major subsystems, a conversational technology system and a content management system. As the enabler of conversational knowledge creation and sharing (i.e. creating and sharing knowledge *"through dialog with questions and answers"* (Wagner (2004) p.266), conversational technologies facilitate knowledge management mainly through communication and cooperation functionalities, such as email, discussion forums, virtual communities, online chatting/instant messaging, video conferencing, virtual collaboration, weblogs, and wikis. As the enabler of explicit knowledge creating and sharing (e.g. creating and sharing knowledge *"through abstraction or aggregation of information"* (Wagner (2004), p.266), content management systems support knowledge management mainly through information functionalities (Davenport and Prusak 1998; Wagner 2004), such as data mining, frequently asked questions, expert reports, information/knowledge repositories, and information/knowledge retrieval and distribution. The two subsystems integrate complementarily together to act as a KMS. For instance, an effective knowledge repository is usually needed to support an effective conversational technology application.

According to the results of the same survey mentioned above by CIBIT & EFQM from November 2001 to January 2002 (Mertins, Heisig et al. 2003), the most often used IT tools for KM in current European organizations are:

- Intranet with email and discussion forums.

- Intranet with document management functionalities (i.e., shared documents/knowledge repositories).
- Intranet with people finding functionalities (i.e., expert locator or yellow pages).
- Video conferencing.
- Tools for communities and project teams.
- E-learning.

One of the major usages of an Intranet is knowledge and information distribution (DeTienne and Jensen 2001), and IT-based communities and project teams can be considered as virtual communities and virtual teams. As a result, the typical components of a KMS can be divided into two functionality types, information-related functions and interaction (communication & collaboration)-related functions.

The information-related functions mainly include:

- Knowledge bases/repositories. Expert locator (knowledge yellow pages), and
- Information and knowledge distribution.

The interaction (communication & collaboration)-related functions mainly comprise:

- Email.
- Online discussion forums.
- Virtual communities.
- Virtual project spaces (or virtual workspaces), and
- Video conferencing.

In summary, the main aims of implementing and using KMS are to integrate organizational knowledge resources by enabling people to network and interact with each other, and create and maintain a rich environment (including trust and shared background knowledge) for people connecting and interacting so as to create and share knowledge effectively and efficiently.

2.6.4 Research Questions

The purpose of this research is to empirically investigate and examine two critical KMS

issues (see Section 2.1),

- Why and how people use KMS in their work?
- What are the impacts of KMS use on organizational knowledge management?

With respect to the impact of KMS, instead of examining the impacts on knowledge management processes and their outcomes (Alavi and Leidner 2001) directly, this study focuses on the effect of KMS on organizational knowledge management 'soft' infrastructures or social capital, as opposed to the hardware systems. According to Nahapiet and Ghoshal (1998), social capital is concerned with social networks, trust relationships, and shared common languages,. These are considered to be the most significant indicators for an organizational KM soft infrastructure which supports knowledge sharing (Tsai and Ghoshal 1998; Lesser 2000; Cohen and Prusak 2001).

For this research, the main research questions could thus be stated as followings:

Q1: Why do end-users accept and use KMS? What are the fundamental determinants to users' acceptance and use of KMS? And

Q2: What are the impacts of KMS use on the end-user's (i.e., knowledge worker's) social capital?

In order to operationalize the research questions, it was felt useful to review the existing research frameworks for KMS and IS success measurement literature in the following chapter.

2.7 Chapter Summary – Knowledge and KMS

At the beginning, this chapter raised two research issues about KMS. In order to approach the issues, a literature review was conducted on knowledge and its nature, the definition of knowledge, organizational knowledge, and on the two most important knowledge processes: knowledge creation and sharing. This provided a rich explanation of the fundamental distinction between information and knowledge, and the potential implications for KMS as emerging and dynamic systems for enabling knowledge processes. Discussion of the knowledge-based theories of the firm provided a systematic

view for understanding knowledge-based competitive advantages and the role of KMS. Furthermore, the view of organizations as knowledge-based activity systems (Spender 1996) highlights the possibility of studying KMS using socio-technical theory and structuration theory. As an emerging area, knowledge management practice has been playing a leading role in knowledge management research. As a result, the KMS was reviewed from a perspective of KM practice, resulting in definitions of their main functions. Finally, this chapter discussed the research questions.

This chapter emphases the importance of tacit knowledge, and the necessity of studying KMS from systematic, networking, and evolutionary perspectives, and sets out two research questions. It thus lays down the necessary foundation for further study of the use and success of knowledge management systems in organizations, in the following chapters.