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Knowledge Management to Support Distributed Cognition and Behavior in Knowledge-Intensive and Computer-Mediated Work: A Manufacturing Perspective

By

Dong Kyoon Yoo

Submitted as partial fulfillment of the requirements for

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Manufacturing Management and Engineering

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An Abstract of

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To survive and prosper in a rapidly changing business environment, firms have an interest in integrating knowledge to reinforce effectiveness, diffusing knowledge to increase problem-solving capability, and creating knowledge to enhance innovation. The success of knowledge management hinges on people's cognition and behavior because knowledge resides in people and people create knowledge. Knowledge management that supports distributed cognition and behavior enables organizational members to effectively coordinate expertise, quickly respond to market changes, and continually create knowledge. This study employs a research framework that explains knowledge management to support distributed cognition and behavior. Specifically, the research framework examines the relationship among a knowledge-sharing climate, knowledge quality, information systems quality, cognitive empowerment, perspective taking, perspective making, and innovation. Drawing upon a sample of 208 firms, this study tests the proposed research framework by applying structural equation modeling. Results indicate that a knowledge-sharing climate and information systems quality have a direct, positive impact on knowledge quality. A knowledge-sharing climate and knowledge quality influence cognitive empowerment. Cognitive empowerment affects knowledge transfer (i.e., perspective taking and perspective making). Perspective taking appears to enhance perspective making. Finally, perspective making has a direct, positive influence on innovation. The results provide a basis for understanding the critical aspects as firms create cross-functional teams to produce innovation. Knowledge repository systems are static. However, knowledge management should respond to changes in a timely manner. This study provides managerial insights to dealing with changes and fostering innovation in the dynamics of knowledge management.

DEDICATION

To Our LORD Jesus Christ

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When I started my dissertation, it was quite exiting that I could develop something novel and useful in the filed of knowledge management. In contrast to my expectations, processes were not always smooth and joyful. I went through a number of ups and downs in the course of conduction this dissertation. However, I really express my thankfulness to my advisors – Dr. Vonderembse and Dr. Ragu-Nathan. They have been leading me throughout the processes. Honestly speaking, they were not always kind and nice to me regarding this dissertation. However, their keen comments and insights were really helpful for me to develop a theory, collect data, and write this dissertation. When I met Dr. Vonderembse and Dr. Ragu-Nathan for the first time in regard to this dissertation, they asked me, "What is knowledge?" In response to their question, I talked to myself, "Knowledge is knowledge." But I was not able to answer well. Likewise, their challenges enabled me to have an in-depth understanding of the issues of knowledge management.

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I need to give my credit to my LORD Jesus Christ. He is the good shepherd who gives me strength. I pray that this dissertation may glorify His name in a way. My family may continue to live through Jesus' name and for His name's sake.

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CHAPTER 1: INTRODUCTION

As a business environment shifts from an industrial economy to a knowledge-based economy, firms deal with the endless pressure of adapting to market changes. New product offerings are growing, product life cycles are shortening, product quality and performance standards are increasing, and product and process complexity are rising (Purser et al., 1992; Koufteros et al., 2002). To survive and prosper in this environment, firms have an interest in integrating knowledge to reinforce effectiveness, diffusing knowledge to increase problem-solving capability, and creating knowledge to enhance innovation. In fact, the knowledge-based view of the firm holds that the firm's ability to manage knowledge is critical to sustain long-term competitive advantage (Teece, 1998; Teece et al., 1997; Grant, 1996a, 1996b; Nonaka, 1994; Barney, 1991; Wernerfelt, 1984, 1985). Knowledge management involves activities that collect what organizational members, suppliers, customers, and competitors know; organize, store, retrieve, and transfer knowledge; enable the effective application of knowledge; and facilitate the firm's ability to create knowledge. Knowledge contains a firm's expertise, experience, and essence. It is embedded in the employees, cultures, routines, and documents of a firm (Grant 1996a, 1996b; Spender, 1996a, 1996b; Nelson & Winter, 1982). Knowledge management initiatives go beyond knowledge repository systems because they involve the cognition and behavior of organizational members (Massey & Montoya-Weiss, 2006;

Malhotra, 2000; Ruppel & Harrington, 2001; Clark & Wilkes-Gibbs, 1986; Fiol & Lyles, 1985).

As a firm's competitiveness hinges on the effective alignment of intellectual resources, knowledge management is an integral element (Grover & Davenport, 2001; Droge et al., 2003; Alavi & Leidner, 2001; Young et al., 2001; Yli-Renko et al., 2001; Ibarra, 1993). One of its focuses is to develop structures and systematize processes by connecting individuals who need certain knowledge and those who have it (Gray & Meister, 2004). The purpose of this study is to explore essential elements of knowledge management to support distributed cognition and behavior in knowledge-intensive and computer-mediated work. Specifically, this study has five objectives. The first objective of this study is to identify differences and relationships among data, information, and knowledge. A widely accepted approach to identifying these differences is inductive where data, information, and knowledge are regarded as a hierarchical structure (Nonaka, 1994; Alavi & Leidner, 2001; Boisot, 1998; Devlin, 1999). Nevertheless, some researchers use data and information interchangeably (Tayi & Ballou, 1998; Ballou et al., 1998; Bovee et al., 2003; Pipino et al., 2002; Strong et al., 1997; Wang, 1998; Ballou & Pazer, 1995), while others clarify their differences (Tozer, 1999; Lillrank, 2003). In a similar fashion, borderlines between information and knowledge are blurred. Before exploring the dynamics of knowledge management, clear distinctions among the three entities should be made. This study compares and contrasts data, information, and knowledge through a literature review of their definitions, attributes, and measurements. Furthermore, this study shows their relationships, including information systems and people.

The second objective of this study is to explain how effectively organizational members are able to organize, develop, and utilize their knowledge by providing a research framework. To cope with the turbulent business environment, firms launch knowledge management projects, which just consolidate data and information and thus do not yield innovation (Gold et al., 2001). This calls for a research framework that explains the successful dynamics of knowledge management. The literature shows that the success of knowledge management requires elements such as knowledge value (Brockman & Morgan, 2003; Miner et al., 2001; Montoya-Weiss & Calantone, 1994), team characteristics (Hoegl et al., 2003; Janz & Prasarnphanich, 2003; Bunderson & Sutcliffe, 2002), information technology (Alavi & Leidner, 2001; Grover & Davenport, 2001; Ruggles, 1998), and human cognition and behavior (Ruppel & Harrington, 2001; Bock et al., 2005; Wasko & Faraj, 2005; Ko et al., 2005; Alavi & Leidner, 2001). Based on the literature review, this study presents a research framework that examines the relationships among a knowledge-sharing climate, knowledge quality, information systems quality, cognitive empowerment, perspective taking, perspective making, and innovation.

The third objective of this study is to propose and validate a second-order factor model of (1) a knowledge-sharing climate, (2) knowledge quality, and (3) information systems quality. *(1) Knowledge-sharing Climate:* A number of firms form cross-functional teams because various functions help teams to tap into a broad array of knowledge and thus produce innovation (Cohen & Levinthal, 1990; Woodman et al., 1993). However, empirical research on functional diversity has shown mixed effects – both positive (Kessler & Chakrabarti, 1996; Hambrick et al., 1996; Brown & Eisenhardt, 1995; Aitsahlia et al., 1995; Williams et al., 1995) and negative (Harrison et al., 2002; Keller, 2001; Pelled et al., 1999; Knight et al., 1999; Hambrick et al., 1996). To reconcile the conflicts, this study presents a knowledge-sharing climate. Relatively little research on a knowledge-sharing climate has been conceptually or empirically conducted. This study addresses a second-order factor model of a knowledge-sharing climate, including three first-order factors (i.e., willingness, trust, and openness).

(2) Knowledge Quality: Knowledge quality affects decision-making in a firm. Data quality has received considerable attention in the literature – dimensions of data quality (Wang & Strong, 1996) and measurements of data quality (Wang & String, 1996; Goodhue, 1995; Fisher & Kingma, 2001). Information quality has also been studied in depth (DeLone & McLean, 1992, 2003; Lee et al., 2002; Lee & Strong, 2003; Nelson et al., 2005). Not much attention, however, has been paid to knowledge quality. After organizing the literature on data quality and information quality, this study examines a second-order factor model of knowledge quality with three first-order factors (i.e., intrinsic knowledge quality, contextual knowledge quality, and actionable knowledge quality).

(3) Information Systems Quality: As the collection of knowledge increases, firms need quality information systems to navigate the vast amount of knowledge available and communicate new developments in a timely manner. Perceived ease of use and perceived usefulness are critical information systems quality that increases IT usage across levels of expertise (Taylor & Todd, 1995), within and across firms (Davis, 1989; Adams et al., 1992; Subranmanian, 1994), and across nations (Rose & Straub, 1998; Straub et al., 1997). In addition, the process of knowledge conversion is affected by various

communication media (Massey & Montoya-Weiss, 2006). The media richness theory explains why people choose particular information technology to communicate with others in a workplace (Daft & Lengel, 1984, 1986). This study combines and tests the three important variables (i.e., perceived ease of use, perceived usefulness, and perceived media richness) to construct information systems quality.

The fourth objective of this study is to introduce a new form of knowledge transfer – perspective taking and perspective making. Knowledge must be disseminated throughout a firm to foster productivity and innovation (Zellman-Bruhn, 2003; Argote, 1999; Epple et al., 1991; Hedlund, 1994). However, knowledge transfer is difficult (Lessard & Zaheer, 1996; Ruggles, 1998; Szulanski, 1996; Miner & Meziah, 1996). The tacitness of knowledge is a widely recognized barrier to knowledge transfer (Lippman & Rumelt, 1982; Zander & Kogut, 1995; Gupta & Govindarajan, 2000). Motivational depositions and absorptive capacity also make it hard to transfer knowledge (Levinthal & March, 1993; Simon 1991; Szulanski, 1996). On cross-functional teams, members may not understand some aspects of knowledge due to specialty, or they may have insufficient backgrounds to render communication meaningful (Massey & Montoya-Weiss, 2006). This calls for research that facilitates knowledge transfer in a group of experts. This study explains the dynamics of perspective taking and perspective making, which may enhance knowledge transfer on cross-functional teams.

The fifth objective of this study is to develop valid and reliable measures of a knowledge-sharing climate, knowledge quality, perspective taking, and perspective making. As a result of this study, these constructs may be better understood and applied in practice. In addition, the instrument may be used as a standardized measure to evaluate and improve each entity in the dynamics of knowledge management.

This study investigates knowledge management to support distributed cognition and behavior in knowledge-intensive and computer-mediated work at the team level. Firms are increasingly relying on teams as a mechanism for developing novel and useful outcomes (Lipnak & Stamps, 1993; Sundstrom, 1999; Hoegel et al., 2003; Ancona, 1990). The team level, as opposed to the organizational level or other levels, is important especially in innovative tasks because it provides a necessary means for the team to work closely with other functional areas. Effective use of teams facilitates the sharing of members' experiences and perspectives (Linderman et al., 2004). Feedback among team members is an essential factor to validate knowledge. For these reasons, it would be viable to see more dynamics of knowledge management at the team level.

The rest of the study is organized as follows. The next Chapter provides a research framework and testable hypotheses with an extensive literature review. The research methodology appears in Chapter Three. The methodology will include interviews with practitioners, expert evaluations of the research model and instruments, Q-sort methodology, a pilot study, and a large-scale survey. Chapters Four and Five will summarize the statistical methods, which rely on structural equation modeling with LISREL. The results of the proposed research framework will be described in those Chapters as well. Chapter Six will discuss findings and implications for research and practice, and, finally, Chapter Seven will conclude with limitations and future study.

CHAPTER 2: THEORY DEVELOPMENT

What factors influence the dynamics of knowledge management and thus result in innovation? With the growing popularity of knowledge management, there has been a corresponding proliferation of research. Some of the research shows that accumulated knowledge is necessary to create new knowledge (Bower & Hilgard, 1981; Cohen & Levinthal, 1990; Huber, 1991; Brockman & Morgan, 2003). Other research contends that close and frequent interactions on a team enhance knowledge creation and dissemination (Janz & Prasarnphanich, 2003; Clark & Fujimoto, 1991). Evidence shows that information technology helps people to communicate, organize, codify, distribute, and maintain knowledge resources (Leidner, 2000; Cross & Baird, 2000; McDermott, 1999). Additionally, it has been known that the success of knowledge management hinges on people's cognition (i.e., developing understanding) and behavior (i.e., using knowledge) (Massey & Montoya-Weiss, 2006; Malhotra, 2000; Ruppel & Harrington, 2001; Clark & Wilkes-Gibbs, 1986; Fiol & Lyles, 1985; Huber, 1991). Based on this review of the literature, Figure 2.1 provides an encompassing framework that proposes knowledge management to support distributed cognition and behavior. In this framework, a knowledge-sharing climate consists of willingness, trust, and openness. Knowledge quality includes intrinsic knowledge quality, contextual knowledge quality, and

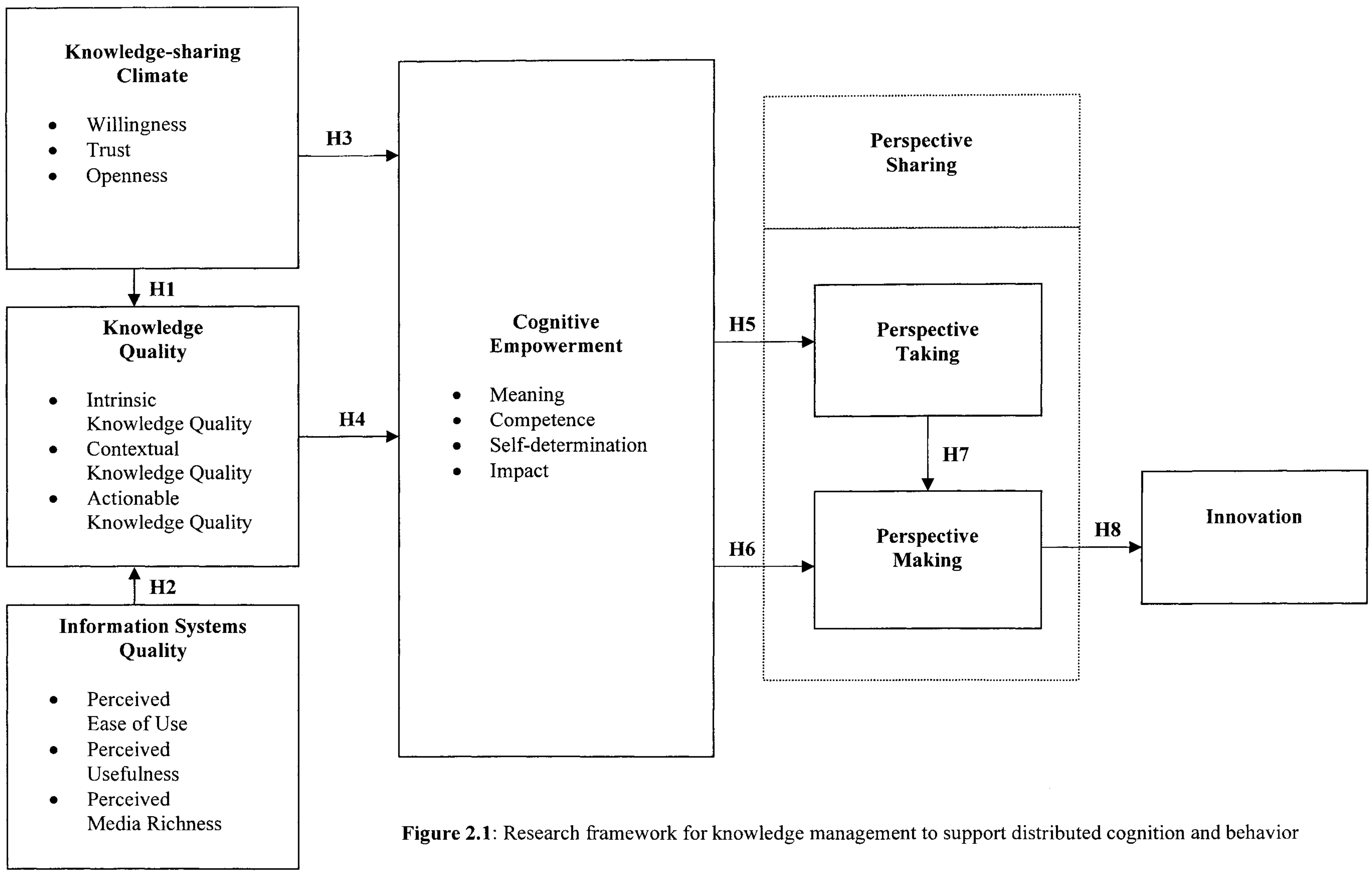


Figure 2.1: Research framework for knowledge management to support distributed cognition and behavior

Table 2.1: Definitions of constructs in the research framework

Construct	Definition	Literature
Knowledge-sharing Climate	The extent to which team members have a set of shared understanding about providing access to information and building or using necessary knowledge	Janz & Prasarnphanich (2003), Hoegl et al. (2003), Hansen (1999)
Knowledge Quality	The extent to which knowledge is justified as fit for use	Nonaka (1994), DeLone & McLean (1992, 2003), Wang & Strong (1996), Huang et al. (1999)
Information Systems Quality	The extent to which information systems have perceived ease of use, perceived usefulness, and perceived media richness	Davis (1989), Daft & Lengel (1984, 1986), Daft et al. (1987), Carlson & Zmud (1999), DeLone & McLean (1992, 2003)
Cognitive Empowerment	The level of intrinsic task motivation manifested in a set of four cognitions (i.e., meaning, competence, self-determination, and impact) reflecting a team's orientation to its work role	Thomas & Velthouse (1990), Brief & Nord (1990), Bandura (1989), Deci et al. (1989), Ashforth (1989)
Perspective Taking	The process whereby team members take the knowledge of other disciplines into account	Boland & Tenkasi (1995), Parker & Axtell (2001), Nonaka (1994), Dougherty (1992)
Perspective Making	The process whereby a team develops and strengthens its knowledge and practices as a whole	Boland & Tenkasi (1995), Bradshaw (1992)
Innovation	The production or adoption of novel and useful systems, processes, products, or services	Damanpour (1991, 1996), Fichman (2001), Gatingnon et al. (2002), Oldham & Cummings (1996), Amabile et al. (1996), Scott & Bruce(1994)

Table 2.2: Definitions of dimensions in the research framework

Construct	Dimension	Definition	Literature
Knowledge-sharing Climate	Willingness	The extent to which team members have positive orientations toward exchanging information and using knowledge	Hansen (1999)
	Trust	The extent to which team members value information, knowledge, or resources possessed or acquired by other team members	Mistzal (1996), Kankanhalli et al. (2005), Von Krough (1998)
	Openness	The extent to which team members are encouraged to express their ideas, even though the ideas may be contrary to existing knowledge	Leonard-Barton (1995), Cohen (1998), Davenport & Prusak (1998), Gold et al. (2001)
Knowledge Quality	Intrinsic Knowledge Quality	The extent to which knowledge has quality in its own right (i.e., accurate, reliable, or believable)	Wang & Strong (1996), Huang et al. (1999)
	Contextual Knowledge Quality	The extent to which knowledge is considered to be within the context of the task (i.e., relevant or value-added)	Wang & Strong (1996), Huang et al. (1999)
	Actionable Knowledge Quality	The extent to which knowledge is expandable, adaptable, or easily applied to tasks	Nonaka & Takeuchi (1995)

Table 2.2: Definitions of dimensions in the research framework (continued)

Construct	Dimension	Definition	Literature
Information Systems Quality	Perceived Ease of Use	The extent to which users believe that using a particular system will be free of effort	Davis (1989), Bandura (1982)
	Perceived Usefulness	The extent to which users believe that using a particular system will enhance job performance	Davis (1989), Schultz & Slevin (1975), Robey (1979)
	Perceived Media Richness	The extent to which media have the capability to transfer or communicate ideas and concepts in various methods (e.g., texts, graphics, or videos)	Daft & Lengel (1984, 1986), Daft et al. (1987), Carlson & Zmud (1999)
Cognitive Empowerment	Meaning	A fit between the requirements of work and the beliefs, values, and behaviors of the team	Brief & Nord, (1990), Hackman & Oldman (1980), Thomas & Velthouse (1990), Spreitzer (1995)
	Competence	A belief in the capability to perform work activities	Gist (1987), Thomas & Velthouse (1990), Spreitzer (1995)
	Self-determination	A sense of choice in initiating and regulating actions	Deci et al. (1989), Thomas & Velthouse (1990), Spreitzer (1995)
	Impact	The extent to which a team's project can influence strategic, administrative, or operating outcomes at work	Ashforth (1989), Thomas & Velthouse (1990), Spreitzer (1995)

actionable knowledge quality. Information systems quality involves perceived ease of use, perceived usefulness, and perceived media richness. Cognitive empowerment includes meaning, competence, self-determination, and impact. Perspective sharing consists of perspective taking and perspective making. The definitions are given in Table 2.1 and 2.2.

2.1 DATA, INFORMATION, AND KNOWLEDGE

Data, information, and knowledge are considered as a hierarchical structure in some of the literature (Nonaka, 1994; Alavi & Leidner, 2001; Boisot, 1998; Devlin, 1999). On the other hand, in several other pieces of the literature, data/information and information/knowledge are viewed as the same. Accordingly, it is worthwhile to review the literature on data, information and knowledge, and to find their distinctions. The following sub-sections explore each entity and describe their differences and relationships among them. Table 2.1.1.1 shows a summary and comparison of the literature on these three entities.

2.1.1 Data

Data are viewed as key organizational resources because they are reused repeatedly for various purposes without consumption (Tayi & Ballou, 1998; Ballou et al., 1998). Traditionally, data are defined as unorganized numbers and facts that are not meaningful and useful. They are a property of things (Boisot, 1998). They are facts about events, agents, and transactions that a business encounters during its operations (Sen, 2001). Lillrank (2003) describes data as the factual contents of information. For the

Table 2.1.1.1: Summary and comparison of the literature on the definitions of data, information, and knowledge

Author(s)	Data	Information	Knowledge
Churchman (1971)			How organizational members react to a collection of information that matters
Dretske (1981)		The commodity capable of yielding knowledge	Information-produced (or sustained) belief
Machlup (1983)		A flow of messages or meanings which might add to, restructure, or change knowledge	
DeLone & McLean (1992)		The output of an information system or the message in a communication system	
Purser et al. (1992)			New formulas, specifications, theories, procedures, and typologies
Kogut & Zander (1992)		Facts, axiomatic propositions, and symbols	
Horwich (1993)			Theoretical statements whose meanings and practical implications depend on their use and on the framework in which they are deployed
Wings (1993)		Facts organized to describe situations or conditions	Truths and beliefs, perspectives and concepts, judgments and expectations, and methodologies and know-how
Nonaka (1994)			A dynamic human process of justifying personal beliefs as part of an aspiration for the truth
		More factual	Beliefs and commitments

Table 2.1.1.1: Summary and comparison of the literature on the definitions of data, information, and knowledge (continued)

Author(s)	Data	Information	Knowledge
Nonaka & Takeuchi (1995)		A flow of meaningful messages	Commitments and beliefs created from messages
Boisot (1998)	A property of things		A property of agents predisposing them to act
Wang (1998)		Data that have been processed in some manner	
Davenport & Prusak (1998)		A message meant to change the receiver's perception	Experience, values, insights, and contextual information
Watson (1999)			The capacity to use and interpret information, and to ascertain what information is necessary in decision-making
Sen (2001)	Facts about events, agents, and transactions that a business encounters during its operations	Transformed data that help decision-making	
Nonaka & Teece (2001)		Something about how the world is	Something about how the world works
Alavi & Leidner (2001)		Processed data	Authenticated information
Lillrank (2003)	The factual content of information	A relation between things and agents	
Brockman & Morgan (2003)			The amount of stored information that a firm has about a particular phenomenon
Hult (2003)			Credible information that is of potential value to a firm
Gray & Meister (2004)			Expertise, opinions, insights, and experience
This study	Raw, unorganized numbers, facts, and observations	Processed, organized data	Being aware of and understanding ideas, logics, relationships, and circumstances

purposes of this study, data are defined as raw, unorganized numbers, facts, and observations.

2.1.2 Information

Information is used to initiate, guide, control, monitor, and improve activities in business functions (Lillrank, 2003). Drestske (1981) defines information as the commodity capable of yielding knowledge, while Machlup (1983) describes information as a flow of messages or meanings that may add to, restructure, or change knowledge. Kogut and Zander (1992) argue that information includes facts, axiomatic propositions, and symbols. Wings (1993) states that information is facts organized to describe situations or conditions. Davenport and Prusak (1998) mention that information is a message meant to change the receiver's perception. In addition, Sen (2001) states that information is transformed data that help decision-making. This study defines information as processed, organized data.

Information is a critical product, not a byproduct of process (Fisher & Kingma, 2001; Huang et al., 1999; Wang et al., 1998; Ballou et al., 1998). Kahn et al. (2002) contend that information has the attributes of both products and services, indicating that considering information as a product only may cause some loss of characteristics.

2.1.3 Knowledge

Knowledge is a complex and multi-faceted concept (Nonaka, 1994; Nonaka & Takeuchi, 1995; Hult, 2003). A number of researchers have paid attention to the definition of knowledge. Churchman (1971) describes that knowledge is how organizational members react to a collection of information, while Drestske (1981) defines knowledge as information-produced (or sustained) belief. Purser et al. (1992) argue that knowledge includes new formulas, specifications, theories, procedures, and typologies. Wings (1993) mentions that knowledge is truths and beliefs, perspectives and concepts, judgments and expectations, and methodologies and know-how. In addition, Horwich (1993) states that knowledge comprises theoretical statements whose meanings and practical implications depend on their use and on the framework in which they are deployed. Nonaka (1994) mentions that knowledge is a dynamic human process of justifying personal beliefs as part of an aspiration for the truth. Davenport and Prusak (1998) mention that knowledge is experience, values, insights, and contextual information. They add that knowledge is complex, accumulated expertise that resides in individuals. Boisot (1998) contends that knowledge is a property of agents predisposing them to act. Watson (1999) states that knowledge is the capacity to use and interpret information, and to ascertain what information is necessary in decision-making. Knowledge is defined as a justified belief that increases an entity's capacity for effective action (Huber, 1991; Nonaka, 1994). Brockman and Morgan (2003) describe knowledge as the amount of stored information that a firm has about a particular phenomenon. Hult (2003) defines knowledge as credible information that is of potential value to a firm. Gray and Meister (2004) state that knowledge can be an ambiguous term and can be described as expertise, opinions, insights, and experience. This study defines knowledge as being aware of and understanding ideas, logics, relationships, and circumstances.

2.1.3.1 Types of Knowledge

Knowledge is generally explicated in two dimensions – tacit and explicit. Tacit knowledge may not be articulated, documented, and communicated (Nonaka, 1994; Polanyi, 1962, 1967; Alavi & Leidner, 2001). It has personal attributes, which make it difficult to store or transfer (Nonaka, 1994). People are the most effective media to acquire tacit knowledge (Nonaka, 1994; Polanyi, 1962, 1967; Alavi & Leidner, 2001). Tacit knowledge provides the background to develop and interpret explicit knowledge (Polyani, 1975).

Explicit knowledge may be articulated, codified, and communicated in many formal, systematic languages (Nonaka, 1994; Polanyi, 1962, 1967; Alavi & Leidner, 2001; Kogut & Zander, 1992). Information technology is the best means to display explicit knowledge (Griffith et al., 2003; Inkpen & Dinur, 1998). Inkpen and Dinur (1998) contend that tacit knowledge has little value until it is converted to explicit knowledge that organizational members may share.

The two dimensions are mutually dependent and reinforce qualities of knowledge. As an effort to extend types of knowledge, Kogut and Zander (1992) identify declarative knowledge and procedure knowledge. Venzin et al. (1998) classify knowledge as tacit, embodied, encoded, embrained, embedded, event, and procedure. In addition, Lee and Strong (2003) present three modes of knowledge pertinent for shaping organizational capabilities – (1) knowing-what, (2) knowing-why, and (3) knowing-how.

2.1.3.2 Impacts of Knowledge

Knowledge has been investigated at various levels – individual knowledge (Nonaka, 1994; Sabherwal & Becerra-Fernandez, 2003), collective (group) knowledge, (Hoegl et al., 2003; Fedor et al., 2003; Sabherwal & Becerra-Fernandez, 2003), organizational knowledge (Brockman & Morgan, 2003; Janz & Prasarnphanich, 2003; Sabherwal & Becerra-Fernandez, 2003; Zander & Kogut, 1995), and inter-organizational knowledge (Gupta & Govindarajan, 2000; Malhotra et al., 2001). Much research has been conducted to explore positive effects of existing knowledge on new product performance (Cooper & Kleinschmidt, 1986; Brockman & Morgan, 2003), competence (Montoya-Weiss & Calantone, 1994; Zirger & Maidique, 1990), organizational improvisation (Miner et al., 2001), and absorptive capacity (Cohen & Levinthal, 1990), while some researchers contend that existing knowledge plays an inhibitive role in innovativeness (Ghemawat, 1991; Leonard-Barton, 1992; McDonough, 1993).

2.1.4 Differences among Data, Information, and Knowledge

As mentioned above, some research does not clarify the borderlines dividing data, information, and knowledge. However, some researchers find critical differences among the three. Sen (2001) claims that data are facts about events, agents, and transactions, whereas information is transformed data that help decision-making. Lillrank (2003) contends that data are the factual content of information, while information establishes a relation between things and agents. Information reveals something about how the world is, whereas knowledge tells something about how the world works (Nonaka & Teece, 2001). Alavi and Leidner (2001) distinguish knowledge from information, stating that

"Information is processed data and knowledge is authenticated information. Knowledge is information processed in the mind of individuals; it is personalized information (which may or may not be new, unique, useful, or accurate) related to facts, procedures, concepts, interpretations, ideas, observations, and judgments. (p. 109)" Both information and knowledge are context-specific and relational. However, information is more factual and knowledge is about beliefs and commitments (Nonaka, 1994).

2.1.5 Relationships among Data, Information, Knowledge, Information Systems, and People

In discussing the relationships among data, information, and knowledge, it is important not to exclude information systems and people. Information systems play an important role in transforming data into information. People are important media that create knowledge from information. Considering information systems and people, this study, as shown in Figure 2.1.5.1, presents a new dynamic structure of data, information, and knowledge.

The literature shows that data, information, and knowledge establish a hierarchical structure (Nonaka, 1994; Alavi & Leidner, 2001; Boisot, 1998; Devlin, 1999). In addition, information systems organize raw numbers, facts, and observations, and transform them into information. DeLone and McLean (1991) mention that information is the output of an information system or the message in a communication system. Knowledge is about how people react to a collection of information (Churchman, 1971), as well as how information is actively processed in an individual (Alavi & Leidner, 2001). So information is converted to knowledge through people. Conversely, knowledge may become information as it is presented in the form of texts, graphics, and words, or other symbolic forms (Alavi & Leidner, 2001). Knowledge may be also transferred to people and provide a basis for new knowledge. When these ideas are put together, the dynamic structure in Figure 2.1.5.1 is derived.

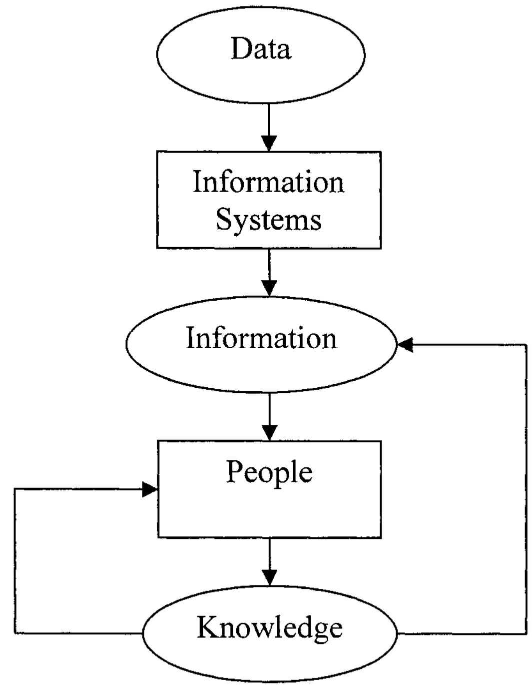


Figure 2.1.5.1: Dynamic structure of data, information, knowledge, information systems, and people

2.2 KNOWLEDGE MANAGEMENT

Knowledge management encompasses a broad range of tools, technologies, and practices intended to make better use of a firm's intellectual resources (Davenport & Prusak, 1998). Melymuka (2003) argues that knowledge management is about sharing knowledge qualitatively and about saving time quantitatively. Knowledge management is defined as a systemic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge of employees so that other employees may make use of it to be more effective and productive in their work (Alavi & Leidner, 1999). This study defines knowledge management as activities that collect what organizational members, suppliers, customers, and competitors know; organize, store, retrieve, and transfer knowledge; enable the effective application of knowledge; and facilitate the firm's ability to create knowledge. In the following sub-sections, two views and four main issues of knowledge management are discussed.

2.2.1 Information-processing View vs. Sense-making View

The information-processing view and the sense-making view have been known to explore the dynamics of knowledge management. The information-processing paradigm has been prevalent over the past decades in the business environment which is characterized as a predictable or incremental pace of change. This perspective emphasizes the benchmarking and transfering of best practices based on explicit knowledge, which is stored in knowledge repository systems (Allee, 1997; O'Dell & Grayson, 1998; Applegate et al., 1998; KPMG 1998a). This view focuses on a necessary amount of information or knowledge, and optimal, efficient storage and retrieval in order to reduce work-related uncertainty (Allen et al., 1979; Tushman, 1979; Malhotra, 2000). It is believed that there is the generalization across contextual frames in this view (Malhotra, 2000).

The sense-making paradigm of knowledge management emerges in the business environment which is characterized as a radical and unforeseen pace of change (Arthur, 1996; Brown & Eisenhardt, 1998). This view emphasizes that best practices are subject to continual reexaminations and modifications in accordance with market changes (Malhotra, 2000). This view asserts that even though organizational members have a sufficient amount of information or knowledge, they must have the capacity to interpret it. Thus, the sense-making view focuses on the capacity of organizational members to interpret multiple, sometimes contradictory, information or knowledge, and to reassess existing knowledge and create new knowledge. Table 2.2.1.1 gives a summary of the differences between the information-processing view and the sense-making view of knowledge management.

Table 2.2.1.1: Information-processing View vs. Sense-making View

	Information-processing View	Sense-making View
Environment	A predictable and incremental pace of change	A radical or unforeseen pace of change (Brown & Eisenhardt, 1998)
Emphasis	The benchmarking and transfering of best practices based on explicit knowledge (Allee, 1997)	Best practices are subject to continual reexamination and modification according to dynamic changes (Malhotra, 2000)
Focus	A necessary amount of information or knowledge to reduce work-related uncertainty (Allen et al., 1979)	Organizational members' capacity to interpret multiple, sometimes contradictory, information or knowledge
	Optimal, efficient storage and retrieval (Malhotra, 2000)	Reassessing existing knowledge and creating new knowledge

The research framework, shown in Figure 2.1, builds on the sense-making view of knowledge management. The distributed cognition and behavior literature explains a mechanism of knowledge management (Boland et al., 1994; Boland & Tenkasi, 1995; Hutchins, 1991; Resnick 1991; Sabherwal & Becerra-Fernandez, 2003; Alavi & Leidner, 2001; Moreland, 1999). Distributed cognition and behavior refer to processes through which organizational members represent their situations, interpret them, and exchange them with others so that each may act with an understanding of situations (Boland et al., 1994; Boland & Tenkasi, 1995; Sabherwal & Becerra-Fernandez, 2003; Alavi & Leidner, 2001). Knowledge management that supports distributed cognition and behavior goes beyond the simple transmission of knowledge (Feldman & March, 1981; Preston, 1991; Silver, 1991). It enables organizational members to effectively coordinate expertise, quickly respond to market changes, and continually create knowledge.

2.2.2 Four Issues of Knowledge Management

Knowledge management includes many activities. Alavi and Lediner (2001) classify four issues in their research – knowledge creation, storage/retrieval, transfer, and application. This study follows their taxonomy and explores each in the following sub-sections.

2.2.2.1 Knowledge Creation

Knowledge creation involves developing new content or replacing existing content within the interactions of tacit and explicit knowledge (Pentland, 1995). Nonaka (1994) presents four modes of knowledge creation through the interactions of tacit and explicit knowledge: (1) socialization, (2) externalization, (3) internalization, and (4) combination. Socialization refers to converting existing tacit knowledge into new tacit knowledge through cognitive interactions and shared experiences. Apprenticeship is an example of socialization (Nonaka, 1994). The circulated processes of observations,

	New Tacit Knowledge	New Explicit Knowledge
Existing Tacit Knowledge	**Socialization** (Apprenticeship)	**Externalization** (Articulation of best practices or lessons)
Existing Explicit Knowledge	**Internalization** (Learning by doing and on the job training)	**Combination** (Categorizing, reclassifying, and synthesizing explicit knowledge)

Figure 2.2.2.1: Knowledge creation through interactions of tacit and explicit knowledge

imitations, and improvements allow people to obtain tacit knowledge from others and create new tacit knowledge (Sabherwal & Becerra-Fernandez, 2003; Janz & Prasarnphanich, 2003; Alavi & Leidner, 2001; Nonaka 1994). Externalization refers to converting existing tacit knowledge into new explicit knowledge. It enables the translation of knowledge into explicit forms that are easier to understand. Articulation of best practices or lessons acquired is an example in this category (Alavi & Leidner, 2001). Internalization refers to converting existing explicit knowledge into new tacit knowledge. Learning by doing and on-the-job training are internalization processes by which knowledge is created (Sabherwal & Becerra-Fernandez, 2003; Nonaka 1994). Combination refers to converting existing explicit knowledge into new explicit knowledge. It is the process of merging, categorizing, reclassifying, and synthesizing explicit knowledge (Alavi & Leidner, 2001). These four modes are highly interdependent. Figure 2.2.2.1 describes these interactions between tacit and explicit knowledge.

Knowledge creation may be viewed as an upward spiral process, starting at the individual level moving up to the collective level, and then to the organizational level, sometimes reaching out to the inter-organizational level (Nonaka, 1994). Organizational culture is regarded as an important condition to escalate knowledge creation (Davenport & Prusak, 1998).

2.2.2.2 Knowledge Storage/Retrieval

When knowledge workers resign or retire from a firm without the proper storage of the knowledge they have obtained, customer relationships or performance may be impaired (KPMG, 1998b). Knowledge storage includes obtaining knowledge inside and outside firms and coding it. An important consideration with knowledge storage is how much context to include (Alavi & Leidner, 2001). Knowledge is context-specific and thus without sufficient contextual details it will not result in effective use.

Alavi and Leidner (2001) present two conceptual models in regard to knowledge retrieval – pull and push. The pull model of knowledge retrieval involves the search for knowledge based on specific user queries. In the push model, knowledge is automatically retrieved and delivered to potential users based on predetermined actions.

2.2.2.3 Knowledge Transfer

Knowledge, once captured, must be disseminated throughout a firm to foster productivity and innovation (Zellman-Bruhn, 2003; Argote, 1999; Epple et al., 1991; Hedlund, 1994). Knowledge transfer occurs at various levels: between individuals, from individuals to groups, between groups, across groups, and from groups to a firm (Sabherwal & Becerra-Fernandez, 2003; Alavi & Leidner, 2001). However, researchers find that knowledge transfer is difficult (Lessard & Zaheer, 1996; Ruggles, 1998; Szulanski, 1996; Miner & Meziah, 1996). The tacitness of knowledge is a widely recognized barrier to its transfer (Lippman & Rumelt, 1982; Zander & Kogut, 1995; Gupta & Govindarajan, 2000). Motivational depositions and absorptive capacity also make knowledge transfer hard (Levinthal & March, 1993; Simon 1991; Szulanski, 1996). Gupta and Govindarajan (2000) address five factors to escalate knowledge transfer: (1) value of knowledge, (2) willingness to share knowledge, (3) existence and richness of transmission channels, (4) willingness to acquire knowledge from the source, and (5) absorptive capacity of the target units. Information technology may enhance the transfer of explicit knowledge by extending people's reach beyond formal communication lines (Alavi & Leidner, 2001). Inkpen and Dinur (1998) argue that experience is also a good way to transfer tacit knowledge.

2.2.2.4 Knowledge Application

Knowledge creation, knowledge storage/retrieval, and knowledge transfer do not necessarily improve the performance of a firm. It is the effective application of knowledge that reduces costs and improves productivity (Davenport & Klahr, 1998;

Alavi & Leidner, 2001). Evidence shows that firms have gaps between what they know and what they do (Pfeffer & Sutton, 2000). Davenport and Prusak (1998) explain several reasons why knowledge is not applied to action: (1) distrusting the source of knowledge, (2) a lack of time and opportunity to apply knowledge, or (3) risk aversion. Alavi and Leidner (2001) argue that researchers should pay more attention to cognitive processes of people for effective knowledge application.

2.3 RESEARCH FRAMEWORK

Figure 2.1 provides a research framework that explains knowledge management to support distributed cognition and behavior in knowledge-intensive and computer-mediated work. It examines the relationships among a knowledge-sharing climate, knowledge quality, information systems quality, cognitive empowerment, perspective taking, perspective making, and innovation. These variables are explored in the following sub-sections.

2.3.1 Knowledge-sharing Climate

A number of firms form cross-functional teams because they have a variety of functional backgrounds, which enable them to tap into a broad array of knowledge and thus facilitate innovation (Cohen & Levinthal, 1990; Woodman et al., 1993; Lovelace et al., 2001; Keller, 2001; Bunderson et al., 2002). Cross-functional teams bring together people from different disciplines that have pertinent expertise to produce innovation (Kanter, 1988; Linderman et al., 2004; Stevens & Campion, 1994). However, empirical research has shown that functional diversity has both positive and negative effects.

Table 2.3.1.1: Positive and negative impacts of functional diversity on team performance

Positive Impacts		Negative Impacts	
More innovation	Bantel and Jackson (1989)	Decreased short-term performance	Murray (1989)
Increased long-term performance	Murray (1989)	Increased cost	Aitsalilia et al. (1995)
Clearer strategies	Bantel (1993)	Lower group cohesiveness	Donnellon (1996), Jehn (1997), Swamidass & Aldridge (1996)
Quick implementation of organizational changes	Williams et al. (1995)	Slow competitive response	Hambrick et al. (1996)
Enhanced speed in the marketing of a new product	Aitsahlia et al. (1995)	Lower consensus	Knight et al. (1999)
Better new product quality	Brown & Eisenhardt (1995)	Increased conflicts	Knight et al. 91999), Pelled et al. (1999)
Increased market share and profit growth	Hambrick et al. (1996)	Increased job stress	Keller (2001)
Shorter development times	Kessler & Chakrabarti (1996)	Decreased team social integration	Harrison et al. (2002)

On the positive side, functional diversity on a team leads to more innovation (Bantel & Jackson, 1989), increased long-term performance (Murray, 1989), clearer strategies (Bantel, 1993), quick implementation of organizational changes (Williams et al., 1995), enhanced speed in the marketing of a new product (Aitsahlia et al., 1995), better new product quality (Brown & Eisenhardt, 1995), increased market share and profit growth (Hambrick et al., 1996), and shorter development times (Kessler & Chakrabarti, 1996). On the negative side, functionally diverse teams induce decreased short-term performance (Murray, 1989), increased cost (Aitsalilia et al., 1995), lower group cohesiveness (Donnellon, 1996; Jehn, 1997; Swamidass & Aldridge, 1996), slow competitive response (Hambrick et al., 1996), lower consensus (Knight et al., 1999), increased conflict (Knight et al., 1999; Pelled et al., 1999), increased job stress (Keller, 2001), and decreased team social integration (Harrison et al., 2002). A summary of both positive and negative impacts of functional diversity is shown in Table 2.3.1.1.

A knowledge-sharing climate may help to reconcile the different impacts of cross-functional teams. In addition, a knowledge-sharing climate is quite important in regard to escalating the dynamics of knowledge management. A knowledge-sharing climate encourages knowledge creation and dissemination on a team (Janz & Prasarphanich, 2003). Close and frequent interactions among team members lead to share tacit knowledge as well as explicit knowledge. Von Krough (1998) states that knowledge-sharing is a mutual intent to help others and optimize task performance. This study defines a knowledge-sharing climate as the extent to which team members have a set of shared understanding about providing access to information and building or using necessary knowledge (Hoegl et al., 2003).

In the cross-functional environment, some teams are able to share ideas, information, or knowledge, whereas others are not. Knowledge-sharing on a team cannot be forced but can only be encouraged (Gibbert & Krause, 2002). Based on the expectancy theory (Vroom, 1964), Bunderson and Sutcliffe (2002) raise three questions related to a knowledge-sharing climate: (1) If I share activities and developments with my team members in my area, will they understand me? (2) If my team members understand activities and developments in my area, will it help us to perform better as a team? and

(3) If I perform as part of a team, will my sharing motivate team members to share their information or knowledge? A knowledge-sharing climate is a complex process that may need to be broken down into dimensions (Janz & Prasarnphanich, 2003). We propose three dimensions – (1) willingness, (2) trust, and (3) openness. As information or knowledge is unequally distributed among team members, their willingness, trust, and openness are critical to share pertinent information and knowledge (Argote et al., 1999; Bunderson & Sutcliffe, 2002). The following sub-sections explore willingness, trust, and openness respectively.

2.3.1.1 Willingness

Henderson (1994) states that developing new products in a pharmaceutical firm requires the integration of knowledge from a broad array of disciplines such as molecular biology, physiology, biochemistry, synthetic chemistry, and pharmacology. In the course of integrating knowledge, the willingness of team members is critical. Project teams may be unwilling to share their data, ideas, or resources if they have an atmosphere of secrecy and competition (Hansen, 1999). In such a secretive and competitive environment, team members consider knowledge-sharing as a way to lose their competitive advantage. Willingness is described as the extent to which team members have positive orientations toward exchanging information and using knowledge. Willingness on a cross-functional team will build and sustain a competitive advantage (Leonard-Barton, 1995).

2.3.1.2 Trust

Cross-functional teams should achieve an environment for team members to understand how components interact to influence overall performance (Linderman et al., 2004). Without establishing trust, it is not easy to share information or knowledge. Trust is the belief that the intended action of others would be appropriate to complete a project (Mistzal, 1996; Kankanhalli et al., 2005). Trust is described as the extent to which team members value information, knowledge, or resources possessed or acquired by other team members. Project team members may not acquire information and knowledge when they do not trust sources or knowledge possessed by others. Trust is an important aspect of accomplishing knowledge sharing (Von Krogh, 1998).

2.3.1.3 Openness

An open knowledge-sharing climate has been discussed as an important attribute that encourages interactions among people (Leonard-Barton, 1995; Cohen, 1998; Davenport & Prusak, 1998; Gold et al., 2001). Project teams bring together disciplines and members needed in order to acquire new knowledge, skills, and abilities. Openness is defined as the extent to which team members are encouraged to express their ideas, even though the ideas may be contrary to existing knowledge. In an open atmosphere, team members may bring forth anything and come up with creative ideas. Openness will enable project teams to realize their potentials for value creation (Von Krogh, 1998). It encourages team members to voice their opinions or give feedback, both of which are critical when building knowledge.

2.3.2 Knowledge Quality

Quality management has its roots in manufacturing and service to accomplish efficiency and customer satisfaction. The scope has been expanded to data quality and information quality (Wang & Strong, 1996; Nelson et al., 2005). It is also pertinent to discuss knowledge quality in the knowledge-based economy. As information technology advances, firms have a tremendous amount of data and information on a daily basis and need their qualities for efficiency. Furthermore, knowledge is about action and its quality affects decision-makings in firms. Studies on data quality and information quality have been conducted in a broad manner. This study organizes the literature on data quality and information quality. Taking the ideas presented in the literature a step further, this study presents the concept of knowledge quality.

2.3.2.1 Data Quality

Everyday firms store a vast amount of data, which are processed to create value. High-quality data reduce cost and increase strategic corporate capacity, whereas poor-quality data have a negative impact on firms (Wang & Strong, 1996; Madnick et al., 2003; Wang, 1998; Yang, 2003). Most firms strive to achieve data quality by establishing routine control procedures in an organization databases (Lee & Strong, 2003). Data quality is described as fitness for use by data users (Wang & Strong, 1996; Strong et al., 1997). Research on data quality has been developed in finding its dimensions (Wang & Strong, 1996) and its measurements (Wang & Strong, 1996; Goodhue, 1995; Fisher & Kingma, 2001; Cappiello et al., 2003). Traditionally, high quality refers to accuracy of data (Goodhue, 1995; Ballou & Pazer, 1995; Redman, 1996; Fisher & Kingma, 2001;

Table 2.3.2.1.1: Summary of the literature on data quality

Author(s)	Data	Level	Type	Measurement
Goodhue (1995)	259 data from 9 companies	Individual	Survey	Accuracy Currency Accessibility
Ballou & Pazer (1995)			Mathematical	Timeliness Accuracy
Wang & Strong (1996)	355 data	Individual	Survey	Intrinsic data quality Contextual data quality Representational data quality Accessibility data quality
Strong et al. (1997)	42 data quality projects from 3 organizations			Intrinsic data quality Contextual data quality Representational data quality Accessibility data quality
Fisher & Kingma (2001)		Project	Case Study	Accuracy Timeliness Completeness Consistency Relevance Fitness for use
Cappiello et al. (2003)			Simulation	Currency Accuracy Completeness
Lee (2003)	5 organizations	Project	A combination of case analysis and longitudinal action research	

Cappiello et al., 2003). In addition, a number of attributes of data quality have been addressed; currency (Goodhue, 1995; Cappiello et al., 2003), accessibility (Goodhue, 1995), relevance (Fisher & Kingma, 2001), timeliness (Ballou & Pazer, 1995; Fisher & Kingma, 2001), completeness (Fisher & Kingman, 2001; Cappiello et al., 2003), and consistency (Fisher & Kingma, 2001). A summary of the literature on data quality is given in Table 2.3.2.1.1. Wang and Strong (1996) present a broader conceptualization of data quality than a conventional view by proposing and testing intrinsic data quality, contextual data quality, representational data quality, and accessibility data quality. Intrinsic data quality denotes that data have quality in their own right (i.e., accurate, objective, or believable). Contextual data quality means that data quality must be considered within the context of the task at hand (i.e., value-added, relevant, timely, complete, or appropriate). Contexts in data quality may be implicit, but must be a critical part (Lee, 2003). Representational data quality includes aspects related to the format of data (i.e., concise or consistent) and the meaning of data (i.e., interpretability or ease of understanding). Accessibility data quality denotes that the system must be accessible but secure (i.e., accessibility or security).

Poor data quality may be dirty data in databases, inadequate data management procedures, software errors, and contextual uncertainty (Redman, 1996). Madnick et al. (2003) contend that the main problems of data quality are entity identification and entity aggregation. An entity may appear in a multiple way (e.g., IBM, I.B.M., or International Business Machines Corporation), which makes it difficult to identify the firm correctly. An entity may also have a number of subsidiaries, branches, divisions, and joint ventures. So it is imperative to determine what exactly the firm is. Another difficulty of data quality is changes in the business environment. Data in databases are static, but the real world keeps changing (Orr, 1998).

2.3.2.2 Information Quality

Availability of information alone is no longer a strategic advantage. Information quality has become a critical issue in dealing with the rapidly changing business environment (Hu et al., 1998; Lee et al., 2002; Lillrank, 2003). In fact, information quality has been regarded as one of the six categories for information systems success (DeLone & MaLean, 1992, 2003; Huang et al., 1999). The poor quality of information is commonly caused by the lack of coordination and shared understanding among information customers, producers, and suppliers (Wang et al., 1998). Information quality is defined as fitness for use by information users. Similar to the four dimensions of data quality, Lee et al. (2002) present four dimensions of information quality – (1) intrinsic information quality, (2) contextual information quality, (3) representational information quality, and (4) accessibility information quality. Intrinsic information quality means that information has quality in its own right. Contextual information quality indicates that information must be considered within the context of the task. Representational information quality describes that the system must present information interpretably, understandably, and consistently. Accessibility information quality means that the system must be accessible but secure. Two dimensions (i.e., representational information quality and accessibility information quality) raise the issue that information quality is often confused with information systems quality (von Hellens, 1997; Anderson & von Hellens, 1997). Nelson et al. (2005) organize information quality through an extensive literature

Table 2.3.2.2.1: Summary of the literature on information quality

Author(s)	Data	Level	Type	Measurement
Strong (1997)			Simulation	Technical Configuration Sourcing
Wang et al. (1998)	4 organizations	Organizational	Case Study	Intrinsic Information Quality Contextual Information Quality Representational Information Quality Accessibility Information Quality
Kahn et al. (2002)	3 health organizations	Organizational	Case Study	Soundness Dependability Usefulness Usability
Rai et al. (2002)	274 data	Individual	Survey	Content Accuracy Format
Lee et al. (2002)	261 respondents from 5 organizations	Organizational	Survey	Accessibility, Appropriate Amount, Believability, Completeness, Concise Representation, Consistent Representation, Ease of Operation, Free of Error, Interpretability, Objectivity, Relevancy, Reputation, Security, Timeliness, Understandability
Lee & Strong (2003)	155 data from 3 organizations	Individual	Survey	Accuracy Completeness Timeliness Relevancy Accessibility
Nelson et al. (2005)	465 data from 7 organizations	Individual	Survey	Completeness Accuracy Format Currency

review. However, they do not distinguish information quality from data quality. Table 2.3.2.2.1 provides a summary of the literature on information quality. It should be noted that the taxonomy used in the table follows the researchers' terms. If they use "information quality" instead of "data quality" in their research, it is considered as an information quality study.

2.3.2.3 Knowledge Quality

In the knowledge-based economy, knowledge quality is quite critical in order to sustain a competitive advantage. However, it remains a vaguely defined concept and so is difficult to specify (Kankanhalli et al., 2005). The standards for judging the quality of knowledge may include speed, lower costs, higher profit margins, and the degree to which knowledge may contribute to a firm's development (Droge et al., 2003). Attempts to define knowledge quality follow patterns established in the quality literature. Quality has been variously defined as value, conformance to requirements, fit for use, and meeting or exceeding customer expectations (Deming, 1986; Dobyns & Crawford-Masson, 1991; Juran, 1989; Juran & Gryna, 1980). The concept of "fitness of use" is widely adopted in the quality literature (Wang & Strong, 1996). Project team members who access knowledge will judge whether or not it is fit for use (Deming, 1986; Dobyns & Crawford-Masson, 1991; Juran, 1989; Juran & Gryna, 1980). Justification by team members is the process of determining the extent to which knowledge is truly worthwhile for the team (Nonaka, 1994). This paper defines knowledge quality as the extent to which knowledge is justified as fit for use.

As knowledge is a multi-faceted concept, knowledge quality may have dimensions. To elicit attributes of knowledge quality, this study illuminates three dimensions – (1) intrinsic knowledge quality, (2) contextual knowledge quality, and (3) actionable knowledge quality. The three different knowledge qualities are conceptually separated, but are used interactively at work. The three dimensions combine to create an overall construct of knowledge quality. Each dimension is explored in the following sub-sections.

2.3.2.3.1 Intrinsic Knowledge Quality

Intrinsic knowledge quality refers to the extent to which knowledge has quality in its own right (i.e., accurate, reliable, or believable). This is a foundational attribute of knowledge quality. Even though knowledge is based on personal beliefs and insights, they should be within a reasonable range for others to accept. Intrinsic knowledge quality allows team members to be rich in understanding activities and relationships among problems, processes, and products.

2.3.2.3.2 Contextual Knowledge Quality

What may be considered as good knowledge in one case may not be useful in another case. Knowledge is context-specific and contexts play a large role in how knowledge is understood (Madnick et al., 2003; Becerra-Fernandez & Sabherwal, 2001; Nonaka & Takeuchi, 1995; Tyre & von Hippel, 1997). Different contexts (i.e., paradigms, goals, roles, time, space, and culture) evaluate knowledge quality in a different manner. Different contexts even need different knowledge management processes (Becerra-Fernandez & Sabherwal, 2001). Contextual knowledge quality refers to the extent to which knowledge is considered within the context of the task (i.e., relevant or value-added). Because tasks and their associated contexts vary across time and people, it is a research challenge to explore contextual knowledge quality.

2.3.2.3.3 Actionable Knowledge Quality

The notion of knowledge quality depends on the actual use of that knowledge. Knowledge is not created for its own sake, but should be converted into action to manifest its usefulness and profitability (Demarest, 1997; Droge et al., 2003). Knowledge is about action and must be used to some end (Nonaka & Takeuchi, 1995; Von Krough, 1998). Actionable knowledge quality refers to the extent to which knowledge is expandable, adaptable, or easily applied to tasks. It allows teams to solve problems and implement solutions effectively. Madnick et al. (2003) use "corporate household knowledge" as actionable knowledge.

2.3.3 Information Systems Quality

Information systems play an important role in diffusing knowledge, as they expand users' reach to expedite large-scale knowledge. Providing a virtual space in which organizational members represent their knowledge and take the knowledge of others into account may allow them to arrive at new insights (Alavi & Leidner, 2001). High quality of information systems should be designed to support coordination, collaboration, and communication for teams. Information systems should have a comprehensive infrastructure that supports various types of knowledge and communication that are critical (Gold et al., 2001). In this study, information systems quality refers to the extent to which information systems have perceived ease of use, perceived usefulness, and perceived media richness.

Research has developed and tested a theoretical extension of the Technology Acceptance Model (TAM) to explain perceived ease of use and perceived usefulness (Davis, 1989; Davis et al., 1989; DeLone & McLean, 1992, 2003; Doll et al., 1998; Venkatesh & Davis, 2000; Gefen et al., 2003). TAM theorizes that perceived ease of use and perceived usefulness are important aspects of information systems quality. Furthermore, this study argues that perceived media richness is also a critical dimension to build information systems quality. Information systems should be designed in such a way that people may flexibly express their knowledge. Due to a lack of social and verbal interactions, computer-mediated communications may be less effective than face-to-face meetings (Hinds & Weisband, 2003). Because the writing, the language, and the context behind texts in information systems may be unfamiliar to others, it may cause equivocality. As a response to coping with this ambiguity, as well as the characteristics of non-routine tasks, rich media is necessary (Daft & Lengel, 1986). The media richness theory is one of the first prescriptive theories to describe why people choose particular information technology to communicate with others in a workplace (Daft & Lengel, 1984, 1986). Perceived media richness enables users to express their understandings and to interpret quite unfamiliar texts received from others in multiple ways. Thus, perceived ease of use, perceived usefulness, and perceived media richness may contribute to the information systems quality. In the following sub-sections, perceived ease of use, perceived usefulness, and perceived media richness are explored.

2.3.3.1 Perceived Ease of Use

Perceived ease of use is supported by Bandura's (1982) work. Information systems may be easy to use if the effort to use the technology is modest according to the users' frame of reference (Doll & Torkzadeh, 1998). Perceived ease of use refers to the degree to which users believe that using a particular system will be free of effort (Davis, 1989). It is an indicator of the cognitive effort needed to learn and utilize information technology (Gefen et al., 2003). Perceived ease of use is the information systems quality that allows users to navigate various different knowledge bases. Knowledge workers may lack specific software knowledge or specific skills necessary to use computers in their work. Unfriendly technology, which does not work as suggested and is frequently down, makes users avoid using it.

2.3.3.2 Perceived Usefulness

Schultz and Slevin (1975) and Robey (1979) introduce perceived usefulness on systems utilization. The concept of "usefulness" implies purposes. Information systems may be considered useful if they contribute to accomplishing users' purposes (Doll et al., 1989). Team members will use information technology to the extent to which they believe that it will enhance their performance. Perceived usefulness refers to the degree to which users believe that using a particular system will enhance job performance (Davis, 1989). It is the information systems quality that allows users to compare and contrast various interpretations so that they may find the most creative way to solve problems. It enables knowledge workers to explore a wide range of knowledge bases in a timely manner. In many empirical tests, perceived usefulness has consistently been a strong determinant of information systems quality (Doll & Torkzadeh, 1998; Delone & Mclean, 1992, 2003).

2.3.3.3 Perceived Media Richness

Information systems should enable users to easily represent contents and contexts, and flexibly exchange those representations with others (Boland et al., 1994). Perceived media richness has been described as a medium's ability to accomplish four goals – (1) sending multiple cues, (2) supporting the use of language variety, (3) providing timely feedback, and (4) supporting a high degree of personalness (Daft & Lengel, 1984, 1986; Webster & Trevino, 1995; Carlson & Davis, 1998; Carlson & Zmud, 1999). Multiple cues involve the use of different senses such as emotional tone, attitude, or formality (Carlson & Zmud, 1999). Language variety refers to the simultaneous use of texts, graphics, and videos in written forms (Ferry et al., 2001; Carlson & Zmud, 1999). Timely feedback describes the ability of the medium to quickly deliver responses. Personalness captures the degree to which a receiver may feel the presence of a sender through the communication medium (Ferry et al., 2001). Perceived media richness refers to the degree to which media have the capability to transfer or communicate messages in various methods (i.e., texts, graphics, or videos) (Daft & Lengel, 1984, 1986; Daft et al., 1987; Carlson & Zmud, 1999; Fichman, 2001; Gatingnon et al., 2002). Rich media enable team members to freely interact through various cues, while sending and receiving quick feedback.

2.3.4 Cognitive Empowerment

As the business environment encountered global competition, the commitment, initiative, and innovation of employees were required (Harrison, 1983; Kanter, 1983; Drucker, 1988). Accordingly, cognitive empowerment has received widespread attention. As the knowledge-based economy begins, the nature of work becomes abstract, stochastic, and autonomous (Weick, 1993). In this context, empowerment is critical to deal with uncertainty and equivocality. Although information technology initiates knowledge management, both academicians and practitioners recognize that effective knowledge management needs to include people (Massey et al., 2002). Knowledge resides in people and people create knowledge. In knowledge-intensive work, empowered teams play an important role in producing benefits to a firm. Empowered teams are willing to search for new knowledge that makes their work meaningful. They provide the leadership behaviors that encourage changes (Spreitzer et al., 1999). They are willing to share half-fledged ideas, knowing that they may explain, defend, and shape knowledge (Blackburn et al., 2003). Cognitive empowerment provides the capability to cope with critical problems (Salancik & Pfeffer, 1982).

In a legal sense, power means authority and thus empowerment is authorization (Thomas & Velthouse, 1990). Power also means capacity and energy (Conger & Kanungo, 1988; Thomas & Velthouse, 1990). Conger and Kanungo (1988) define empowerment as increases in workers' effort-performance expectancy or self-efficacy. Kirkman and Rosen (2000) define team empowerment as increased task motivation that is due to team members' collective, positive assessments of their organizational tasks. This study defines cognitive empowerment as the level of intrinsic task motivation manifested in a set of four cognitions (i.e., meaning, competence, self-determination, and impact) reflecting a team's orientation to its work role (Thomas & Velthouse, 1990). Even though teams have little self-determination, they may still perceive empowerment to the extent to which they feel a sense of meaning, competence, and impact (Spreitzer, 1995; Kirkman et al., 2004). Spreitzer (1995) argues that employees may be viewed as more or less empowered, rather than empowered or not empowered.

Researchers focus on the empowerment of management practices such as access to information and resources (Blau & Alba, 1982; Bowen & Lawler, 1992; Mainiero, 1986; Neilsen, 1986). Conger and Kanungo (1988), however, argue that management practices may not necessarily empower employees. With this perspective, Thomas and Velthouse (1990) and Spreitzer (1995, 1996) make a distinction between management practices and job cognitions. They also address the four cognitions that form cognitive empowerment. In the following sub-sections, the four cognitions are explained.

2.3.4.1 Meaning

Meaning is a fit between the requirements of work and the beliefs, values, and behaviors of the team (Brief & Nord, 1990; Hackman & Oldman, 1980). It includes values, goals, or purposes in given tasks (Thomas & Velthouse, 1990). A high level of meaning results in commitment and concentrated energy, while a low level of meaning results in apathy and unrelated feelings (Kanter, 1968; Sjoberg et al., 1983). When teams perceive that given tasks are meaningful, they are more likely to respond to the tasks with a high level of motivation (Hackman & Oldham, 1980).

2.3.4.2 Competence

Competence is a belief in the capability to perform work activities (Gist, 1987). Conger and Kanungo (1988) call it self-efficacy that is the self-appraisal of the ability to complete tasks successfully. A high level of competence leads people to face hard tasks with enhanced effort, persistence, and endurance, whereas a low level of competence leads people to avoid difficult situations (Bandura, 1997; Doll et al., 2002). Kirkman et al. (2004) find that competence brings the capability that responds to changing customer needs, often coming up with creative solutions in the context of virtual teams. A high level of competence enables teams to behave actively, seek continuous improvement, revise work processes, and search out innovative solutions to work problems (Crant, 2000; Hyatt & Ruddy, 1997).

2.3.4.3 Self-determination

Self-determination is a sense of choice in initiating and regulating actions (Deci et al., 1989). It means that important decisions are made and executed by the teams (Kirkman & Rosen, 1999; Bell & Staw, 1989; Spector, 1986). It has been found that self-determination produces greater flexibility, creativity, self-regulation, greater risk-taking, and resilience in the face of adversity (Deci & Ryan, 1985; Deci et al., 1989; Tushman & O'Relly, 1996). Teams do not have to wait for managerial permission before engaging in risk-taking activities that are crucial to improvement (Edmondson, 1999). Campion et al. (1993) and Henderson and Lee (1992) use the term autonomy instead of self-determination. They show that an increasing level of autonomy enhances work satisfaction and performance.

2.3.4.4 Impact

Impact is the degree to which a team's project may influence strategic, administrative, or operating outcomes at work (Ashforth, 1989). In Hackman and Oldham's (1980) model of work redesign, impact is analogous to perceived consequences. When teams perceive that their work does not have perceived consequences, motivation is reduced and the abilities to recognize opportunities are declined (Spreitzer, 1995). Impact allows teams to enhance motivation by improving team members' collective understanding of situations (Edmondson, 1999).

2.3.5 Perspective Sharing

Project teams may be composed of members who have specialized knowledge and considerable expertise. In order for teams to reach their performance potential, they must be able to capitalize on members' resources by discerning, weighting, and transferring task-relevant knowledge (Littlepage et al., 1997; Henry, 1995). Knowledge transfer is a very important practice (Huber, 1991; Szulanski, 1996; Argote & Ingram, 2000; Darr & Kurtzberg, 2000; Ko et al., 2005). The extent to which a team transfers members' expertise affects group performance (Moreland & Myaskovsky, 2000; Moreland, 1999; Hollingshead, 1998; Littlepage et al., 1997; Liang et al., 1995; Faraj & Sproull, 2000; Thomas-Hunt & Gruenfeld, 2003).

Knowledge transfer has been defined by different researchers. Szulanski (1996) defines knowledge transfer as dyadic exchanges of organizational knowledge between a source and a recipient unit in which the identity of the recipient matters. Argote and Ingram (2000) describe it as the process through which one unit (e.g., group, department, or division) is affected by the experience of another. Ko et al. (2005) depicts it as the communication of knowledge from a source so that it is learned and applied by a recipient. Darr and Kurtzberg (2000) state that knowledge transfer occurs when a contributor shares knowledge that is used by an adopter.

An important factor of knowledge transfer is quality relationships (Argote, 1999; Ko et al., 2005). However, members on a cross-functional team often lack in a shared language and a common ground, which significantly limit the ability to transfer knowledge. For example, consider a new product development team consisting of a marketing representative, a finance representative, engineers, and manufactures. Even though they are charged with developing innovative products, they are less likely to have salient attributes or experiences in common. It calls for a framework that understands and combines different disciplines in the context of knowledge transfer. Boland and Tenkasi (1995) present the concept of perspective taking and perspective making. They state that perspective taking and perspective making may occur among members who possess different disciplines, characteristics, experiences, and values. Purser et al. (1992) contend that the failure to achieve perspective taking is a very critical problem in new product development. Boland and Tenkashi (1995) indicate that producing knowledge requires the ability of perspective taking and perspective making. Team performance is not just a function of having right expertise, but of coordinating it on a team (Faraj & Sproull, 2000).

Although many theories explain the dynamics of knowledge transfer, few theories explore perspective sharing. This study describes the major mechanism that accounts for perspective taking and perspective making. In the following sub-sections, the dynamics of perspective taking and perspective making are explored.

2.3.5.1 Perspective Taking

There has been a long tradition of research examining perspective taking. Piaget (1932) and Piaget and Inhelder (1973) investigate it in the context of child development. Best effort and hard work, not guided by new stimuli, only dig deeper the pit in which we are already (Deming, 1994). Purser et al. (1992) conduct a comparative study of two product development projects in which one project succeeded and the other failed. They argue that the main reason for the failed project is due to the inability to achieve perspective taking through depicting and exchanging representations of each team members' unique understandings. Perspective taking is critical to organizational learning (Boland & Tenkasi, 1995). The same assemblage of knowledge may evoke different responses from different people and even from the same person according to a different context (Malhotra, 2000). Product success is the result of collaborations in which diverse individuals appreciate and utilize their distinctive perspectives through the process of perspective taking (Dougherty, 1992; Purser et al., 1992; Nonaka, 1994; Henderson, 1994).

In a group of experts, each person may not master the unique knowledge domains of the others. In other words, marketing personnel do not have to master the specialized knowledge of engineering. Yet, marketing personnel need to integrate important aspects of engineering to improve their overall understanding of products. A perspective refers to a cognitive judgment based on the knowledge a team member has. Perspective taking refers to the process whereby team members take the knowledge of other disciplines into account. Innovation does not lie in simply combining and sharing knowledge, or making knowledge commonly available. It lies in perspective taking in which experts take the knowledge of others into account from various disciplines. Yesterday's best practices may turn into today's worst practices, and yesterday's core competencies may turn into today's core rigidities. Taking different perspectives triggers new insights into problems and plays a critical role in creating knowledge. Team members need to surface and reconcile others' perspectives continually.

2.3.5.2 Perspective Making

Team members may have different perspectives that have been shaped by their positions and backgrounds. Knowledge-intensive workers do not follow a set of rules to arrive at a single prescribed solution (Boland & Tenkasi, 1995; Markus et al., 2002). Disagreements on why, what, and how they are doing on a team may cause poor outcomes (Bennett, 1996; Gerwin & Moffat, 1997; Ko et al., 2005). As such, a team's ability to gain a shared interpretation out of many perspectives is critical (Brockman & Morgan, 2003; Kanter, 1988; Purser et al., 1992; Kieras & Polson, 1985; Polson, 1987).

Perspective making refers to the process whereby a team develops and strengthens its knowledge and practices as a whole (Boland & Tenkasi, 1995). Perspective making is a dynamic process that drives a team toward the uniformity of cognitive maps and the consistency of framing. It indicates that team members compare and contrast various perspectives and eventually arrive at hybrid combinations (Boland & Tenkasi, 1995; Markus et al., 2002). Perspective making produces conflict resolution, enhanced teamwork, and united effort. As a perspective strengthens, knowledge-intensive workers may have an increased ability to work better because their scopes of understanding get bigger.

2.3.5.3 Perspective Taking vs. Perspective Making

It is noteworthy to mention differences between perspective taking and perspective making. Perspective taking is to exchange unique understandings from diverse disciplines, while perspective making is to reach an agreement for unity. Perspective taking allows a team to interpret the same knowledge in a different manner, while perspective making is the process of recognizing incongruous sets of knowledge and combining them to arrive at a consensus. Finally, perspective taking is a team's ability to appreciate and utilize distinctive perspectives, while perspective making reflects a team's ability to harvest and incorporate knowledge into operation.

2.3.6 Innovation

The empty idea war-chest phenomenon is due to a lack of innovation in a firm (Massey et al., 2002). The central role of innovation is the long-term survival of a firm amid severe global competition (Scott & Bruce, 1994; Ancona & Caldwell, 1987; Fichman, 2001; Nelson, 1995; Teece & Pisano, 1994; Huang et al., 1999). Innovation is defined as the adoption of an idea or behavior that is new (Daft, 1978; Damanpour, 1991, 1996; Fichman, 2001; Gatingnon et al., 2002; Oldham et al., 1996; Amabile, 1996; Scott & Bruce, 1994). It is the process of initiating, adopting, and implementing one or more new technology (Fichman, 2000). This study describes innovation as the production or adoption of novel and useful systems, processes, products, or services. Innovation may be new knowledge-embedded products or services, new processes, new structures or administrative systems, or new programs (Damanpour, 1991). Firms should respond to changes in internal and external environments through innovation. In the following sub-sections, characteristics and types of innovation are explained.

2.3.6.1 Characteristics of Innovation

Innovation is substantially different from routine problem solutions (Malhotra et al., 2001). Characteristics of innovation are as follows. Innovation demands the synthesis of a wide range of knowledge domains (Kalay, 1989). Its solutions are generated in unpredictable ways (Safoutin & Thurston, 1993). In innovative work, problems are often poorly specified and may be understood only when they are resolved (Sage, 1992). Innovative tasks are high in complexity and uncertainty and may not be apportioned to any single person or function (Pava, 1983). Innovation is inherently both an orderly and a disorderly process (Purser et al. 1992). Teams may be viewed as innovative when they exhibit novel and useful behaviors early, frequently, and intensively (Fichman, 2001).

2.3.6.2 Types of Innovation

Types of innovation have been distinguished by a number of researchers – technical versus administrative (Damanpour & Evan, 1984), product versus process (Knight, 1967; Utterback & Abernathy, 1975; Dougherty, 1992), radical versus incremental (Ettlie et al., 1984; Dewar & Dutton, 1986; Damanpour, 1996; Green et al., 1995), and architectural versus generational (Henderson & Clark, 1990; Christensen &

Rosenbloom, 1995; Sanderson & Uzumeri, 1995). Technical innovation includes new products, services, and production process technology, while administrative innovation involves novel organizational structures and administrative processes (Damanpour & Evan, 1984). Product innovation refers to new products or services to meet changing customer expectations, while process innovation is work and information flow to produce products and render services efficient (Knight, 1967; Utterback & Abernathy, 1975). Radical innovation represents clear departures from existing practices and technology, while incremental innovation exhibits refining and improving existing practices and technology (Dewar & Dutton, 1986; Ettlie et al., 1984). The empirical literature consistently demonstrates that radical innovation is riskier, yet it has more profound effects than incremental innovation (Damanpour, 1996; Cooper & Smith, 1992; Foster, 1986). Architectural innovation contains changes in linking mechanisms between existing subsystems, while generational innovation describes changes in subsystems (Henderson & Clark, 1990; Gatignon et al., 2002).

2.4 HYPOTHESES DEVELOPMENT

This study provides a research framework that examines relationships among a knowledge-sharing climate, knowledge quality, information systems quality, cognitive empowerment, perspective taking, perspective making, and innovation. (See Figure 2.1) In fact, it explores knowledge management to support distributed cognition and behavior in knowledge-intensive and computer-mediated work. In the following sub-sections, several hypotheses that will be tested are derived.

2.4.1 Knowledge-sharing Climate and Knowledge Quality

Firms increasingly create cross-functional teams that have relevant expertise and consequently are believed to foster productivity and innovation (Keller, 2001; Bunderson et al., 2002; Cohen & Lavinthal, 1990). Empirical research on the impact of functional diversity, however, reveals a mixed picture - both positive (Bantel & Jackson, 1989; Brown & Eisenhardt, 1995; Hambrick et al. 1996) and negative (Aitsahlia et al., 1995; Murray, 1989; Knight et al., 1999; Keller, 2001). It indicates that a simple gathering of experts does not necessarily bring desired results. A knowledge-sharing climate may reconcile the conflicts. It encourages the development of cohesion, consensus, and communication on a team despite their functional differences. A knowledge-sharing climate also increases the breadth and depth of knowledge by attaining cross-fertilization which is needed for the problem-solving capability of teams (Bunderson & Sutcliffe, 2002). Research supports that close and frequent interactions on a team lead to project effectiveness (Clark & Fujimoto, 1991; Leonard-Barton & Sinha, 1993; Henderson & Cockburn, 1994; Eisenhardt & Tabrizi, 1995; Szulanski, 1996). The value of knowledge increases with the frequency that it is gathered and shared (Davenport & Prusak, 1998; Janz & Prasarnphanich, 2003). A team with a high level of knowledge-sharing climate may have a high level of knowledge quality because team members validate their understandings through the interactions of tacit and explicit knowledge. When teams have a high level of knowledge-sharing climate, team members bring necessary functional expertise to a team and provide multiple sources of knowledge, thereby increasing the quality of knowledge (Keller, 2001; Bunderson & Sutcliffe, 2002). Consequently, this study hypothesizes that:

Hypothesis 1: A project team with a high level of knowledge-sharing climate will have a high level of knowledge quality.

2.4.2 Information Systems Quality and Knowledge Quality

Information technology capabilities expand the reach of teams to expedite expertise from team members. Information technology is the best way of collecting, organizing, and evaluating knowledge (Griffith et al., 2003; Inkpen & Dinur, 1998). A high level of information systems quality enables teams to obtain better coordination, collaboration, and communication, which in turn result in quality of knowledge. Information systems designed to be used easily may allow cognitive, effective knowledge diffusion (Boland et al., 1994). Useful information systems will make teams search for knowledge for their tasks appropriately. Contexts play a crucial role in how knowledge is understood and applied (Madnick et al., 2003; Becerra-Fernandez & Sabherwal, 2001). A high level of perceived media richness in information systems quality enables team members to send multiple cues, support the use of language variety, provide a high degree of personalness, and explain context in a proper manner. Droge et al. (2003) contend that a standard for the quality of knowledge is speed. A high level of information systems quality allows a team to access and validate knowledge easily, usefully, and quickly. As teams have better quality of information systems, the transferability of critical knowledge is enhanced. Consequently, this study presents the following hypothesis:

Hypothesis 2: A project team with a high level of information systems quality will have a high level of knowledge quality.

2.4.3 Knowledge-sharing climate and Cognitive Empowerment

Knowledge gathering and sharing are important aspects of the successful completion of projects, especially for innovative projects (Hansen, 1999). As teams review and assess necessary knowledge for their tasks, a knowledge-sharing climate provides an environment in which team members may obtain critical knowledge and complementary skills. In fact, frequent interactions among team members are viewed as evidence of a firm's competitiveness (DeTienne & Jackson, 2001; Pitman, 1994; Janz & Prasarnphanich, 2003). Research also shows that making more information and knowledge available is empowering (Kanter, 1989; Nonaka, 1988; Spreitzer, 1995, 1996). In a participative climate, acknowledgement, creation, and autonomy are valued, whereas in a non-participative climate, top-down command, order, and predictability are valued (Evered & Selman, 1989; Spreitzer, 1996; Lawer, 1992). A team with a high level of knowledge-sharing climate may be less susceptible to changes because of the timely integration of knowledge. It helps teams to recognize appropriate values and enhance their capability of decision-making. Willingness to share knowledge will increase a team's understanding. Trust in the knowledge possessed by others will make teams collaborate effectively. Openness makes teams accessible to the information and knowledge involved (Souder & Moenaert, 1992). A knowledge-sharing climate embraces all manifestations on a team of learning, mentoring, and communicating (Janz & Prasarnphanich, 2003). Team members may have opportunities to learn expertise from others, and so increase their perceived empowerment (Janz, 1999; Mikkelsen et al., 2000). A knowledge-sharing climate provides teams with proper knowledge and the perception that they will complete their project successfully. Consequently, this study hypothesizes that:

Hypothesis 3: A project team with a high level of knowledge-sharing climate will have a high level of cognitive empowerment.

2.4.4 Knowledge Quality and Cognitive Empowerment

Accumulated knowledge is necessary for new developments (Bower & Hilgard, 1981; Cohen & Levinthal, 1990, Huber, 1991; Brockman & Morgan, 2003). Without appropriate knowledge, people have difficulty making novel and useful knowledge (Lindsay & Norman, 1977). Knowledge quality enables teams to make their experience more potent (Guzzo et al., 1993; Kirkmand & Rosen, 1999). Research indicates that task-related expertise increases a team's empowerment (Trafimow & Sniezek, 1994). Teams are more likely to find their goals meaningful because they participate in potential creation with the quality of knowledge (Hackman, 1987; Hackman & Oldham, 1980). A high level of knowledge quality allows teams to use their inputs, enhancing their sense of control. Teams may develop novel and useful discoveries with the quality of knowledge, expecting an impact on the firm. A high level of knowledge quality allows teams to enhance common understandings and thus facilitate the perception of cognitive empowerment. Consequently, this study derives the following hypothesis:

Hypothesis 4: A project team with a high level of knowledge quality will have a high level of cognitive empowerment.

2.4.5 Cognitive Empowerment and Perspective Taking

Cognitive empowerment motivates teams to behave actively, seek continuous improvement, revise work processes, and search out innovative solutions (Crant, 2000; Hyatt & Ruddy, 1997). Research shows that empowered teams are willing to change and to display greater initiatives (Locke & Schweiger, 1979; Thomas & Velthouse, 1990; Spreitzer, 1995). They exhibit more proactive behaviors and persistent efforts (Bandura, 1977; Doll et al., 2002). Empowerment leads to greater experimentations (Tushman & O'Reilly, 1996; Edmondson, 1999). It is also considered as an important facilitator of knowledge flow among members (Garvin, 1993; Schulz, 2001). As teams have a collective sense of meaning, competence, self-determination, and impact, their motivation to complete tasks will be enhanced. Accordingly, individual and collective actions to take others' perspectives will be more proactive. Perspective taking is achieved by communicating experiences and then analyzing them (Boland et al., 1995). Cognitive empowerment may increase the ability to reflect upon new insights and understandings for the successful project completion of a project (Thomas-Hunt et al., 2003; Boland et al., 1995). Consequently, this study presents the following hypothesis:

Hypothesis 5: A team with a high level of cognitive empowerment will have a high level of perspective taking.

2.4.6 Cognitive Empowerment and Perspective Making

Cross-functional teams consist of heterogeneous disciplines with specialized knowledge. It requires them to leverage and combine divergent perspectives effectively. Although it is not an easy process, empowered teams show proactive behaviors (Crant, 2000; Hyatt & Ruddy, 1997). As teams construct, revise, or comment on various perspectives, cognitive empowerment allows them to have the uniformity of cognitive maps and the consistency of framing. Cognitive empowerment facilitates the integration of specialized knowledge domains because intrinsic motivation enables the transfer of tacit and explicit knowledge (O'Dell & Grayson, 1998; Osterloh & Frey, 2000; Argote, 1999; Zander & Kogut, 1995). Through empowerment, people want to control their work environment from noises (Boland et al., 1995; Doll et al., 2002). Empowered teams are more likely to recognize different sets of knowledge and combine them to arrive at consensus. Empowered teams transfer knowledge and make their own perspectives as a whole as they collaborate, communicate, and coordinate interdisciplinary knowledge. People's cognition and group collaboration enable perspective making (Boland et al., 1995). Consequently, this study derives the following hypothesis:

> ***Hypothesis 6:*** A team with a high level of cognitive empowerment will have a high level of perspective making.

2.4.7 Perspective Taking and Perspective Making

As perspective taking is ongoing, teams better understand what problems are important and what serves as good exemplars (Boland et al., 1995). Maintenance and refinement of the existing knowledge from various functions may be attributed to feedback processes (Boland et al., 1995). A collective mind is an important characteristic for a team's effectiveness (Weick & Roberts, 1993). Perspective taking is an essential process that promotes mutual adjustments and coordination (Bunderson & Sutcliffe, 2002). Agreement that knowledge is progressing is the agreement that the perspective is strengthening (Boland et al., 1995). Extensive interactions facilitate socialization processes whereby team members communicate and strengthen their knowledge (Boland et al., 1995; Linderman et al., 2004). Perspective taking allows teams to be more appreciative and aware of the inter-dependent nature of innovative tasks. It enhances the shared interpretive context of a team and drives the team to reach agreement. As teams articulate, critique, and extend interdisciplinary knowledge, their perspectives may be embedded. Consequently, this study hypothesizes that:

> ***Hypothesis 7:*** A project team with high levels of perspective taking will have higher levels of perspective making.

2.4.8 Perspective Making and Innovation

Innovation needs cross-fertilization from a variety of function (Pava, 1983). It is the adaptation of a team's collective perspectives (Brockman & Morgan, 2003). So perspective making serves as the basis for yielding innovation. Boland and Tenkasi (1995) contend that making strong perspectives in knowledge-intensive work is a way of achieving innovation. Shared consensus is a requirement for the successful completion of a project (Day, 1994; Slater & Narver, 1995; Brockman & Morgan, 2003). Perspective making enhances a team's interdisciplinary understanding of a task and decreases any conflicts. It enables teams to use their diverse, specialized knowledge in appropriate ways to create new knowledge. It increases their tendency to remain united in pursuit of goals. Accordingly, innovation may be generated more efficiently with the assistance provided through perspective making on a team. Consequently, this study presents the following hypothesis:

> ***Hypothesis 8:*** A project team with a high level of perspective making will have a high level of innovation.

CHAPTER 3: INSTRUMENT DEVELOPMENT

The proposed research framework was tested in three stages – (1) a pre-pilot test, (2) a pilot study, and (3) a large-scale survey.

3.1 PRE-PILOT STUDY

In the first stage, a pre-pilot test was conducted through item generation, structured interviews, Q-sort methodology, and pre-testing of a questionnaire. Item generation started with a theory development and a literature review. The items were evaluated through structured interviews with experts from both academicians and practitioners. Q-sort methodology is to pre-assess convergent and discriminant validity of the items through practitioners. A pre-pilot test was completed with pre-testing of a questionnaire. The following sub-sections explore the processes in more detail.

3.1.1 Item Generation

Item generation was intended to cover the domain of construct and ensure the validity of content (Churchill, 1979; Nunally, 1967). Content validity is usually achieved by a comprehensive literature review and by conducting interviews with academicians and practitioners. This study used existing items for those constructs which have been validated in prior research. In the case of the new constructs which were conceptualized in this research, measurement items were developed based on definitions and theoretical discussions. The scale for constructs and dimensions was a five-point Likert scale ranging from 1: "Strongly Disagree", 3: "Neutral", to 5: "Strongly Agree". An option, "Not Applicable", was given so as not to force respondents to answer in any particular way.

3.1.1.1 Item Generation for A Knowledge-sharing Climate

A few studies have examined a knowledge-sharing climate at the organizational level (Hoegl et al., 2003; Janz & Prasarnphanich, 2003). More research should be conceptually and empirically conducted to build on the literature of a knowledge-sharing climate. This study proposes a second-order factor of a knowledge-sharing climate, including three first-order factors (i.e., willingness, trust, and openness). Items were developed at the team level based on existing studies.

3.1.1.2 Item Generation for Knowledge Quality

Valid measurement items for data quality and information quality have been developed and tested. Instruments for knowledge quality, however, need to be developed. Knowledge quality is a multifaceted construct whose essence may not be captured by a single dimension. This study divided knowledge quality into three dimensions – (1) intrinsic knowledge quality, (2) contextual knowledge quality, and (3) actionable knowledge quality. Items were developed based on definitions and theoretical discussions.

3.1.1.3 Item Generation for Information Systems Quality

Information systems quality was described as the extent to which information systems have perceived ease of use, perceived usefulness, and perceived media richness. Davis et al. (1989) and Davis (1989) provided strong theoretical support for perceived ease of use and perceived usefulness, and developed instruments for them. The instruments have received considerable attention and have been widely accepted by researchers. They are relevant to measure information systems quality across levels of expertise (Taylor & Todd, 1995), within and across firms (Davis, 1989; Adams et al., 1992; Subranmanian, 1994), and across nations (Rose & Straub, 1998; Straub et al., 1997). The items for perceived ease of use and perceived usefulness were taken from Davis (1989). His instruments were designed at the organizational level. Davis' (1989) items were altered because this study was conducted at the team level. Researchers have also developed instruments to measure perceived media richness (Webster & Trevino, 1995; Fulk, 1993; Dennis & Kinney, 1998; Carlson & Zmud, 1999; Ferry et al., 2001). Fulk et al. (1995) measured perceived media richness with a single five-point scale ranging from "not at all rich" to "extremely rich". Webster and Trevino (1995), Calson and Zmud (1999), and Ferry et al. (2001) developed items based on the four categories of Daft & Lengel (1984) – multiple cues, language variety, immediate feedback, and personalness. This study adopted the items of Carlson and Zmud (1999) and altered them because their study was done at the organization level and this study was conducted at the team level.

3.1.1.4 Item Generation for Cognitive Empowerment

Cognitive empowerment is described as the level of intrinsic task motivation manifested in a set of four cognitions (i.e., meaning, competence, self-determination, and impact). Instruments for each scale have been developed by researchers– meaning (Hackman & Oldham, 1980; Tymon, 1988; Spreitzer, 1995), competence (Jones, 1986; Spreitzer, 1995), self-determination (Hackman & Oldham, 1980; Janz & Prasarnphanich, 2003), and impact (Ashforth, 1989). Spreitzer (1995) tested a second-order factor model of cognitive empowerment with the four first-order factors (i.e., meaning, competence, self-determination, and impact), based on instruments from the literature. Kirkman et al. (2004) also tested the second-order factor model of cognitive empowerment in the context of virtual teams. This study took items from Spreitzer (1995), however Spreitzer's items were developed at the individual level. This study was conducted at the team level and so Spreitzer's items were altered accordingly.

3.1.1.5 Item Generation for Perspective Taking

Perspective taking is a general practice among multiple disciplines. Boland and Tenkasi (1995) provided a definition of perspective taking. In an effort to provide valid and reliable measurement items, instruments were developed and validated in this study. Due to the lack of empirical investigation, measures were largely derived from theoretical development.

3.1.1.6 Item Generation for Perspective Making

This research developed measures for perspective making. Boland and Tenkasi (1995) provided a definition of perspective making. Based on their research, an initial list of items was identified. This study developed a comprehensive set of measures to assess perspective making.

3.1.1.7 Item Generation for Innovation

A variety of measures have been used to capture innovation (Downs & Mohr, 1976; Massetti & Zmud, 1996; Saga & Zmud, 1993; Tornatzky & Klein, 1982; Zmud & Apple, 1992). Fichman (2001) summarized different measures that have been used to capture innovation – earliness of adoption, internal diffusion, infusion, routinization, assimilation, and aggregated initiation/adoption/implementation. Earliness of adoption refers to the relative earliness of adoption within a population of potential adopters (Rogers, 1995; Gatingnon & Robertson, 1989; Grover et al., 1997). Internal diffusion is the extent of use of innovation across people, projects, tasks, or organizational units (Zmud, 1982; Bretschneider & Wittmer, 1993; Zmud & Apple, 1992; Rai & Howard, 1994; Hart & Saunders, 1998). Infusion describes the extent to which innovation's features are used in a complete and sophisticated way (Zmud & Apple, 1992; Cooper and Zmud, 1990; Rai & Howard, 1994). Routinization refers to the extent to which innovation has become a stable and regular part of organizational procedure and behavior (Yin, 1979; Zmud & Apple, 1992). Assimilation refers to the extent to which a firm has progressed through the assimilation lifecycle for particular innovation stretching from initial awareness to full institutionalization (Meyer & Goes, 1988; Fichman & Kemere, 1997; Armstong & Sambamurthy, 1999). Frequency or incidence of initiation, adoption, and implementation are also operationalized to measure innovation (Grover & Goslar, 1993; Nilakanta & Scamell, 1990; Zmud, 1982; Miller & Friesen, 1982). Most of the existing instruments were conducted at the organizational level of analysis, so they did not fit at the team level of analysis. Therefore, some measurements were modified and new measurement items were generated to make them more applicable to this study.

3.1.2 Structural Interviews

The generated items were evaluated through structured interviews with academicians and practitioners. The purpose of these structural interviews was to check definitions and content validity of constructs/dimensions. The academic community involved members of the fileds of information systems, operations management, human resources, and psychology. Practitioners were a CEO of a small mechanical engineering firm, a system administrator of a vehicle manufacturing firm, a senior engineer of a mechanical engineering firm, and an engineer of a major windows manufacturing firm. Practitioners had firsthand knowledge of teamwork, knowledge management, and innovation. During the structured interviews, definitions of the research framework were presented to interviewees. Based on their feedback, definitions and instruments were revised, new items were added and ambiguous items was modified or eliminated. The revised items were used for Q-sort analysis. Table 3.1.2.1 shows the number of items. Items entered for Q-sort analysis are listed in Appendix A.

3.1.3 Q-sort Methodology

The procedure of Q-sort is to have practitioners act as judges and sort items into categories based on similarities and differences. Its objective is to pre-assess the convergent and discriminant validity of instruments through examining how items are sorted into categories. If an item is placed within a particular category consistently, it will demonstrate convergent validity with the category, and discriminant validity with the others. The analysis of inter-judge disagreement on item placement shows bad items that need to be examined. Inappropriately worded or ambiguous items may be either modified or eliminated.

Table 3.1.2.1: The number of items entering Q-sort analysis

Construct	Dimension	# of item	Sub-total
Knowledge Quality	Intrinsic Knowledge Quality	7	19
	Contextual Knowledge Quality	6	
	Actionable Knowledge Quality	6	
Information Systems Quality	Perceived Ease of Use	6	18
	Perceived Usefulness	6	
	Perceived Media Richness	6	
Cognitive Empowerment	Meaning	5	21
	Competence	5	
	Self-determination	6	
	Impact	5	
Knowledge-sharing Climate		7	7
Perspective Taking		6	6
Perspective Making		7	7
Innovation		6	6
		Total	84

3.1.3.1 Sorting Procedures

Each instrument was prepared on a 3 x 5 card for judges to sort into categories. Before starting Q-sort procedures, judges were briefed with a set of instructions. Items were shuffled and presented in random order. Judges were asked to sort each item into a category. A "Not Applicable" category was included to ensure that judges were not forced to categorize an instrument in any particular way. Judges were allowed to ask questions while working on sorting procedures to enhance their understanding.

3.1.3.2 Inter-rater Reliabilities

In the Q-sort method, inter-rater reliabilities are derived by three measures – (1) inter-judge raw agreement ratio, (2) item placement ratios, and (3) Cohen's Kappa. The inter-judge raw agreement ratio is calculated by adding up the number of items that a pair of judges placed in the same category. Judges may choose to place items in a category, even though they are originally planned in a different category. Item placement ratios are obtained by summating all items that are correctly sorted by a pair of judges and dividing them by twice the total number of items. Cohen's Kappa (Cohen, 1960) is used to measure the level of agreement on categorizing items between two judges. Landis and Koch (1977) provide a guideline to interpret Cohen's Kappa by assigning different values of this index to the degree of agreement beyond chance. If the value is above .76, the degree of agreement beyond chance is regarded as excellent. If the value is between .40 and .75, the degree of agreement beyond chance is moderate. If the value is less than .39, the degree of agreement beyond change is poor.

3.1.3.3 Results of First Sorting Round

As a result of the first-round Q-sort method, inter-judge raw agreement ratio was .81, as shown in Table 3.1.3.3.1. The average of item placement ratio was 91%, as shown in Table 3.1.3.4.3. Cohen's Kappa was .79, which was an excellent degree of agreement beyond chance (Landis & Koch, 1977). For item placement ratios, several of the sub-constructs (i.e., actionable knowledge quality, meaning, competence, self-determination, impact, knowledge-sharing climate, perspective making, and innovation) obtained 100%, which indicated a high degree of construct validity. The least item placement ratio was perceived ease of use, which was 73%.

To improve convergent and discriminant validity, items in the placement matrix that were especially off-diagonal, shown in Table 3.1.3.3.1, were examined. The number of items for each of the sub-constructs after the first-round Q-sort is shown in Table 3.1.3.3.3.

3.1.3.4 Results of Second Sorting Round

Another pair of judges was used in the second sorting round, and a Q-sort analysis was subsequently conducted to test convergent and discriminant validity of measurement items. The inter-judge raw agreement ratio was .85, as shown in Table 3.1.3.4.1 and the average of item placement ratio was 93%, as shown in Table 3.1.3.4.3. Cohen's Kappa was .83, which indicated that the degree of agreement beyond chance was excellent. For item placement ratios, eight sub-constructs (i.e., intrinsic knowledge quality, perceived media richness, meaning, competence, self-determination, impact, knowledge-sharing climate, and innovation) out of fourteen sub-constructs obtained 100%, which indicated a

Table 3.1.3.3.1: Inter-judge raw agreement scores - first sorting round

	JUDGE 1															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	NA
	1	4	3													
	2		4	3												
	3			5												
	4				2	3										
	5					4	3									
J	6				1		5									
U	7							5								
D	8								5							
G	9									6						
E	10										5					
2	11											7				
	12												5	3		
	13													5		
	14														6	
	NA															

Total Items Placement: 84	Number of Agreements: 68	Agreement Ratio: .81

1. Intrinsic Knowledge Quality
2. Contextual Knowledge Quality
3. Actionable Knowledge Quality
4. Perceived Ease of Use
5. Perceived Usefulness
6. Perceived Media Richness
7. Meaning
8. Competence
9. Self-determination
10. Impact
11. Knowledge-sharing Climate
12. Perspective Taking
13. Perspective Making
14. Innovation

Table 3.1.3.3.2: Items placement ratios - first sorting round

	JUDGE 1																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	NA	T	%
JUDGE 2	1	11	3														14	79%
	2		11	3													14	79%
	3			10													11	91%
	4				8	3											11	73%
	5					10	3										13	77%
	6				1		11										12	92%
	7							10									10	100%
	8								10								10	100%
	9									12							12	100%
	10										10						10	100%
	11											14					14	100%
	12												11	3			14	79%
	13													12			12	100%
	14														12		12	100%
	NA																	

Total Items Placement: 168	Number of Hits: 152	Overall Hit Ratio: 90%

1. Intrinsic Knowledge Quality
2. Contextual Knowledge Quality
3. Actionable Knowledge Quality
4. Perceived Ease of Use
5. Perceived Usefulness
6. Perceived Media Richness
7. Meaning
8. Competence
9. Self-determination
10. Impact
11. Knowledge-sharing Climate
12. Perspective Taking
13. Perspective Making
14. Innovation

Table 3.1.3.3.3: The number of items entering the second Q-sort analysis

Construct	Dimension	# of item	Sub-total
Knowledge Quality	Intrinsic Knowledge Quality	7	19
	Contextual Knowledge Quality	6	
	Actionable Knowledge Quality	6	
Information Systems Quality	Perceived Ease of Use	6	18
	Perceived Usefulness	6	
	Perceived Media Richness	6	
Cognitive Empowerment	Meaning	5	21
	Competence	5	
	Self-determination	6	
	Impact	5	
Knowledge-sharing Climate		7	7
Perspective Taking		6	6
Perspective Making		7	7
Innovation		6	6
		Total	84

high degree of construct validity. The lowest placement ratios were actionable knowledge quality, perceived usefulness, and perspective making, which were 79%.

Table 3.1.3.4.3 shows a summary of each round of sorting. Inter-judge raw agreement was improved from .81 and .85. Cohen's Kappa was increased from .79 to .83, which manifested that the degree of agreement beyond chance was excellent. The overall average of placement ratios became better from the first round (91%) to the second round (93%). The sub-constructs (i.e., intrinsic knowledge quality, contextual knowledge quality, perceived ease of use, perceived usefulness, perceived media richness, and perspective taking) showed improvement in light of placement ratios. Meaning, competence, self-determination, impact, and knowledge-sharing climate remained at 100%. On the other hand, actionable knowledge quality became worse, going from 91% to 79%. Perspective making also became worse, going from 100% down to 79%.

Table 3.1.3.4.1: Inter-judge raw agreement scores - second sorting round

		JUDGE 1														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	NA
JUDGE 2	1	6														
	2	1	4													
	3		3	5												
	4				4		1									
	5				2	5	1									
	6						5									
	7							5								
	8								5							
	9									6						
	10										5					
	11											7				
	12												4	2		
	13												3	4		
	14														6	
	NA															

Total Items Placement: 84	Number of Agreements: 71	Agreement Ratio: .85

1. Intrinsic Knowledge Quality
2. Contextual Knowledge Quality
3. Actionable Knowledge Quality
4. Perceived Ease of Use
5. Perceived Usefulness
6. Perceived Media Richness
7. Meaning
8. Competence
9. Self-determination
10. Impact
11. Knowledge-sharing Climate
12. Perspective Taking
13. Perspective Making
14. Innovation

Table 3.1.3.4.2: Items placement ratios - second sorting round

		JUDGE 1																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	NA	T	%
JUDGE 2	1	13															13	100%
	2	1	10														11	91%
	3		3	11													14	79%
	4				10		1										11	91%
	5				2	11	1										14	79%
	6						11										11	100%
	7							10									10	100%
	8								10								10	100%
	9									12							12	100%
	10										10						10	100%
	11											14					14	100%
	12												10	2			12	83%
	13												3	11			14	79%
	14														12		12	100%
	NA																	
Total Items Placement: 168							Number of Hits: 143							Overall Hit Ratio: 85%				

1. Intrinsic Knowledge Quality
2. Contextual Knowledge Quality
3. Actionable Knowledge Quality
4. Perceived Ease of Use
5. Perceived Usefulness
6. Perceived Media Richness
7. Meaning
8. Competence
9. Self-determination
10. Impact
11. Knowledge-sharing Climate
12. Perspective Taking
13. Perspective Making
14. Innovation

Table 3.1.3.4.3: Comparisons between the first and second Q-sort round

Agreement Measure	Round 1	Round 2
Raw Agreement	**.81**	**.85**
Cohen's Kappa	**.79**	**.83**
Placement Ratio Summary		
Intrinsic Knowledge Quality	79%	100%
Contextual Knowledge Quality	79%	91%
Actionable Knowledge Quality	100%	79%
Perceived Ease of Use	73%	91%
Perceived Usefulness	77%	79%
Perceived Media Richness	92%	100%
Meaning	100%	100%
Competence	100%	100%
Self-determination	100%	100%
Impact	100%	100%
Knowledge-sharing Climate	100%	100%
Perspective Taking	79%	83%
Perspective Making	100%	79%
Innovation	100%	100%
Average	91%	93%

Table 3.1.3.4.4: The number of items after entering the second Q-sort analysis

Construct	Dimension	# of item	Sub-total
Knowledge Quality	Intrinsic Knowledge Quality	7	19
	Contextual Knowledge Quality	6	
	Actionable Knowledge Quality	6	
Information Systems Quality	Perceived Ease of Use	6	18
	Perceived Usefulness	6	
	Perceived Media Richness	6	
Cognitive Empowerment	Meaning	5	21
	Competence	5	
	Self-determination	6	
	Impact	5	
Knowledge-sharing Climate		7	7
Perspective Taking		6	6
Perspective Making		7	7
Innovation		6	6
		Total	84

In order to continually improve convergent and discriminant validity, items in the placement matrix that were especially off-diagonal, shown in 3.1.3.4.1, were examined. As in the first round of sorting, ambiguous items were either deleted or reworded. The number of items after the second round of Q-sort was shown in Table 3.1.3.4.4.

At this point, this study stopped the Q-sort method at round two because inter-judge raw agreement of .85, the average placement ratio of 93%, and Cohen's Kappa of .83 indicate a high level of reliability and construct validity.

3.1.4 Pre-testing of Questionnaire

After the Q-sort methodology, items were reviewed by academicians and practitioners. They suggested changing definitions, and keeping, dropping, or modifying certain items. They also recommended new items if they thought that the existing items did not cover the domain of the constructs or dimensions. The focus of this analysis was to assess whether or not the items measured the proposed constructs or dimensions. Changes were made in the format of the survey as a result of the pre-test. In particular, a knowledge-sharing climate was divided into three dimensions (i.e., willingness, trust, and openness). A knowledge-sharing climate is a multi-faceted dimension whose essence may not be captured by a single dimension. As a matter of fact, two items had been developed for each dimension. More items were added to create three dimensions. Table 3.1.4.1 shows the items that were used, based on the feedback from six faculty members and four practitioners. 26 items for contextual variables, 5 items for absorptive capacity, 4 items for functional diversity, and 6 items for knowledge network were added to the questionnaire. 130 questionnaire items were prepared to be sent out for pilot surveys.

Measurement items used in the pilot study are displayed in Table 3.2.2.1 and Appendix B.

Table 3.1.4.1: The number of items entering the pilot study

Construct	Sub-construct	# of items	Subtotal
Knowledge-sharing Climate	Willingness	4	
	Trust	4	
	Openness	4	12
Knowledge Quality	Intrinsic Knowledge Quality	7	
	Contextual Knowledge Quality	6	
	Actionable Knowledge Quality	6	19
Information Systems Quality	Perceived Ease of Use	6	
	Perceived Usefulness	6	
	Perceived Media Richness	6	18
Cognitive Empowerment	Meaning	5	
	Competence	5	
	Self-determination	6	
	Impact	5	21
Perspective Taking		6	6
Perspective Making		7	7
Innovation		6	6
		Total	89

3.2 PILOT STUDY

In the second stage of testing the research framework, a pilot study was conducted prior to the administration of the large-scale survey. Such an analysis provides a final opportunity to find problems and revise them before the major survey is conducted. It is to assess the preliminary reliability and validity of measurement items.

Questionnaires containing 130 items were sent to a sample of 500 manufacturing firms. The Society of Manufacturing Engineers (SME) provided a list of 4,000 manufacturing firms. 500 manufacturing firms were randomly selected for the purpose of the pilot study. The list was from five industries where SIC codes were Fabricated Metal Products (34), Machinery, except Electrical (35), Electric and Electronic Equipment (36), Transportation Equipment (37), and Instruments and Related Products (38). These industries were chosen because they represented major manufacturing firms in which this study would see the dynamics of knowledge management. The firm size ranged from small to large, but only the firms with 100 or more employees were included in the sample. The pilot study resulted in 33 responses, making the response rate about 7%.

3.2.1 Pilot Study Procedures

The pilot study was conducted to test for the following four construct validities – purification, unidimensionality, reliability, and convergent and discriminant validity. First, corrected-item to total correlations (CITCs) were employed to test for purification. Churchill (1979) emphasized the need for purification before conducting factory analysis. He mentioned that factor analysis without purification might result in multiple dimensions that make it difficult to interpret. A CITC for an item is the correlation between the item and the sum of other items in its category. It is useful to remove items that have a lower correlation with the overall construct. Items are deleted if a CITC is below .50, unless there are clear reasons to keep them.

Second, exploratory factor analysis was used to test for unidimensionality and discriminant validity after purification. The purpose of exploratory factor analysis is to remove items that are not pure factorially (Weiss, 1970). Items in each category are assumed to build the same construct. If exploratory factor analysis shows more than one factor, additional factors may be eliminated or it may be interpreted that the construct has multi-faceted dimensions. If a factor loading shows below .40, the item is a candidate for elimination.

Third, Cronbach's alpha was employed to test for reliability. Internal consistency of items may be examined by Cronbach's alpha in empirical research (Flynn et al., 1990). Alpha values > .80 are very good for empirical research (Nunnally, 1978).

Fourth, convergent and discriminant validity were tested by correlation analysis. Convergent validity requires significant inner-scale item-to-item correlations. The smallest correction within a dimension needs to be significantly different from zero to attain convergent validity. Discriminant validity was tested at the item-level using a single-method, multi-trait approach (Campbell & Fiske, 1959). If the number of violations (i.e., cases where correlation of item to outer-scale-items being higher than the minimum inner-scale item-to-item correlation) is less that half of all comparisons, discriminant validity may be obtained.

3.2.2 Results of Pilot Study

The following acronyms were used in displaying the results of the pilot study. It is also shown in Appendix B.

3.2.2.1 Knowledge-sharing Climate

The construct knowledge-sharing climate was analyzed through a set of purification, exploratory factor analysis, Cronbach's alpha, and correlation examinations. CITCs for willingness, trust, and openness were shown in Table 3.2.2.1.1. All CITCs were above .5 in the first run. The exploratory factor analysis for a knowledge-sharing

Table 3.2.2.1: Items entering pilot study

Construct	Sub-construct	Item	Acronym
Knowledge-sharing Climate	Willingness	My team members are willing to	
		access ideas from other team members	WLN1
		share their information among team members	WLN2
		use resources provided by team members	WLN3
		acquire knowledge from other team members	WLN4
	Trust	My team members trust	
		data possessed by other team members	TRS1
		information possessed by other team members	TRS2
		knowledge possessed by other team members	TRS3
		resources possessed by other team members	TRS4
	Openness	My team members are encouraged to	
		produce their ideas even when they differ from their knowledge	OPN1
		express their ideas even when they differ from their knowledge	OPN2
		develop their ideas even when they differ from their knowledge	OPN3
		Implement their ideas even when they differ from their knowledge	OPN4
Knowledge Quality	Intrinsic Knowledge Quality	Knowledge possessed by my team	
		is accurate	IKQ1
		is reliable	IKQ2
		is objective	IKQ3
		is unbiased	IKQ4
		is believable	IKQ5
		is current	IKQ6
		is updated	IKQ7
	Contextual Knowledge Quality	Knowledge possessed by my team	
		adds value for decision-making	CKQ1
		adds value to team's operations	CKQ2
		gives my team competitive advantage	CKQ3
		is relevant to our tasks	CKQ4
		is appropriate to our jobs	CKQ5
		is context-specific	CKQ6
	Actionable Knowledge Quality	Knowledge possessed by my team	
		is actionable	AKQ1
		is adaptable	AKQ2
		is expandable	AKQ3
		is applicable to our tasks	AKQ4
		increases effective actions	AKQ5
		provides the capacity to react to circumstances	AKQ6

Table 3.2.2.1: Items entering pilot study (continued)

Construct	Sub-construct	Item	Acronym
Information Systems Quality	Perceived Ease of Use	My team finds	
		it easy to access the information systems	EOU1
		it easy to understand the information systems	EOU2
		it easy to use the information systems	EOU3
		it easy to become skillful at using the information systems	EOU4
		the information systems to be easily adaptable to requirements	EOU5
		interaction with the information systems to be clear and understandable	EOU6
	Perceived Usefulness	Using information systems	
		makes it easier for my team to do our tasks	USE1
		improves team performance	USE2
		increases team productivity	USE3
		enhances team effectiveness	USE4
		enables my team to accomplish tasks quickly	USE5
		makes it useful for my team to implement our jobs	USE6
	Perceived Media Richness	The information systems allow my team to	
		give and receive timely feedback	MR1
		reduce message ambiguity	MR2
		tailor concepts to meet our needs	MR3
		sense the presence of communication partners	MR4
		use a variety of methods to communicate messages (text, graphics, videos)	MR5
		communicate a variety of different cues (emotional tone, attitude, formality)	MR6

Table 3.2.2.1: Items entering pilot study (continued)

Construct	Sub-construct	Item	Acronym
Cognitive Empowerment	Meaning	The work my team does	
		is important to us	MN1
		is meaningful to us	MN2
		The work requirements are consistent with	
		the beliefs of my team	MN3
		the values of my team	MN4
		the behaviors of my team	MN5
	Competence	My team	
		is very confident about its ability to do work	CO1
		has mastered the skills necessary for our tasks	CO2
		believes that we can successfully complete our tasks	CO3
		believes that we have the required abilities to perform tasks competently	CO4
		expects to do the job well	CO5
	Self-determination	My team	
		has significant autonomy in determining how work is done	SLD1
		has the opportunity for independence and freedom in work execution	SLD2
		has a sense of choice in initiating work	SLD3
		has a sense of choice in planning work	SLD4
		makes decisions about how tasks are undertaken	SLD5
		makes decisions about when tasks are undertaken	SLD6
	Impact	My team's project has a(n)	
		significant impact on my organization	IM1
		significant influence on what happens in my organization	IM2
		influence on strategic outcomes in my organization	IM3
		influence on administrative outcomes in my organization	IM4
		influence on operating outcomes in my organization	IM5

Table 3.2.2.1: Items entering pilot study (continued)

Construct	Item	Acronym
Perspective Taking	My team members	
	appreciate inter-disciplinary knowledge of other team members	PT1
	compare and contrast inter-disciplinary expertise in their group-decisions	PT2
	take points of view of the rest of the team into account	PT3
	take useful perspectives from inter-disciplinary knowledge	PT4
	surface and reconcile different points of view	PT5
	consider unique perspectives of team members	PT6
Perspective Making	My team	
	nurtures its potential perspectives	PM1
	advances its unique perspectives	PM2
	seeks to strengthen its knowledge	PM3
	applies its perspectives to team's tasks	PM4
	makes inter-disciplinary knowledge relevant to its tasks	PM5
	makes sense of inter-disciplinary perspectives to team's tasks	PM6
	makes inter-disciplinary perspectives to team's useful practices	PM7
Innovation	Novel and useful systems, processes, products, or services	
	are developed by my team	IN1
	are produced by my team	IN2
	are adopted from an outside organization by my team	IN3
	are successfully implemented by my team	IN4
	have become a stable and regular part of the organization	IN5
	Time until novel and useful systems, processes, products, or services are adopted by my team is short	IN6

climate is shown in Table 3.5.2.1.2. All of the sub-constructs were loaded on a single dimension, which showed unidimensionality. The lowest factor loading was .70 for item OPN2. Because none of the scales displayed multiple dimensions, the final Cronbach's alphas were the values shown in Table 3.2.2.1.1. Cronbach's alphas were very good: .93 for willingness, .90 for trust, and .83 for openness. A correlation matrix of the 12 items retained for further assessment was examined to determine the level of convergent validity and discriminant validity. The smallest correlation within a sub-construct was .736 for willingness ($p < .01$), .587 for trust ($p < .01$), and .385 for openness ($p < .05$). All of them were significantly different from zero, indicating that there was good convergent validity within the sub-constructs. An examination of the correlation matrix to assess discriminant validity is conducted by counting the number of items to outer-scale items correlations greater than the minimum inner-scale item-to-item correlation. If the number of violations exceeds half of the potential comparisons, it is considered to be an indication of poor discriminant validity. To test discriminant validity, the correlation matrix, shown in Table 3.2.2.1.3, was examined. A total of 19 violations out of 96 total comparisons were displayed. One item out of 12 items exceeded half of the potential comparisons, which indicated a low level of discriminant validity. Prior to conducting the large-scale survey, items were reexamined in light of the results of the pilot study. In particular, the item that showed a low level of discriminant validity was reworded. One more item was also reworded to make its meaning clearer to respondents. As a result, each of the sub-constructs had four items.

Table 3.2.2.1.1: Purification for a knowledge-sharing climate (Pilot)

Sub-construct	Acronym	Item	CITC	Cronbach's alpha
Willingness		My team members are willing to		.93
	WLN1	access ideas from other team members	.84	
	WLN2	share their information among team members	.88	
	WLN3	use resources provided by team members	.84	
	WLN4	acquire knowledge from other team members	.84	
Trust		My team members trust		.90
	TRS1	data possessed by other team members	.82	
	TRS2	information possessed by other team members	.77	
	TRS3	knowledge possessed by other team members	.79	
	TRS4	resources possessed by other team members	.73	
Openness		My team members are encouraged to		.83
	OPN1	produce their ideas even when they differ from their knowledge	.69	
	OPN2	express their ideas even when they differ from their knowledge	.51	
	OPN3	develop their ideas even when they differ from their knowledge	.76	
	OPN4	Implement their ideas even when they differ from their knowledge	.65	

3.2.2.2 Knowledge Quality

The construct knowledge quality was analyzed through a series of purification, exploratory factor analysis, Cronbach's alpha, and correlation examinations for the pilot study. CITCs for intrinsic knowledge quality, contextual knowledge quality, and actionable knowledge quality are shown in Table 3.2.2.2.1. Items (i.e., IKQ4 and IKQ7) were deleted in the first run because their CITCs were below .5. In the second run, all the items for intrinsic knowledge quality, contextual knowledge quality, and actionable knowledge quality were beyond .5 in light of CITCs. The exploratory factor analysis for knowledge quality is shown in Table 3.2.2.2. All of the items for each sub-construct were loaded on a single factor, indicating unidimensionality within the items. The lowest factor loading was .58 (IKQ3). Since all sub-constructs showed a single factor, the recalculation of Cronbach's alpha was unnecessary. Final Cronbach's alphas, shown in Table 3.2.2.2.1, were the final reliability for each of the sub-constructs. Cronbah's alphas were very good; .85 for intrinsic knowledge quality, .89 for contextual knowledge quality, and .88 for actionable knowledge quality. A correlation

Table 3.2.2.1.2: Factor loadings (within each sub-construct) for the retained knowledge-sharing climate (Pilot)

Sub-construct	Acronym	Item	Factor Loading
		My team members are willing to	
	WLN1	access ideas from other team members	.91
Willingness	WLN2	share their information among team members	.93
	WLN3	use resources provided by team members	.92
	WLN4	acquire knowledge from other team members	.91
		My team members trust	
	TRS1	data possessed by other team members	.90
Trust	TRS2	information possessed by other team members	.88
	TRS3	knowledge possessed by other team members	.89
	TRS4	resources possessed by other team members	.85
		My team members are encouraged to	
	OPN1	produce their ideas even when they differ from their knowledge	.84
	OPN2	express their ideas even when they differ from their knowledge	.70
Openness	OPN3	develop their ideas even when they differ from their knowledge	.89
	OPN4	Implement their ideas even when they differ from their knowledge	.81

Table 3.2.2.1.3: Item correlation matrix, descriptive statistics, and discriminant validity tests for a knowledge-sharing climate (Pilot)

	WLN1	WLN2	WLN3	WLN4	TRS1	TRS2	TRS3	TRS4	OPN1	OPN2	OPN3	OPN4
WLN1	1.000											
WLN2	0.840	1.000										
WLN3	0.736	0.814	1.000									
WLN4	0.764	0.765	0.811	1.000								
TRS1	0.607	0.380	0.527	0.456	1.000							
TRS2	0.315	0.184	0.284	0.077	0.707	1.000						
TRS3	0.263	0.042	0.174	0.248	0.695	0.771	1.000					
TRS4	0.553	0.346	0.481	0.415	0.754	0.587	0.635	1.000				
OPN1	0.050	0.237	0.281	0.149	0.213	0.236	-0.106	0.220	1.000			
OPN2	0.204	0.350	0.275	0.516	0.248	0.214	0.384	0.273	0.411	1.000		
OPN3	0.266	0.406	0.384	0.483	0.283	0.179	0.220	0.281	0.673	0.623	1.000	
OPN4	0.241	0.208	0.150	0.135	0.360	0.298	0.165	0.366	0.598	0.385	0.621	1.000
	WLN1	WLN2	WLN3	WLN4	TRS1	TRS2	TRS3	TRS4	OPN1	OPN2	OPN3	OPN4
Mean	4.179	4.214	4.357	4.344	4.034	3.931	4.063	4.103	3.828	4.121	3.818	3.759
SD	0.772	0.738	0.731	0.602	0.626	0.651	0.716	0.673	0.848	0.781	0.882	0.830
# of Violations	0	0	0	0	1	1	0	0	4	6	3	4

Note: The count of violations for 1 item exceeded half of the potential comparisons, indicating a low level of discriminant validity for the item. (Total # of violations = 19)

Table 3.2.2.2.1: Purification for knowledge quality (Pilot)

Sub-construct	Acronym	Item	CITC – 1	CITC – 2	Cronbach's alpha
Intrinsic Knowledge Quality		Knowledge possessed by my team			CITC-1: .83 CITC-2: .85
	IKQ1	is accurate	.66	.71	
	IKQ2	is reliable	.74	.81	
	IKQ3	is objective	.53	.51	
	IKQ4	is unbiased	.45		
	IKQ5	is believable	.66	.68	
	IKQ6	is current	.76	.68	
	IKQ7	is updated	.44		
Contextual Knowledge Quality		Knowledge possessed by my team			.89
	CKQ1	adds value for decision-making	.73		
	CKQ2	adds value to team's operations	.83		
	CKQ3	gives my team competitive advantage	.72		
	CKQ4	is relevant to our tasks	.72		
	CKQ5	is appropriate to our jobs	.90		
	CKQ6	is context-specific	.53		
Actionable Knowledge Quality		Knowledge possessed by my team			.88
	AKQ1	is actionable	.64		
	AKQ2	is adaptable	.83		
	AKQ3	is expandable	.74		
	AKQ4	is applicable to our tasks	.61		
	AKQ5	increases effective actions	.63		
	AKQ6	provides the capacity to react to circumstances	.69		

matrix of 17 items after the exploratory factor analysis was examined to test convergent and discriminant validity. The smallest correlations within the sub-constructs (factors) were .303 for intrinsic knowledge quality ($p < .087$), .315 for contextual knowledge quality ($p < .074$), and .354 for actionable knowledge quality ($p < .05$). The magnitude of correlation indicated that it would be significant when a larger sample was obtained. A correlation matrix to assess discriminant validity, shown in Table 3.2.2.2.3, revealed a total of 129 violations out of 192 total comparisons. 10 out of 17 items exceeded half of the potential comparisons, indicating a low level of discriminant validity for these items. A lot of correlations were found among scales of intrinsic knowledge quality, contextual knowledge quality, and actionable knowledge quality. These correlations may be explained theoretically. As teams evaluate their knowledge quality, intrinsic knowledge quality, contextual knowledge quality, and actionable knowledge are interrelated. The small size of the pilot study sample did not capture these differences well. Before administering the large-scale survey, items for knowledge quality were reexamined based on the results of the pilot study. Instruments were modified, deleted or added. Each sub-construct had at least 5 items.

Table 3.2.2.2.2: Factor loadings (within each sub-construct) for the retained knowledge quality items (Pilot)

Sub-construct	Acronym	Item	Factor Loading
Intrinsic Knowledge Quality		Knowledge possessed by my team	
	IKQ1	is accurate	.89
	IKQ2	is reliable	.91
	IKQ3	is objective	.58
	IKQ5	is believable	.81
	IKQ6	is current	.80
Contextual Knowledge Quality		Knowledge possessed by my team	
	CKQ1	adds value for decision-making	.86
	CKQ2	adds value to team's operations	.92
	CKQ3	gives my team competitive advantage	.78
	CKQ4	is relevant to our tasks	.83
	CKQ5	is appropriate to our jobs	.95
	CKQ6	is context-specific	.62
Actionable Knowledge Quality		Knowledge possessed by my team	
	AKQ1	is actionable	.74
	AKQ2	is adaptable	.89
	AKQ3	is expandable	.83
	AKQ4	is applicable to our tasks	.73
	AKQ5	increases effective actions	.74
	AKQ6	provides the capacity to react to circumstances	.80

Table 3.2.2.2.3: Item correlation matrix, descriptive statistics, and discriminant validity tests for knowledge quality (Pilot)

	IKQ1	IKQ2	IKQ3	IKQ5	IKQ6	CKQ1	CKQ2	CKQ3	CKQ4	CKQ5	CKQ6	AKQ1	AKQ2	AKQ3	AKQ4	AKQ5	AKQ6
IKQ1	1.000																
IKQ2	0.778	1.000															
IKQ3	0.303	0.323	1.000														
IKQ5	0.605	0.707	0.444	1.000													
IKQ6	0.578	0.695	0.456	0.460	1.000												
CKQ1	0.488	0.531	0.357	0.515	0.451	1.000											
CKQ2	0.423	0.467	0.423	0.583	0.399	0.834	1.000										
CKQ3	0.371	0.334	0.485	0.591	0.415	0.509	0.653	1.000									
CKQ4	0.356	0.345	0.530	0.461	0.449	0.677	0.677	0.517	1.000								
CKQ5	0.443	0.430	0.356	0.551	0.449	0.824	0.898	0.645	0.805	1.000							
CKQ6	0.304	0.215	0.145	0.401	0.392	0.315	0.405	0.634	0.394	0.513	1.000						
AKQ1	0.616	0.488	0.283	0.552	0.406	0.419	0.419	0.586	0.464	0.464	0.565	1.000					
AKQ2	0.575	0.707	0.097	0.582	0.699	0.402	0.402	0.320	0.365	0.523	0.455	0.581	1.000				
AKQ3	0.512	0.618	0.222	0.467	0.656	0.376	0.376	0.373	0.299	0.432	0.395	0.542	0.812	1.000			
AKQ4	0.437	0.494	0.277	0.631	0.489	0.614	0.614	0.447	0.559	0.649	0.496	0.515	0.714	0.463	1.000		
AKQ5	0.519	0.475	0.435	0.485	0.537	0.480	0.409	0.528	0.580	0.486	0.338	0.417	0.465	0.486	0.414	1.000	
AKQ6	0.517	0.618	0.301	0.564	0.630	0.472	0.289	0.452	0.497	0.416	0.437	0.542	0.589	0.524	0.354	0.778	1.000
	IKQ1	IKQ2	IKQ3	IKQ5	IKQ6	CKQ1	CKQ2	CKQ3	CKQ4	CKQ5	CKQ6	AKQ1	AKQ2	AKQ3	AKQ4	AKQ5	AKQ6
Mean	4.182	4.121	4.182	4.242	4.091	4.424	4.424	4.242	4.485	4.485	4.212	4.125	4.097	4.031	4.424	4.303	4.303
SD	0.635	0.650	0.635	0.614	0.805	0.751	0.751	0.867	0.566	0.566	0.927	0.751	0.746	0.861	0.614	0.585	0.684
# of violations	12	11	6	11	5	11	7	3	6	3	8	9	5	4	10	9	9

Note: The count of violations for 10 items exceeded half of the potential comparisons, indicating a low level of discriminant validity for the items. (Total # of violations = 96)

3.2.2.3 Information Systems Quality

The construct information systems quality was analyzed through a series of purification, exploratory factor analysis, Cronbach's alpha, and correlation examinations for the pilot study. All CITCs for perceived ease of use and perceived usefulness showed above .5 in the first run, as shown in Table 3.2.2.3.1. However, items (i.e., MR5 and MR6) for perceived media richness were below .5 in the first run, and consequently the two items were eliminated. In the second run, the results of all CITCs for the sub-constructs were above .5. The exploratory factor analysis for information systems quality is shown in Table 3.2.2.3.2. All the sub-constructs were loaded on a single dimension, which manifested unidimensionality. The lowest factor loadings for each of the sub-constructs were .88 (EOU5), .81 (USE4), and .71 (MR4), respectively. Since all the sub-constructs contained a single factor, it is not necessary to recalculate Cronbach's alphas. (Refer to Table 3.2.2.3.1.) Cronbach's alphas were .95 for perceived ease of use and perceived usefulness, and .79 for perceived media richness. A correlation matrix was examined to explore convergent and discriminant validity. The smallest correlation for each sub-construct was .697 for perceived ease of use ($p < .01$), .968 for perceived usefulness ($p < .01$), and .338 for perceived media richness ($p < .068$). Perceived ease of use and perceived usefulness were significantly different from zero, while perceived media richness was not significant. The magnitude of correlation indicated that it would be significant as a larger sample was obtained. In order to test discriminant validity, the correlation matrix, shown in Table 3.2.2.3.3, was examined. A total of 32 violations out of 168 total comparisons were displayed. Three items out of 16 items exceeded half of the potential comparisons, which indicated a low level of discriminant validity. Prior to

Table 3.2.2.3.1: Purification for information systems quality (Pilot)

Sub-construct	Acronym	Item	CITC -1	CITC -2	Cronbach's alpha
Perceived Ease of Use		My team finds			.95
	EOU1	it easy to access the information systems	.87		
	EOU2	it easy to understand the information systems	.80		
	EOU3	it easy to use the information systems	.87		
	EOU4	it easy to become skillful at using the information systems	.90		
	EOU5	the information systems to be easily adaptable to requirements	.83		
	EOU6	interaction with the information systems to be clear and understandable	.89		
Perceived Usefulness		Using information systems			.95
	USE1	makes it easier for my team to do our tasks	.80		
	USE2	improves team performance	.91		
	USE3	increases team productivity	.93		
	USE4	enhances team effectiveness	.74		
	USE5	enables my team to accomplish tasks quickly	.90		
	USE6	makes it useful for my team to implement our jobs	.88		
Perceived Media Richness		The information systems allow my team to			CITC-1: .74 CITC-2: .79
	MR1	give and receive timely feedback	.65	.65	
	MR2	reduce message ambiguity	.55	.63	
	MR3	tailor concepts to meet our needs	.57	.62	
	MR4	sense the presence of communication partners	.54	.51	
	MR5	use a variety of methods to communicate messages (text, graphics, videos)	.33		
	MR6	communicate a variety of different cues (emotional tone, attitude, formality)	.26		

Table 3.2.2.3.2: Factor loadings (within each sub-construct) for the retained information systems quality (Pilot)

Sub-construct	Acronym	Item	Factor Loading
		My team finds	
Perceived Ease of Use	EOU1	it easy to access the information systems	.91
	EOU2	it easy to understand the information systems	.86
	EOU3	it easy to use the information systems	.91
	EOU4	it easy to become skillful at using the information systems	.93
	EOU5	the information systems to be easily adaptable to requirements	.88
	EOU6	interaction with the information systems to be clear and understandable	.92
		Using information systems	
Perceived Usefulness	USE1	makes it easier for my team to do our tasks	.86
	USE2	improves team performance	.94
	USE3	increases team productivity	.96
	USE4	enhances team effectiveness	.81
	USE5	enables my team to accomplish tasks quickly	.93
	USE6	makes it useful for my team to implement our jobs	.92
		The information systems allow my team to	
Perceived Media Richness	MR1	give and receive timely feedback	.83
	MR2	reduce message ambiguity	.82
	MR3	tailor concepts to meet our needs	.79
	MR4	sense the presence of communication partners	.71

conducting the large-scale survey, instruments were reexamined in light of the results of the pilot study. Specifically items that showed a low level of discriminant validity were carefully examined. Three items were eliminated and one item was reworded to remove ambiguity. Accordingly, each sub-construct had 5 items.

Table 3.2.2.3.3: Item correlation matrix, descriptive statistics, and discriminant validity tests for information systems quality (Pilot)

	EOU1	EOU2	EOU3	EOU4	EOU5	EOU6	USE1	USE2	USE3	USE4	USE5	USE6	MR1	MR2	MR3	MR4
EOU1	1.000															
EOU2	0.762	1.000														
EOU3	0.824	0.791	1.000													
EOU4	0.833	0.745	0.845	1.000												
EOU5	0.719	0.715	0.697	0.792	1.000											
EOU6	0.839	0.705	0.788	0.846	0.838	1.000										
USE1	0.587	0.445	0.509	0.525	0.411	0.659	1.000									
USE2	0.483	0.371	0.486	0.527	0.397	0.577	0.855	1.000								
USE3	0.429	0.395	0.614	0.606	0.372	0.522	0.766	0.853	1.000							
USE4	0.220	0.242	0.352	0.375	0.203	0.340	0.608	0.665	0.766	1.000						
USE5	0.415	0.426	0.523	0.539	0.323	0.434	0.728	0.828	0.908	0.704	1.000					
USE6	0.415	0.391	0.523	0.510	0.323	0.434	0.693	0.864	0.874	0.669	0.871	1.000				
MR1	0.621	0.403	0.531	0.603	0.615	0.664	0.478	0.461	0.380	0.343	0.307	0.368	1.000			
MR2	0.468	0.282	0.416	0.538	0.432	0.541	0.476	0.526	0.440	0.371	0.323	0.323	0.757	1.000		
MR3	0.661	0.582	0.705	0.770	0.705	0.767	0.502	0.506	0.561	0.334	0.423	0.455	0.580	0.517	1.000	
MR4	0.307	0.164	0.487	0.431	0.300	0.491	0.132	0.190	0.284	0.166	0.133	0.263	0.374	0.338	0.576	1.000
	EOU1	EOU2	EOU3	EOU4	EOU5	EOU6	USE1	USE2	USE3	USE4	USE5	USE6	MR1	MR2	MR3	MR4
Mean	3.79	3.85	3.78	3.67	3.48	3.76	3.97	4.09	4.15	4.06	4.03	4.03	3.78	3.56	3.63	3.45
SD	0.86	0.91	0.94	1.08	1.03	0.97	0.92	0.88	0.94	0.90	0.98	0.98	1.07	0.91	1.01	1.03
# of Violations	0	0	0	1	1	1	1	0	0	0	0	0	9	9	7	3

Note: The count of violations for 3 items exceeded half of the potential comparisons, indicating a low level of discriminant validity for the times. (Total # of violations = 32)

3.2.2.4 Cognitive Empowerment

The construct cognitive empowerment was analyzed through a series of purification, exploratory factor analysis, Cronbach's alpha, and correlation examinations for the pilot study. All CITCs for meaning, competence, self-determination, and impact showed above .5 in the first run. (Refer to Table 3.2.2.4.1.) The exploratory factor analysis for cognitive empowerment is shown in Table 3.2.2.4.2. All of the sub-constructs were loaded on a single factor, which represented unidimensionality. The lowest factor loadings for each of sub-constructs were .82 (MN1), .77(CO5), .66 (SLD1), and .76 (IM1) respectively. Since all of the scales were composed of a single factor, it was not necessary to recalculate Cronbach's alphas. (Refer to Table 3.2.2.4.1.) Cronbah's alphas were very good; .92 for meaning, .89 for competence, .88 for self-determination, and .90 for impact. A correlation matrix was examined to explore convergent validity and discriminant validity. The smallest correlations for each sub-construct were .539 ($p < .01$) for meaning, .468 ($p < .01$) for competence, .211 ($p < .238$) for self-determination, and .343 ($p < .50$) for impact. Meaning, competence, and impact were significantly different from zero, while self-determination was not significant. The magnitude of the correlation indicated that it would be significant as a larger sample was obtained. In order to test discriminant validity, the correlation matrix, shown in Table 3.2.2.4.3, was examined. A total of 38 violations out of 330 total comparisons were displayed. One item out of 21 items exceeded half of the potential comparisons, which indicated a low level of discriminant validity. Prior to conducting the large-scale survey, items were reexamined in light of the results of the pilot study. In particular, careful attention was given to the sub-construct self-determination, and one item was eliminated. Accordingly, each sub-construct had 5 items.

Table 3.2.2.4.1: Purification for cognitive empower (Pilot)

Sub-construct	Acronym	Item	CITC – 1	Cronbach's alpha
Meaning		The work my team does		.92
	MN1	is important to us	.70	
	MN2	is meaningful to us	.71	
		The work requirements are consistent with		
	MN3	the beliefs of my team	.89	
	MN4	the values of my team	.87	
	MN5	the behaviors of my team	.87	
Competence		My team		.89
	CO1	is very confident about its ability to do work	.71	
	CO2	has mastered the skills necessary for our tasks	.74	
	CO3	believes that we can successfully complete our tasks	.82	
	CO4	believes that we have the required abilities to perform tasks competently	.72	
	CO5	expects to do the job well	.66	
Self-determination		My team		.88
	SLD1	has significant autonomy in determining how work is done	.51	
	SLD2	has the opportunity for independence and freedom in work execution	.66	
	SLD3	has a sense of choice in initiating work	.67	
	SLD4	has a sense of choice in planning work	.78	
	SLD5	makes decisions about how tasks are undertaken	.80	
	SLD6	makes decisions about when tasks are undertaken	.82	
Impact		My team's project has a(n)		.90
	IM1	significant impact on my organization	.62	
	IM2	significant influence on what happens in my organization	.81	
	IM3	influence on strategic outcomes in my organization	.84	
	IM4	influence on administrative outcomes in my organization	.68	
	IM5	influence on operating outcomes in my organization	.84	

Table 3.2.2.4.2: Factor loadings (within each sub-construct) for the cognitive empowerment (Pilot)

Sub-construct	Acronym	Item	Factor Loading
Meaning		The work my team does	
	MN1	is important to us	.82
	MN2	is meaningful to us	.83
		The work requirements are consistent with	
	MN3	the beliefs of my team	.92
	MN4	the values of my team	.90
	MN5	the behaviors of my team	.91
Competence		My team	
	CO1	is very confident about its ability to do work	.82
	CO2	has mastered the skills necessary for our tasks	.85
	CO3	believes that we can successfully complete our tasks	.90
	CO4	believes that we have the required abilities to perform tasks competently	.83
	CO5	expects to do the job well	.77
Self-determination		My team	
	SLD1	has significant autonomy in determining how work is done	.66
	SLD2	has the opportunity for independence and freedom in work execution	.77
	SLD3	has a sense of choice in initiating work	.76
	SLD4	has a sense of choice in planning work	.85
	SLD5	makes decisions about how tasks are undertaken	.88
	SLD6	makes decisions about when tasks are undertaken	.89
Impact		My team's project has a(n)	
	IM1	significant impact on my organization	.76
	IM2	significant influence on what happens in my organization	.89
	IM3	influence on strategic outcomes in my organization	.90
	IM4	influence on administrative outcomes in my organization	.78
	IM5	influence on operating outcomes in my organization	.91

Table 3.2.2.4.3: Item correlation matrix, descriptive statistics, and discriminant validity tests for cognitive empowerment (Pilot)

	MN1	MN2	MN3	MN4	MN5	CO1	CO2	CO3	CO4	CO5	SLD1	SLD2	SLD3	SLD4	SLD5	SLD6	IM1	IM2	IM3	IM4	IM5
MN1	1.000																				
MN2	0.938	1.000																			
MN3	0.566	0.575	1.000																		
MN4	0.539	0.558	0.951	1.000																	
MN5	0.589	0.596	0.902	0.858	1.000																
CO1	0.206	0.256	0.344	0.409	0.512	1.000															
CO2	-0.053	-0.028	0.117	0.100	0.316	0.568	1.000														
CO3	0.039	0.076	0.242	0.226	0.408	0.658	0.708	1.000													
CO4	0.139	0.190	0.339	0.416	0.458	0.574	0.689	0.713	1.000												
CO5	0.358	0.399	0.398	0.316	0.545	0.602	0.540	0.634	0.468	1.000											
SLD1	0.204	0.310	0.293	0.392	0.208	0.412	0.061	0.214	0.224	0.169	1.000										
SLD2	0.236	0.290	0.213	0.213	0.232	0.342	0.051	0.240	0.110	0.307	0.464	1.000									
SLD3	0.389	0.365	0.409	0.464	0.478	0.256	0.007	0.180	0.193	0.220	0.211	0.523	1.000								
SLD4	0.490	0.466	0.499	0.616	0.488	0.294	-0.062	0.168	0.297	0.155	0.347	0.546	0.749	1.000							
SLD5	0.438	0.443	0.400	0.454	0.419	0.345	0.102	0.283	0.316	0.248	0.653	0.675	0.516	0.624	1.000						
SLD6	0.381	0.436	0.440	0.537	0.484	0.281	0.004	0.227	0.223	0.249	0.574	0.538	0.635	0.770	0.752	1.000					
IM1	0.469	0.486	0.240	0.246	0.270	0.203	0.007	0.124	0.016	0.275	0.278	0.185	0.321	0.321	0.195	0.268	1.000				
IM2	0.522	0.514	0.293	0.347	0.313	0.259	0.137	0.183	0.147	0.296	0.271	0.154	0.319	0.394	0.172	0.341	0.765	1.000			
IM3	0.402	0.392	0.230	0.227	0.398	0.386	0.369	0.453	0.240	0.401	0.154	-0.008	0.162	0.169	0.012	0.133	0.503	0.737	1.000		
IM4	0.457	0.421	0.371	0.349	0.509	0.366	0.294	0.388	0.240	0.265	0.004	0.117	0.242	0.350	0.091	0.178	0.343	0.596	0.744	1.000	
IM5	0.363	0.366	0.183	0.203	0.323	0.176	0.128	0.245	0.020	0.168	0.013	0.016	0.256	0.261	-0.024	0.172	0.675	0.686	0.823	0.657	1.000
	MN1	MN2	MN3	MN4	MN5	CO1	CO2	CO3	CO4	CO5	SLD1	SLD2	SLD3	SLD4	SLD5	SLD6	IM1	IM2	IM3	IM4	IM5
Mean	4.636	4.606	4.212	4.273	4.212	4.485	4.212	4.364	4.424	4.455	4.182	3.879	3.697	3.727	4.121	3.848	4.273	4.000	3.939	3.485	4.121
SD	0.489	0.496	0.740	0.626	0.820	0.566	0.545	0.603	0.502	0.617	0.683	0.960	1.045	1.008	0.650	0.870	0.719	0.880	0.998	1.093	0.960
# of violations	0	0	0	1	0	0	0	0	0	1	8	0	11	7	0	0	2	0	0	8	0

Note: The count of violations for 1 item exceeded half of the potential comparisons, indicating a low level of discriminant validity for the item. (Total # of violations = 38)

3.2.2.5 Perspective Taking

The construct perspective taking was analyzed through a set of purification, exploratory factor analysis, and Cronbach's alpha. Correlation examinations were not conducted to test convergent and discriminant validity since the construct has a single dimension. All CITCs were above .5. The exploratory factor analysis for perspective taking is shown in Table 3.2.2.5.2. This construct was loaded on two factors. After careful examination, PT5 and PT6 were eliminated because they may measure contents similar to PT1 and PT2 respectively. After deleting the two items, the results of the exploratory factor analysis showed unidimensionality. (Refer to Table 3.2.2.5.3.) The lowest factor loading was .84 (PT1). The recalculated Cronbach's alpha was .89, which was very good. Prior to conducting the large-scale survey, items were seriously examined in light of the results of the pilot study. Two items were created and the total number of items for perspective taking was 6.

Table 3.2.2.5.1: Purification for perspective taking (Pilot)

Construct	Acronym	Item	CITC – 1	Cronbach's alpha
		My team members		
	PT1	appreciate inter-disciplinary knowledge of other team members	.57	
	PT2	compare and contrast inter-disciplinary expertise in their group-decisions	.67	
Perspective Taking	PT3	take points of view of the rest of the team into account	.85	.89
	PT4	take useful perspectives from inter-disciplinary knowledge	.85	
	PT5	surface and reconcile different points of view	.65	
	PT6	consider unique perspectives of team members	.63	

Table 3.2.2.5.2: Factor loadings (within each sub-construct) for the retained perspective taking I (Pilot)

Construct	Acronym	Item	Factor Loading	Factor Loading
Perspective Taking		My team members		
	PT1	appreciate inter-disciplinary knowledge of other team members	.92	
	PT2	compare and contrast inter-disciplinary expertise in their group-decisions	.82	
	PT3	take points of view of the rest of the team into account	.63	.66
	PT4	take useful perspectives from inter-disciplinary knowledge	.80	
	PT5	surface and reconcile different points of view		.91
	PT6	consider unique perspectives of team members		.91

Table 3.2.2.5.3: Factor loadings (within each sub-construct) for the retained perspective taking II (Pilot)

Construct	Acronym	Item	Factor Loading	Cronbach's alpha
Perspective Taking		My team members		
	PT1	appreciate inter-disciplinary knowledge of other team members	.84	
	PT2	compare and contrast inter-disciplinary expertise in their group-decisions	.85	.89
	PT3	take points of view of the rest of the team into account	.87	
	PT4	take useful perspectives from inter-disciplinary knowledge	.94	

3.2.2.6 Perspective Making

The construct perspective making was analyzed through a set of purification, exploratory factor analysis, and Cronbach's alpha. Correlation examinations were not carried out to test convergent and discriminant validity since the construct has a single dimension. All CITCs showed above .5 in the first run and were relatively high. The exploratory factor analysis for perspective making is shown in Table 3.2.2.6.2. The construct was loaded on a single dimension, which represented unidimensionality. The lowest factor loading was .78 (PM3). Since the construct contained a single factor, it was not necessary to recalculate Cronbach's alpha. (Refer to Table 3.2.2.6.1.) Cronbach's alpha was .93, which was very good. Prior to conducting the large-scale survey, items were reexamined in light of the results of the pilot study. One item was removed because it was redundant. Accordingly, the total number of items for perspective making was 6.

Table 3.2.2.6.1: Purification for perspective making (Pilot)

Construct	Acronym	Item	CITC – 1	Cronbach's alpha
		My team		
Perspective Making	PM1	nurtures its potential perspectives	.73	.93
	PM2	advances its unique perspectives	.72	
	PM3	seeks to strengthen its knowledge	.72	
	PM4	applies its perspectives to team's tasks	.80	
	PM5	makes inter-disciplinary knowledge relevant to its tasks	.72	
	PM6	makes sense of inter-disciplinary perspectives to team's tasks	.89	
	PM7	makes inter-disciplinary perspectives to team's useful practices	.82	

Table 3.2.2.6.2: Factor loadings (within each sub-construct) for the retained perspective making (Pilot)

Sub-construct	Acronym	Item	Factor Loading
		My team	
Perspective Making	PM1	nurtures its potential perspectives	.81
	PM2	advances its unique perspectives	.80
	PM3	seeks to strengthen its knowledge	.78
	PM4	applies its perspectives to team's tasks	.86
	PM5	makes inter-disciplinary knowledge relevant to its tasks	.80
	PM6	makes sense of inter-disciplinary perspectives to team's tasks	.93
	PM7	makes inter-disciplinary perspectives to team's useful practices	.88

3.2.2.7 Innovation

The construct innovation was analyzed through a set of purification, exploratory factor analysis, and Cronbach's alpha. Correlation examinations were not carried out to test convergent and discriminant validity since the construct had a single dimension. In the first run of CITCs, IN1, IN3, and IN6 were below .5. Consequently IN6 was deleted. However, IN1 and IN3 were kept because development and adoption are critical aspects of innovation. In the second run of CITCs, all items were above .5 except IN3 (.47). Because IN3 is close to .5, it was kept for the large-scale survey. The exploratory factor analysis for innovation is shown in Table 3.2.2.7.2. The construct was loaded on a single dimension, which manifested unidimensionality. The lowest factor loading was .59 (IN3). Since the construct contained a single factor, it was not necessary to recalculate Cronbach's alpha. (Refer to Table 3.2.2.7.1.) Cronbach's alpha was .89, which was very good. Prior to conducting the large-scale survey, items were reexamined in line with the results of the pilot study. The total number of items for innovation, entered for the large-scale survey, was 5.

Table 3.2.2.7.1: Purification for innovation (Pilot)

Construct	Acronym	Item	CITC – 1	CITC – 2	Cronbach's alpha
		Novel and useful systems, processes, products, or services			
	IN1	are developed by my team	.49	.70	
	IN2	are produced by my team	.69	.86	
	IN3	are adopted from an outside organization by my team	.41	.47	
Innovation	IN4	are successfully implemented by my team	.76	.87	CITC1: .81 CITC2: .89
	IN5	have become a stable and regular part of the organization	.80	.86	
	IN6	Time until novel and useful systems, processes, products, or services are adopted by my team is short	.37		

Table 3.2.2.7.2: Factor loadings (within each sub-construct) for the retained innovation (Pilot)

Construct	Acronym	Item	Factor Loading
		Novel and useful systems, processes, products, or services	
	IN1	are developed by my team	.82
	IN2	are produced by my team	.93
Innovation	IN3	are adopted from an outside organization by my team	.59
	IN4	are successfully implemented by my team	.94
	IN5	have become a stable and regular part of the organization	.93

3.3 LARGE-SCALE SURVEY METHODS

In the third stage of testing the research framework, the large-scale survey was conducted to examine the validity and reliability of instruments and to test the hypotheses. After conducting the pilot study, the questionnaire for the large-sale survey contained 12 items for a knowledge-sharing climate (i.e., 4 items for willingness, trust, and openness each), 16 items for knowledge quality (i.e., 5 items for intrinsic knowledge quality and contextual knowledge quality each, and 6 items for actionable knowledge quality), 15 items for information systems quality (i.e., 5 items for perceived ease of use, perceived usefulness, and perceived media richness each), 20 items for cognitive empowerment (i.e., 5 items for meaning, competence, self-determination, and impact each), 6 items for perspective taking, 6 items for perspective making, and 5 items for innovation. The measurement items are listed in Appendix C.

3.3.1 Large-scale Survey Procedures

The survey methodology was used to collect data in attempts to test the proposed research framework. The methodology was chosen because it enhanced the generalizability of the results (Dooly, 2001; Kankanhalli et al., 2005). The Society of Manufacturing Engineers (SME) provided a mailing list, and the Society of Automotive Engineers (SAE) provided an e-mailing list.

First, the questionnaires were administered to a mailing list of 3,500 firms from SME. Surveys were mailed along with a cover letter that explained the nature of the study, the time frame for completing the survey, and the criticality of the study. The cover letter showed the URL of a web-based survey so that respondents may be able to answer the questions electronically. It also offered a report that compares their team to the aggregate statistics of all teams in the sample as an incentive to participate. The questionnaire asked respondents to rate each question on a scale from 1 to 5, where 1 was "Strongly Disagree", 3 was "Neutral", and 5 was "Strongly Agree". Respondent's participation in this research was strictly voluntary and the cover letter of the survey assured confidentiality. Target respondents were project leaders, project managers, project engineers, project specialists, senior development, development engineers, product development, and business development from five industries, where SIC codes were 34-38: Fabricated Metal Products (34), Machinery, except Electrical (35), Electric and Electronic Equipment (36), Transportation Equipment (37), Instruments and Related Products (38). These industries were selected because they represent major manufacturing firms in which this study would like to test the dynamics of knowledge management. Surveys were administered three times, which resulted in 130 usable responses. Unusable data were as follows: 71 undeliverables, 8 blank returns, and 1 incomplete.

Second, the questionnaires were administered to an emailing list of 5,000 firms from SAE. The e-mail contained a brief explanation of the research. It also offered a report that compares their team to the aggregate statistics of all teams in the sample as an incentive to participate. It also provided a hyperlink that led them to a web-based survey. The questionnaire asked respondents to rate each question on a scale from 1 to 5, where 1 was "Strongly Disagree", 3 was "Neutral", and 5 was "Strongly Agree". Respondent's participation in this research was strictly voluntary and the front page of the survey assured confidentiality. Target respondents were engineering management, design/development engineers, manufacturing/production engineers, and manufacturing/production managers from five industries, where SIC codes were 34-38: Fabricated Metal Products (34), Machinery, except Electrical (35), Electric and Electronic Equipment (36), Transportation Equipment (37), Instruments and Related Products (38). These industries were chosen because they were major manufacturing firms in which this study would like to test the dynamics of knowledge management. When the e-mails were sent, 676 showed intention to participate in the survey. Then 78 actually visited the web-based survey and answered it.

The overall response rate was 5.1%. All projects were completed at the time of data collection. The research also included failed projects so that the results might not be biased toward successfully completed projects. Since the teams were randomly selected from lists provided by SME and SAE, it was believed that the data collected represented the broad range of U.S. firms.

3.3.2 Description of Sample

To support quantitative evidence of this study, data descriptions are presented in this section. Responses were received from SIC codes 34 (Fabricated Metal Products, 25%), 35 (Machinery, except Electrical, 14%), 36 (Electric and Electronic Equipment, 17%), 37 (Transportation Equipment, 25%), 38 (Instruments and Related Products, 10%). The remainder did not specify a SIC code. (Refer to Table 3.3.2.1.) Respondents were CEO/presidents (5%), vice presidents (4%), directors (6%), senior project engineers (4%), project leaders/managers (36%), team leaders/managers (20%), and engineers (17%). (Refer to Table 3.3.2.2.) The number of team members was: 2-5 (20%), 6-10

(38%), 11-15 (15%), 16-20 (7%), 21-30 (6%), 31-40 (2%), 41-50 (2%), 61 and over (4%). The remainder did not specify team size. (Refer to Table 3.3.2.3.) The number of employees was: 100-249 (24%), 250-499 (8%), 500-999 (10%), 1,000-2,499 (14%), and 2,500 and over (38%). The remainder did not specify their firm size. (Refer to Table 3.3.2.4.) Average annual sales were: less than 10 million (13%), 10-49.9 million (13%), 50-99.9 million (12%), 100-499.9 million (13%), 500-1 billion (7%), and over 1 billion (37%). The remainder did not answer their average annual sales. (Refer to Table 3.3.2.5.)

Table 3.3.2.1: Respondents by SIC code:

SIC Code	Name	Percent
34	Fabricated Metal Products	25%
35	Machinery, except Electrical	14%
36	Electric and Electronic Equipment	17%
37	Transportation Equipment	25%
38	Instruments and Related Products	10%
N/A	No Response	8%
	TOTAL	100%

Table 3.3.2.2: Respondents by position

Position	Percent
CEO/President	5%
Vice President	4%
Director	6%
Senior Project Engineer	4%
Project Leader	14%
Project Manager	22%
Team Leader	13%
Team Manager	7%
Engineer	17%
Miscellaneous	5%
No Response	3%
TOTAL	100%

Table 3.3.2.3: Teams by size

Number of Team members		Percent
2 to 5		20%
6 to 10		38%
11 to 15		15%
16 to 20		7%
21 to 30		6%
31 to 40		2%
41 to 50		2%
61 and over		4%
No Response		4%
	Total	100%

Table 3.3.2.4: Firms by size:

Number of Employees		Percent
100 to 249		24%
250 to 499		8%
500 to 999		10%
1,000 to 2,499		14%
2,500 and over		38%
No Response		5%
	Total	100%

Table 3.3.2.5: Average annual sales:

Average Annual Sales		Percent
Less than 10 million		13%
10 – 49.9 million		13%
50 – 99.9 million		12%
100 – 499.9 million		13%
500 – 1 billion		7%
Over 1 billion		37%
No Response		6%
	Total	100%

The duration of the project in the study had an average of 3.29 years (median = 1.92, standard deviation = 4.98), and respondents spent an average of 3.17 years (median = 1.50, standard deviation = 5.72) on the team. Respondents had 12 years experience in their firm (median = 8.88, standard deviation = 9.83). The percentage of time the team spent on the project each week was: 100% (23%), 90-99% (9%), 80-89% (6%), 70-79% (10%), 60-69% (5%), 50-59% (8%), 40-49% (4%), 30-39% (7%), 20-29% (12%), 10-19% (19%), and 5-9% (2%). (Refer to Table 3.3.2.6.) Tables 3.3.2.7 and 3.3.2.8 show the analysis of contextual variables (i.e., extent of computer usage, competition, project innovativeness, project results, finishing the project within a planned time frame, product complexity, and process complexity). Table 3.3.2.9 shows functional diversity on the teams surveyed.

Table 3.3.2.6: Percentage of time the team spent on the project each week

Percentage of time the team spent on the project each week	Percent
100%	23%
90 – 99%	9%
80 – 89%	6%
70 – 79%	10%
60 – 69%	5%
50 – 59%	8%
40 – 49%	4%
30 – 39%	7%
20 – 29%	12%
10 – 19%	10%
5 – 9%	2%
No Response	6%
Total	100%

Table 3.3.2.7: Various contextual variables I:

	Extent of Computer Usage	Extent of Competition	Extent of Project Innovativeness	Extent of Project Results
Very Low	1%	1%	1%	0%
Low	1%	3%	8%	2%
Medium	8%	11%	23%	19%
High	27%	28%	38%	46%
Very High	60%	53%	28%	29%
Not Applicable /No Response	2%	2%	3%	3%
Total	100%	100%	100%	100%

Table 3.3.2.8: Various contextual variables II:

	Extent of finishing the project within a planned time frame	Extent of Product Complexity	Extent of Process Complexity
Very Low	1%	1%	0%
Low	8%	7%	6%
Medium	26%	19%	22%
High	29%	29%	33%
Very High	30%	37%	33%
Not Applicable /No Response	6%	6%	6%
Total	100%	100%	100%

Table 3.3.2.9: Functional diversity on a team

Items	Mean (S.D.)
My team	
functionally diverse.	4.10 (.92)
is composed of specialists from different functional areas.	3.93 (.97)
has representatives from all functions that affect the project.	3.73 (1.07)
has representatives from all functions that are affected by the project	3.58 (1.10)

1: Strongly Disagree; 3: Neutral; 5: Strongly Agree

3.3.3 Test of Response/Non-response Bias

The response rate was 5.1%, which was relatively low. This was caused in part by the characteristics of the survey, which required about 30 minutes for the busy project managers and leaders to complete (Hong et al., 2005). The single most serious limitation to direct survey data collection is the relatively low response rate (Melnyk et al., 2003). Large-scale survey response rates are often only 5-10% (Alreck & Settle, 1995). Taking into consideration the low response rate, this research examined response/non-response bias. Response/non-response bias was tested by comparing earlier respondents to late respondents because the original lists did not provide demographic information (Tu et al., 2001; Tu et al., 2004). Data from SME were split into two groups as a result of three rounds of the survey. Each batch had 69, 34, and 27 responses respectively. The second and the third batches are considered as one, which resulted in 61 responses. The respondents and non-respondents were compared on the SIC code and the number of employees using a Chi-square test. No significant differences between the two groups were found in SIC code ($\chi^2 = 4.842$, d.f. = 4, $p < .05$) and the number of employees ($\chi^2 = 11.496$, d.f. = 4, $p < .05$). Data from SAE were split into two groups according to the time log. The first batch had 38 and the second had 40. No significant differences between the two groups were found in SIC code ($\chi^2 = 11.922$, d.f. = 4, $p < .05$) and the number of employees ($\chi^2 = 9.549$, d.f. = 4, $p < .05$). The results are shown in Table 3.3.3.1.

Table 3.3.3.1: Chi-square test of response/non-response bias

(1) SME

SIC	1st Batch	Percentage	2nd Batch	Expected Frequency	Chi-square
34	15	.268	21	14.196	3.261
35	9	.161	8	8.518	.031
36	11	.196	7	10.411	1.117
37	12	.214	10	11.357	.162
38	9	.161	7	8.518	.270
Total	56	1.000	53	5.000	4.842

# of Employees	1st Batch	Percentage	2nd Batch	Expected Frequency	Chi-square
100 – 249	18	.300	15	18.300	.595
250 – 499	5	.083	7	5.083	.723
500 – 999	6	.100	11	6.100	3.936
1,000 – 2,499	7	.117	12	7.117	3.351
Over 2500	24	.400	16	24.400	2.892
Total	60	1.000	61	61.000	11.496

(2) SAE

SIC	1st Batch	Percentage	2nd Batch	Expected Frequency	Chi-square
34	11	.306	5	11.611	3.764
35	6	.167	3	6.333	1.754
36	5	.139	10	5.278	4.225
37	13	.361	18	13.722	1.334
38	1	.028	2	1.056	0.845
Total	36	1.000	38	38.000	11.922

# of Employees	1st Batch	Percentage	2nd Batch	Expected Frequency	Chi-square
100 – 249	10	.278	7	10.556	1.198
250 – 499	4	.111	1	4.222	2.459
500 – 999	1	.028	3	1.056	3.582
1,000 – 2,499	5	.139	6	5.278	0.099
Over 2500	16	.444	23	16.888	2.211
Total	36	1.000	40	38	9.459

3.3.4 Power Analysis

A power analysis is an advanced technique that allows researchers to estimate how large a sample is needed to enable statistical judgments that are accurate and reliable (Cohen & Cohen, 1983). Performing a power test (i.e., sample size estimation) is an important aspect because without these calculations sample size may be too low. If sample size is too low, the statistical results will lack the precision to provide reliable answers to investigating questions. Cohen and Cohen (1983) provide a formula to estimate the appropriate sample size (p. 158). The results of the power test indicate that this proposed research framework needs at least 150 at the significance level of 5% and the power of 99%. This research has 208 responses, which indicates that the following statistical judgments are accurate and reliable.

CHAPTER 4: MEASUREMENT MODEL METHODS AND RESULTS

Structural equation modeling (SEM) was used to test the measurement and structural model with LISREL. SEM examines a series of dependence relationships simultaneously with statistical efficiency (Hair et al., 1995). In the measurement model, SEM provides a stricter interpretation of unidimensionality than traditional methods (Gerbing & Anderson, 1988). In the structural model, SEM allows researchers to examine relationships among multiple exogenous and endogenous variables and between endogenous variables simultaneously (Nahm et al., 2003). In this Chapter, the results of the measurement model are described. In the next Chapter, the results of the structural model are explained.

For the measurement model, confirmatory factor analysis was performed on every item simultaneously (Anderson et al., 1987). The significance of each item was determined by t values. The overall goodness of fit was tested by Comparative Fit Index (CFI) (Bentler, 1990), Normed Fit Index (NFI) (Bentler, 1990), Non-Normed Fit Index (NNFI) (Bentler & Bonnet, 1980), Root Mean Square Error of Approximation (RMSEA) (Steiger & Lind, 1980), and the ratio of chi-square to degrees of freedom (Heck, 1998). CFI compares the researcher's model to the null model, which assumes that latent variables are uncorrelated. For example, CFI = .90 means that 90% of the covariance in the data may be reproduced by the given model. Values between .80 and .89 represent reasonable fit, and values .90 and above are the evidence of good fit (Jöreskog & Sörbom, 1986; Byrne, 1989; Segars & Grover, 1993). NFI reflects a relative comparison of the researcher's model to the null model. For instance, NFI = .50 means that the researcher's model improves fit by 50% compared to the null model. Values between .80 and .89 represent reasonable fit and values .90 and above are the evidence of good fit (Jöreskog & Sörbom, 1986; Byrne, 1989; Segars & Grover, 1993). NNFI is similar to NFI, but panelizes for model complexity. It is one of the fit indexes less affected by sample size. Values between .80 and .90 represent a good fit (Segars & Grover, 1993). RMSEA represents the goodness-of-fit that may be expected if the model is estimated according to the population instead of the sample. The recommended maximum value is .10 (Chau, 1997; Hair et al., 1995). The ratio of χ^2 to degrees of freedom provides information on the relative efficiency of competing models. It should be less than three (Carmines & McIver, 1981; Segars & Grover, 1998) or less than two in a more restrictive sense (Premkumar & King, 1994).

4.1 SECOND-ORDER FACTOR MODEL

A knowledge-sharing climate, knowledge quality, information systems quality, and cognitive empowerment were conceptualized as a second-order factor model. Second-order confirmatory factor analysis was used to assess the convergent and discriminant validity. In the following sub-sections, results for each of the second-order factor model are discussed.

4.1.1 Second-order Factor Model of A Knowledge-sharing Climate

The results of the second-order confirmatory factor analysis for a knowledge-sharing climate showed that there was sufficient model-to-data fit (CFI = .98, NFI = .96, NNFI = .97, RMSEA = .084, χ^2 = 126.26, d.f. = 51, χ^2/d.f. = 2.48, GFI = .91; AGFI = .86) and no significantly correlated error terms. As the fitted residual matrix was examined, the smallest residual was -.08 and the largest .07, indicating that the model explained the correlations quite well. Hu and Bentler (1985) stated that the absolute value of .4 or more for a residual may indicate that the model was not explaining some of the correlations.

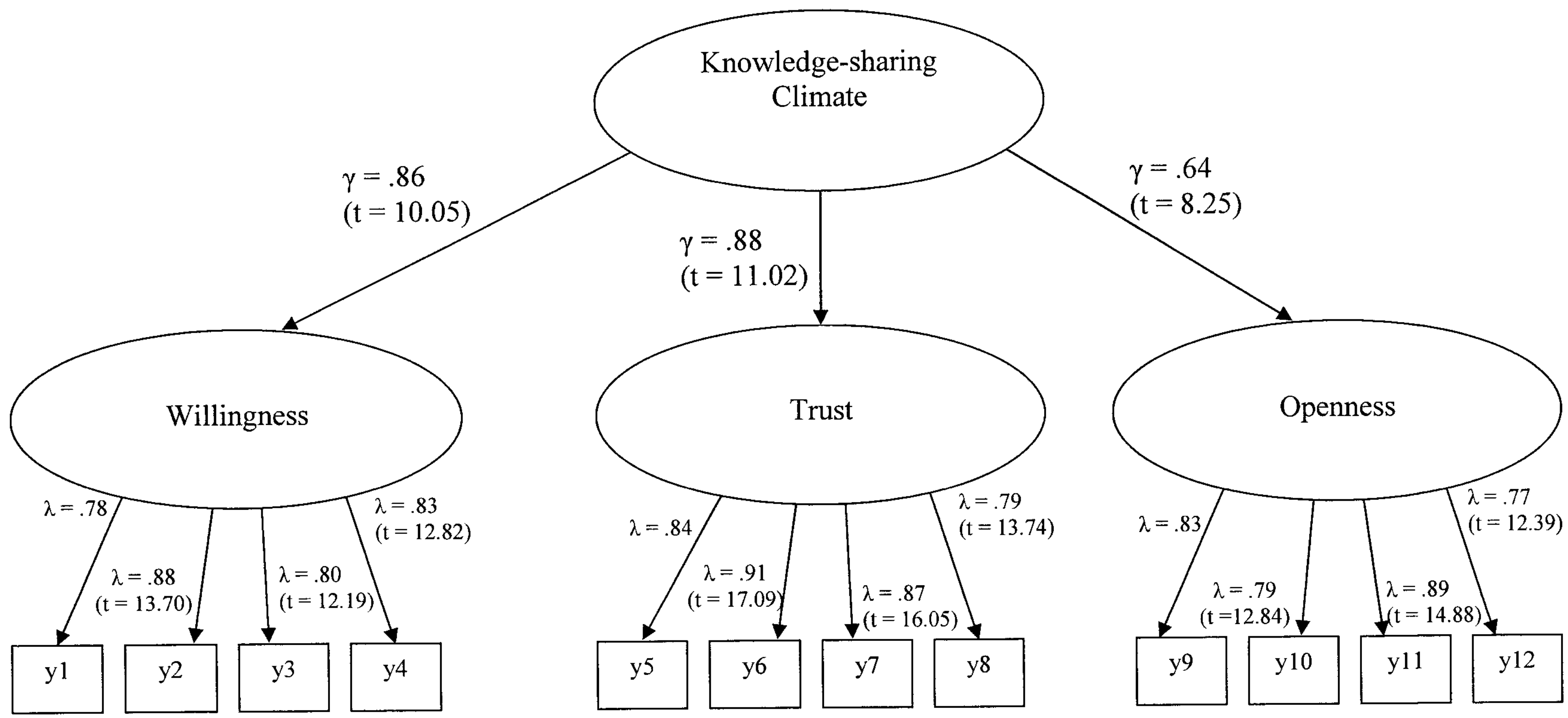
Further evidence of convergent validity was provided by the completely standardized coefficients. All factor loadings (λ) of indicators were statistically significant at $p < .01$ and were large in magnitude, which manifested that indicators for a latent variable stuck together. (Refer to Figure 4.1.1.1.) The completely standardized coefficients and t-values used maximum likelihood for the estimation.

Descriptive statistics, correlations, composite reliability, average variance extracted, and discriminant validity tests are given in Table 4.1.1.1. Discriminant validity was examined in two ways. First, structural equation modeling methodology was employed to see discriminant validity between pairs of constructs (Bagozzi et al., 1991). This is done to determine a χ^2 difference between a constrained and an unconstrained model. The constrained model is to run with the correlation between two latent variables fixed at 1.0. Restricting the correlation between two factors to 1.0 represents an extreme case of no discriminant validity. The unconstrained model is to run with the correlation between the two latent variables freed to assume any value. A χ^2 difference of 7.879 or higher at d.f. = 1 between the constrained and the unconstrained model provides evidence of discriminant validity at the significance level of p = .001 (Koufteros et al., 1998; Koufteros, 1999). Second, discriminant validity was tested by comparing the average variance extracted with the squared correlation between the two constructs. Discriminant validity exists if items share more common variance with the respective construct (Fornell & Larcker, 1981). In other words, the average variance extracted for a construct should be substantially higher than the squared correlation between the construct and each of the other constructs. Both methods showed evidence of discriminant validity.

The completely standard structural coefficients and corresponding t-values for the latent variables are provided in Figure 4.1.1.1. The structural coefficients were significant: willingness: .86 (t = 10.05), trust: .88 (t = 11.02), and openness: .64 (t = 8.25). This indicated good construct validity for the latent factors comprising a knowledge-sharing climate. A higher-order factor was confirmed as explaining variance and covariance correlated to the first-order factors in capturing a knowledge-sharing climate.

Because knowledge is unequally dispersed among team members, their willingness, trust, and openness are critical to share pertinent knowledge (Argote et al., 1999; Bunderson & Sutcliffe, 2002). Team members will not be willing to share resources if they feel secrecy and competition in their environment (Hansen, 1999). Trust is a substantial condition for knowledge-sharing (Von Krough, 1998). Openness is an important attribute that encourages interactions on a team (Leonard-Barton, 1995; Cohen, 1998; Davenport & Prusak, 1998; Gold et al., 2001). The three dimensions capture the components of a knowledge-sharing climate.

Figure 4.1.1.1: Results of second-order confirmatory factor analysis of a knowledge-sharing climate



CFI = .98, NFI = .96, NNFI = .97, RMSEA = .084, χ^2 = 126.26, d.f. = 51, χ^2/d.f. = 2.48, GFI = .91, AGFI = .86

Table 4.1.1.1: Descriptive statistics, correlations, composite reliability, average variance extracted, and discriminant validity tests for a knowledge-sharing climate

	Mean	Standard Deviation	Willingness	Trust	Openness
Willingness	4.15 (4 items)	.73	.89 [a] [.68] [b]		
Trust	3.84 (4 items)	.72	.62** (242.55)	.92 [.73]	
Openness	3.89 (4 items)	.80	.50** (452.37)	.55** (417.17)	.89 [.67]

[a] Composite reliabilities are on the diagonal.
[b] Average variances extracted are on the diagonal in brackets.
[c] The χ^2 differences are indicated in parentheses. All differences in χ^2 for d.f. are significant at 0.001.
** Correlation is significant at the 0.01 level (two-tailed t-test, d.f. = ∞).

Table 4.1.1.2: χ^2 differences between a constrained model and an unconstrained model for a knowledge-sharing climate

		Constrained Model		Unconstrained Model		Difference		
		χ^2	d.f.	χ^2	d.f.	χ^2	d.f.	p-value
Willingness	Trust	291.28	20	48.73	19	242.55	1	0.000
Willingness	Openness	525.82	20	73.45	19	452.37	1	0.000
Trust	Openness	472.10	20	54.93	19	417.17	1	0.000

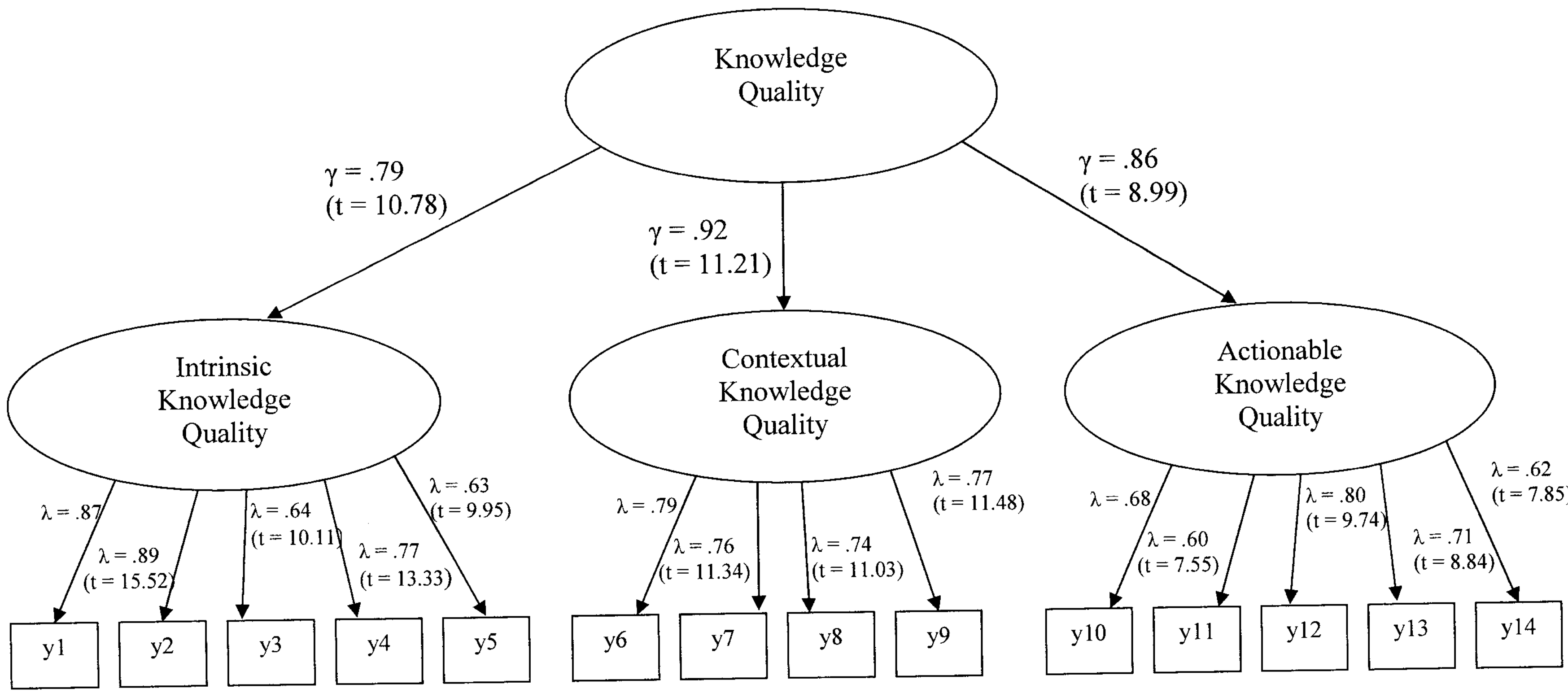
4.1.2 Second-order Factor Model of Knowledge Quality

In the process of the second-order confirmatory factor analysis for knowledge quality, two items (i.e., akq2 and ckq3) were deleted. The error terms of akq2 and akq3 were correlated, indicating that they shared variances and possibly measured the same content. In addition, the error term of ckq3 was correlated with that of akq5. Deleting akq2 and ckq3 should have minimal effect on content validity because the portion of domain was preserved by the remaining items. The results showed that there was sufficient model-to-data fit (CFI = .97, NFI = .95, NNFI = .96, RMSEA = .091, χ^2 = 200.74, d.f. = 74, χ^2/d.f. = 2.71, GFI = .84, AGFI = .73) and no significantly correlated error terms. As the fitted residual matrix was examined, the smallest residual was -.05 and the largest .10, indicating that the model explained the correlations quite well.

Further evidence of convergent validity was provided by the completely standardized coefficients. All factor loadings (λ) of indicators were statistically significant at $p < .01$ and were large in magnitude, which revealed that indicators for a latent variable stuck together. (Refer to Figure 4.1.2.1.) The standardized coefficient and t-values used maximum likelihood for the estimation.

Descriptive statistics, correlations, composite reliability, average variance extracted, and discriminant validity tests are given in Table 4.1.2.1. Discriminant validity was examined in two ways (i.e., structural equation modeling methodology and comparing the average variance extracted with the squared correlation between two constructs). Both methods showed evidence of discriminant validity.

Figure 4.1.2.1: Results of second-order confirmatory factor analysis of knowledge quality



CFI = .97, NFI = .95, NNFI = .96, RMSEA = .091, χ^2 = 200.74, d.f. = 74, χ^2/d.f. = 2.71, GFI = .84, AGFI = .73

Table 4.1.2.1: Descriptive statistics, correlations, composite reliability, average variance extracted, and discriminant validity tests for knowledge quality

	Mean	Standard Deviation	Intrinsic Knowledge Quality	Contextual Knowledge Quality	Actionable Knowledge Quality
Intrinsic Knowledge Quality	3.97 (5 items)	.62	.88 [a] [.59] [b]		
Contextual Knowledge Quality	4.28 (4 items)	.60	.70** (46.16)	.85 [.59]	
Actionable Knowledge Quality	4.10 (5 items)	.57	.63** (163.55)	.69** (63.86)	.81 [.47]

[a] Composite reliabilities are on the diagonal.
[b] Average variances extracted are on the diagonal in brackets.
[c] The χ^2 differences are indicated in parentheses. All differences in χ^2 for d.f. are significant at 0.001.
** Correlation is significant at the 0.01 level (two-tailed t-test, d.f. = ∞).

Table 4.1.2.2: χ^2 differences between a constrained model and an unconstrained model for knowledge quality

Variables		Constrained Model		Unconstrained Model		Difference		
		χ^2	d.f.	χ^2	d.f.	χ^2	d.f.	p-value
Intrinsic Knowledge Quality	Contextual Knowledge Quality	160.65	27	114.49	26	46.16	1	0.000
Intrinsic Knowledge Quality	Actionable Knowledge Quality	241.22	35	77.67	34	163.55	1	0.000
Contextual Knowledge Quality	Actionable Knowledge Quality	182.94	27	119.08	26	63.86	1	0.000

The completely standard structural coefficients and corresponding t-values for the latent variables are provided in Figure 4.1.2.1. The structural coefficients were significant: intrinsic knowledge quality: .79 ($t = 10.78$), contextual knowledge quality: .92 ($t = 11.21$), and actionable knowledge quality: .86 ($t = 8.99$). This indicated good construct validity for the latent factors comprising knowledge quality. A higher-order factor is confirmed as explaining variance and covariance correlated to the first-order factors in capturing knowledge quality.

Knowledge quality is difficult to specify (Kankanhalli et al., 2005). It remains a vaguely defined concept. The three dimensions (i.e., intrinsic knowledge quality, contextual knowledge quality, actionable knowledge quality) combine to create an overall construct of knowledge quality. High quality of knowledge provides a high level of correctness. Incomplete representations of context may lead to a decreased ability to make sense of the knowledge (Mark 2002; Weick & Meader, 1993). High quality of knowledge must be converted into actions to manifest its usefulness and profitability (Demarest, 1997; Droget et al., 2003; Nonaka & Takeuchi, 1995). This study empirically tested knowledge quality and may ignite a new stream for future study.

4.1.3 Second-order Factor Model of Information Systems Quality

The results of second-order confirmatory factor analysis for information systems quality showed that there was sufficient model-to-data fit (CFI = .98, NFI = .97, NNFI = .98, RMSEA = .077, $\chi^2 = 194.35$, d.f. = 87, $\chi^2/d.f. = 2.23$, GFI = .89, AGFI = .85) and no significantly correlated error terms. As the fitted residual matrix was examined, the smallest residual was -.13 and the largest .16, indicating that the model explained the correlations quite well.

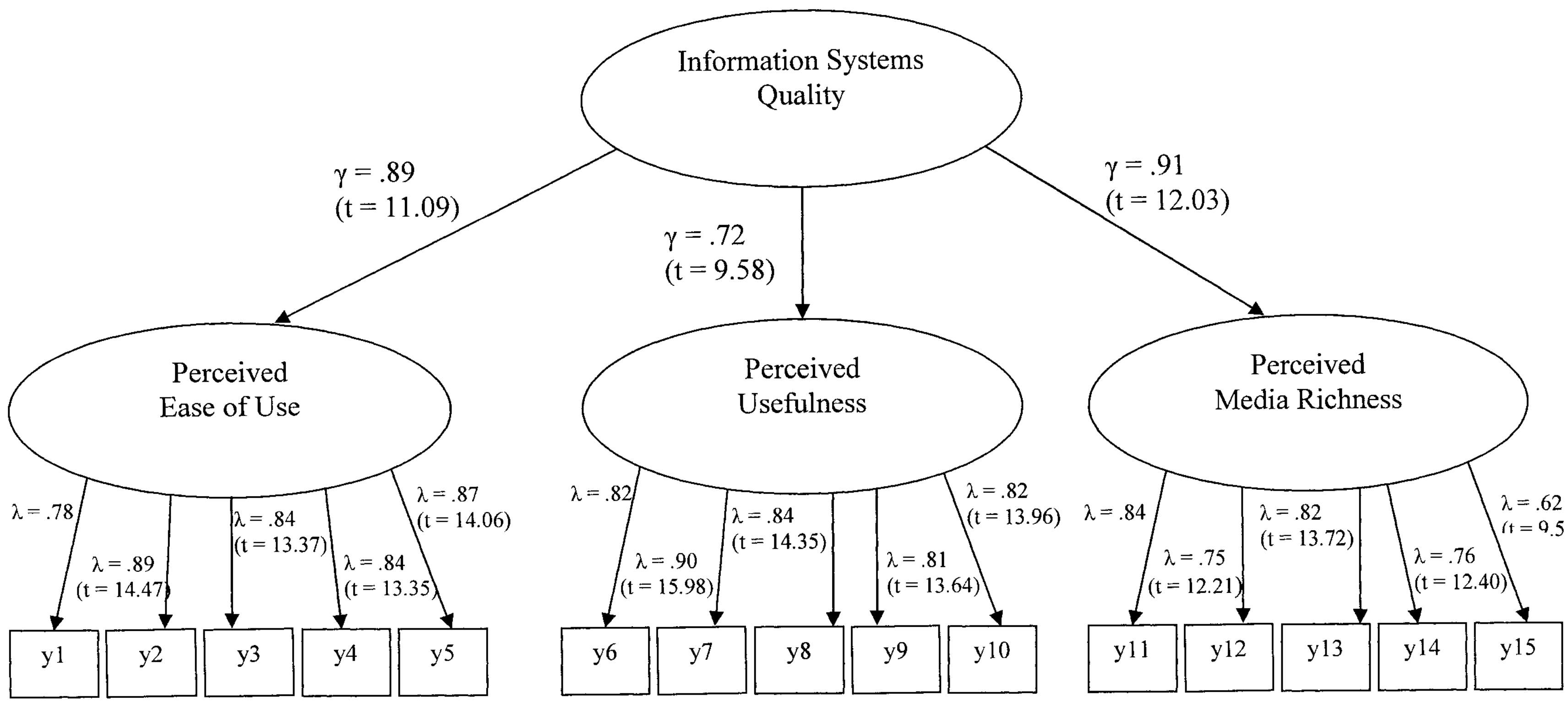
Evidence of convergent validity was provided by the completely standardized coefficients. All factor loadings (λ) of indicators were statistically significant at $p < .01$ and were large in magnitude, which revealed that indicators for a latent variable stuck together. (Refer to Figure 4.1.3.1.) The completely standardized coefficients and t-values use maximum likelihood for the estimation.

Descriptive statistics, correlations, composite reliability, average variance extracted, and discriminant validity tests are given in Table 4.1.3.1. Discriminant validity was examined in two ways (i.e., structural equation modeling methodology and comparing the average variance extracted with the squared correlation between two constructs). Both methods showed evidence of discriminant validity.

The completely standard structural coefficients and corresponding t-values for the latent variables are provided in Figure 4.1.3.1. The structural coefficients were significant: perceived ease of use: .89 ($t = 11.09$), perceived usefulness: .72 ($t = 9.58$), and perceived media richness: .91 ($t = 12.03$). This indicated good construct validity for the latent factors comprising information systems quality. A high-order factor was confirmed as explaining variance and covariance correlated to the first-order factors in capturing information systems quality.

Research has illustrated that perceived ease of use and perceived usefulness are indicators of information systems quality across levels of expertise (Taylor & Todd, 1995), within and across firms (Davis, 1989; Adams et al., 1992; Subranmanian, 1994), and even across nations (Rose & Straub, 1998; Straub et al., 1997). Writing, language,

Figure 4.1.3.1: Results of second-order confirmatory factor analysis of information systems quality



CFI = .98, NFI = .97, NNFI = .98, RMSEA = .077, χ^2 = 194.35, d.f. = 87, χ^2/d.f. = 2.23, GFI = .89, AGFI = .85

Table 4.1.3.1: Descriptive statistics, correlations, composite reliability, average variance extracted, and discriminant validity tests for information systems quality

	Mean	Standard Deviation	Perceived Ease of Use	Perceived Usefulness	Perceived Media Richness
Perceived Ease of Use	3.29 (5 items)	.92	.93 [a] [.71] [b]		
Perceived Usefulness	3.83 (5 items)	.84	.59** (716.35)	.92 [.70]	
Perceived Media Richness	3.41 (5 items)	.87	.71** (155.36)	.63** (383.72)	.84 [.52]

[a] Composite reliabilities are on the diagonal.
[b] Average variances extracted are on the diagonal in brackets.
[c] The χ^2 differences are indicated in parentheses. All differences in χ^2 for d.f. are significant at 0.001.
** Correlation is significant at the 0.01 level (two-tailed t-test, d.f. = ∞).

Table 4.1.3.2: χ^2 differences between a constrained model and an unconstrained model for information systems quality

Variables		Constrained Model		Unconstrained Model		Difference		
		χ^2	d.f.	χ^2	d.f.	χ^2	d.f.	p-value
Perceived Ease of Use	Perceived Usefulness	828.49	35	112.34	34	716.15	1	0.000
Perceived Ease of Use	Perceived Media Richness	234.02	35	78.46	34	155.56	1	0.000
Perceived Usefulness	Perceived Media Richness	445.64	35	61.92	34	383.72	1	0.000

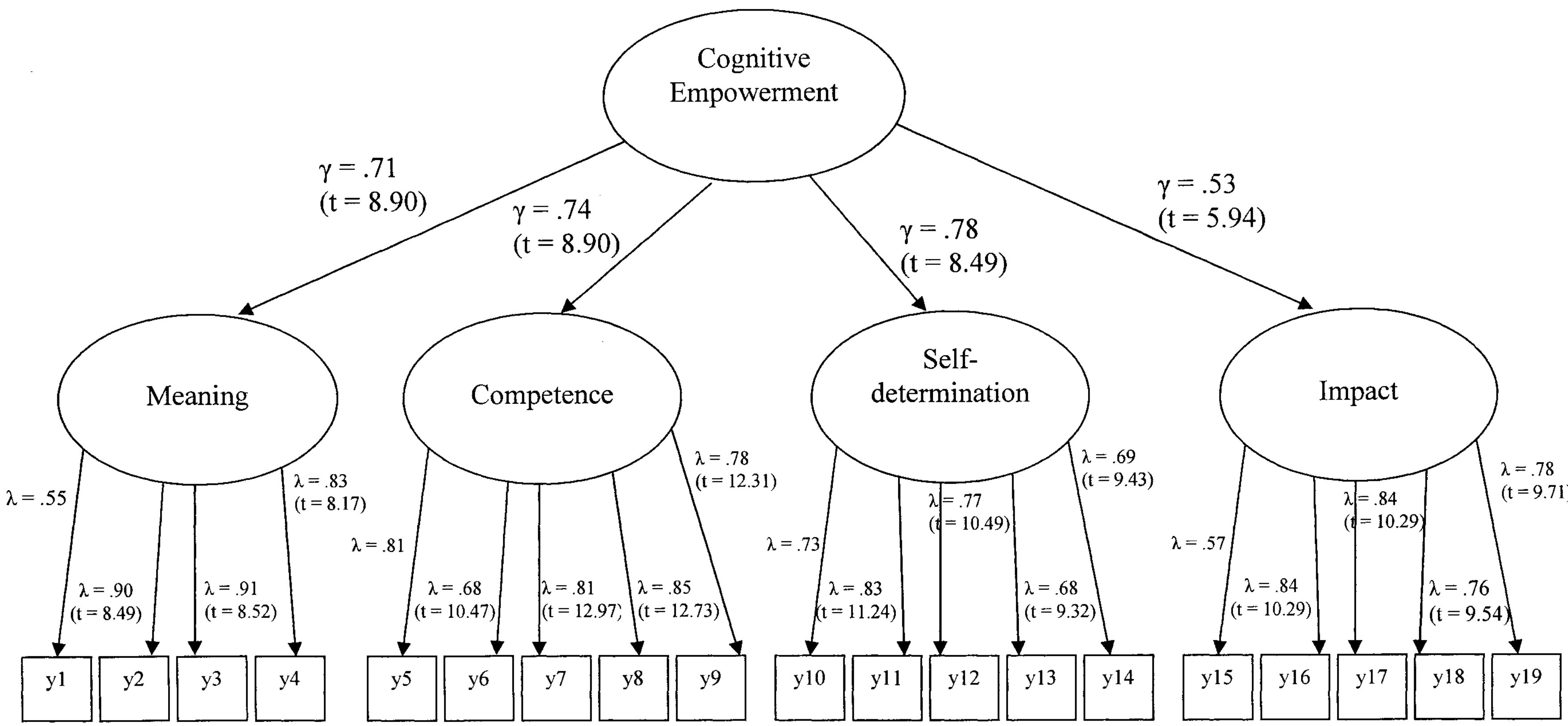
and context behind texts in information systems may be unfamiliar to others, which may cause equivocality. Perceived media richness helps knowledge workers to interpret texts efficiently (Daft & Lengel, 1986). In short, information systems should have functions that knowledge workers use easily, represent contents and contexts usefully, and exchange them with others flexibly. This study combines the three important aspects to build information systems quality.

4.1.4 Second-order Factor Model of Cognitive Empowerment

In the process of the second-order confirmatory factor analysis for cognitive empowerment, one item (i.e., mn2) was deleted. The error terms of mn1 and mn2 were correlated, indicating that they shared variances and possibly measured the same content. Deleting mn2 should have minimal effect on content validity because the portion of domain was preserved by the remaining items. The results showed that there was sufficient model-to-data fit (CFI = .95, NFI = .92, NNFI = .94, RMSEA = .092, χ^2 = 405.80, d.f. = 148, χ^2/d.f. = 2.74, GFI = .83, AGFI = .78) and no significantly correlated error terms. As the fitted residual matrix examined, the smallest residual was -.12 and the largest .12, indicating that the model explained the correlations quite well.

Evidence of convergent validity was provided by the completely standardized coefficients. All factor loadings (λ) of indicators were statistically significant at $p < .01$ and were large in magnitude, which revealed that indicators for a latent variable stuck together. (Refer to Figure 4.1.4.1.) The completely standardized coefficients and t-values use maximum likelihood for the estimation.

Figure 4.1.4.1: Results of second-order confirmatory factor analysis of cognitive empowerment



CFI = .95, NFI = .92, NNFI = .94, RMSEA = .092, χ^2 = 405.80, d.f. = 148, χ^2/d.f. = 2.74, GFI = .83, AGFI = .78

Table 4.1.4.1: Descriptive statistics, correlations, composite reliability, average variance extracted, and discriminant validity tests for cognitive empowerment

	Mean	Standard Deviation	Meaning	Competence	Self-determination	Impact
Meaning	4.15 (4 items)	.71	.88 [a] [.65] [b]			
Competence	4.21 (5 items)	.66	.48** (419.28)	.89 [.62]		
Self-determination	3.77 (5 items)	.79	.53** (394.91)	.44** (341.13)	.86 [.55]	
Impact	3.95 (5 items)	.83	.37** (432.19)	.34** (738.37)	.43** (485.46)	.88 [.61]

[a] Composite reliabilities are on the diagonal.

[b] Average variances extracted are on the diagonal in brackets.

[c] The χ^2 differences are indicated in parentheses. All differences in χ^2 for d.f. are significant at 0.001.

** Correlation is significant at the 0.01 level (two-tailed t-test, d.f. = ∞).

Table 4.4.2: χ^2 differences between a constrained model and an unconstrained model for cognitive empowerment

Variables		Constrained Model		Unconstrained Model		Difference		
		χ^2	d.f.	χ^2	d.f.	χ^2	d.f.	p-value
Meaning	Competence	475.90	27	56.62	26	419.28	1	0.000
Meaning	Self-determination	467.11	27	72.2	26	394.91	1	0.000
Meaning	Impact	560.85	27	128.66	26	432.19	1	0.000
Competence	Self-determination	448.39	35	107.26	34	341.13	1	0.000
Competence	Impact	859.42	35	121.05	34	738.37	1	0.000
Self-determination	Impact	639.21	35	153.75	34	485.46	1	0.000

Descriptive statistics, correlations, composite reliability, average variance extracted, and discriminant validity tests are given in Table 4.1.4.1. Discriminant validity was examined in two ways (i.e., structural equation modeling methodology and comparing the average variance extracted with the squared correlation between two constructs). Both methods showed evidence of discriminant validity.

The completely standard structural coefficients and corresponding t-values for the latent variables are provided in Figure 4.1.4.1. The structural coefficients were significant: meaning: .71 (t = 8.90), competence: .74 (t = 8.90), self-determination: .78 (t = 8.49), and impact: .53 (t = 5.94). This indicated good construct validity for the latent factors comprising cognitive empowerment. A high-order factor was confirmed as explaining variance and covariance correlated to the first-order factors in capturing cognitive empowerment.

Thomas and Velthouse (1990) presented four cognitions to build cognitive empowerment. Since then, the construct has been examined at the individual level of analysis (Conger & Kanungo, 1988; Ford & Fottler, 1995; Koberg et al., 1999; Liden et al., 2000; Spreitzer, 1995, 1996; Spreitzer et al., 1997; Thomas & Velthouse, 1990) and at the team level of anlaysis (Kirkman et al., 2004; Burpitt & Bigoness, 1997; Hyatt & Ruddy, 1997; Kirkman & Rosen, 1997, 1999; Welins et al., 1991). The results from this study are also consistent with the literature.

4.2 LARGE-SCALE MEASUREMENT RESULTS

Confirmatory factor analysis was performed by applying LISEL to 208 responses in pursuit of testing the unidimensionality of instruments and assessing the overall model fit. This analysis showed correlated error terms between measurement items. The error term for PT2 was correlated with that of PT1, indicating that they shared variance and possibly measured the same content. PT2 was consequently deleted. In addition, PM1 was deleted because it was correlated with the construct of willingness, suggesting a high cross-loading. Deleting PT2 and PM1 should have minimal effect on content validity because the domain of the construct would be preserved by the remaining reflective indicators of the construct.

The resulting trimmed measurement model (Table 4.2.1) had a good model-to-data fit (CFI = .97, NFI = .94, NNFI = .97, RMSEA = .064, χ^2 = 608.85, d.f. = 329, χ^2 /d.f. = 1.85, GFI = .83, AGFI = .79) and no significantly correlated error terms. As the fitted residual matrix was examined, the smallest residual was -.17 and the largest .15, indicating that the model explained the correlations quite well.

Evidence of convergent validity was provided by the completely standardized coefficients. The coefficients represent relationships between each observed indicators and associated latent variables. t-values of exogenous and endogenous indicators showed statistical significance between observed indicators and latent variables. The standardized coefficient and t-values used maximum likelihood for the estimation, as shown in Table 4.2.1. They were all statistically significant at $p < .01$ and were large in magnitude, revealing that indicators for a latent variable stuck together.

Descriptive statistics, correlations, composite reliability, average variance extracted, and discriminant validity tests are given in Table 4.2.2. Discriminant validity was examined in two ways (i.e., structural equation modeling methodology and comparing the average variance extracted with the squared correlation between two constructs). Both methods showed evidence of discriminant validity.

Table 4.2.1: Results of measurement model

	Completely Standardized Coefficients (Loadings)	t-values
Exogenous Indicators		
WLN_M	.64	9.51
TRS_M	.77	11.94
OPN_M	.67	9.99
EOU_M	.81	13.25
USE_M	.74	11.85
MR_M	.88	14.91
Endogenous Indicators		
IKQ_M	.87	14.91
CKQ_M	.86	14.77
AKQ_M	.78	14.85
MN_M	.76	12.01
CO_M	.65	9.77
SLD_M	.69	10.47
IM_M	.54	7.80
PT1	.74	12.02
PT3	.82	14.06
PT4	.84	14.66
PT5	.75	12.27
PT6	.78	13.01
PM2	.76	12.78
PM3	.73	12.03
PM4	.80	13.78
PM5	.93	17.39
PM6	.90	16.63
IN1	.77	12.68
IN2	.79	13.12
IN3	.55	8.21
IN4	.85	14.80
IN5	.84	14.48

- The actual indicators that correspond to the coding can be found in Appendix C.
- CFI = .97, NFI = .94, NNFI = .97, RMSEA = .064, χ^2 = 608.85, 329 degrees of freedom, χ^2 /degrees of freedom = 1.85, GFI = .83, AGFI = .79
- All t-values are significant at $p < .01$ (two-tailed t-test, d.f. = ∞)

Table 4.2.2: Descriptive statistics, correlations, composite reliability, average variance extracted, and discriminant validity tests for the research framework

Constructs	Mean	# of items	SD	Knowledge Quality	Knowledge-sharing Climate	Information Systems Quality	Cognitive Empowerment	Perspective Taking	Perspective Making	Innovation
Knowledge Quality	4.12	3	.52	.88[a] [.70][b]						
Knowledge-sharing Climate	3.96	3	.63	.58** (79.24)[c]	.73 [.48]					
Information Systems Quality	3.51	3	.77	.39** (244.52)	.32** (104.90)	.85 [.66]				
Cognitive Empowerment	4.02	4	.56	.63** (121.29)	.65** (14.05)	.50** (150.33)	.76 [.44]			
Perspective Taking	3.86	6	.72	.52** (261.00)	.67** (41.28)	.29** (251.94)	.59** (107.08)	.89 [.62]		
Perspective Making	3.68	6	.72	.53** (275.39)	.65** (94.49)	.45** (239.89)	.61** (129.55)	.74** (307.58)	.90 [.66]	
Innovation	3.86	5	.80	.42** (291.97)	.46** (95.01)	.42** (258.51)	.54** (153.20)	.48** (571.07)	.59** (541.21)	.88 [.59]

SD: Standard Deviation

[a] Composite reliabilities are on the diagonal.

[b] Average variances extracted are on the diagonal in brackets.

[c] The χ^2 differences are indicated in parentheses. All differences in χ^2 for d.f. are significant at 0.001.

** Correlation is significant at the 0.01 level (two-tailed t-test, d.f. = ∞).

Table 4.2.3: χ^2 differences between a constrained model and an unconstrained for the research framework

Variables		Constrained Model		Unconstrained Model		Difference		p-value
		χ^2	d.f.	χ^2	d.f.	χ^2	d.f.	
Knowledge Quality	Knowledge-sharing Climate	98.16	9	18.92	8	79.24	1	0.000
	Information Systems Quality	277.59	9	32.37	8	245.22	1	0.000
	Cognitive Empowerment	155.02	14	33.73	13	121.29	1	0.000
	Perspective Taking	289.99	20	28.99	19	261.00	1	0.000
	Perspective Making	345.21	20	69.82	19	275.39	1	0.000
	Innovation	335.14	20	43.17	19	291.97	1	0.000
Knowledge-sharing Climate	Information Systems Quality	117.37	9	12.47	8	104.90	1	0.000
	Cognitive Empowerment	39.88	14	25.83	13	14.05	1	0.000
	Perspective Taking	85.42	20	44.14	19	41.28	1	0.000
	Perspective Making	184.16	20	89.67	19	94.49	1	0.000
	Innovation	148.14	20	53.13	19	95.01	1	0.000
Information Systems Quality	Cognitive Empowerment	171.57	14	21.24	13	150.33	1	0.000
	Perspective Taking	289.32	20	37.38	19	251.94	1	0.000
	Perspective Making	316.16	20	76.27	19	239.89	1	0.000
	Innovation	306.23	20	47.72	19	258.51	1	0.000
Cognitive Empowerment	Perspective Taking	150.83	27	43.75	26	107.08	1	0.000
	Perspective Making	213.88	27	84.33	26	129.55	1	0.000
	Innovation	219.62	27	66.42	26	153.20	1	0.000
Perspective Taking	Perspective Making	418.18	35	110.6	34	307.58	1	0.000
	Innovation	714.99	44	143.9	43	571.07	1	0.000
Perspective Making	Innovation	706.49	44	165.3	43	541.21	1	0.000

CHAPTER 5: STRCUTURAL MODEL METHODS AND RESULTS

Once the validity and reliability of the measurement model is obtained, the structural model may be tested by LISREL. Results indicated that there was sufficient model-to-data fit (CFI = .97, NFI = .94, NNFI = .97, RMSEA = .068 with the 90% confidence interval for RMSEA being .060 to .076, χ^2 = 666.94, d.f. = 341, χ^2/d.f. = 1.96, GFI = .81, AGFI = .78). A matrix of fitted residual did not show any problematic pattern (Hu & Bentler, 1995). The smallest residual was -.18 and the largest was .21. Because the structural model has a good model-to-data fit, path coefficients may be examined (Marsch & Hocevar, 1985).

Figure 5.1 and Table 5.1 show the path results, which display statistical significance for each hypothesis. The first hypothesis predicted that a project team with a high level of knowledge-sharing climate would have a high level of knowledge quality. As seen in Figure 5.1 and Table 5.1, the gamma coefficient from knowledge-sharing climate to knowledge-quality was significant and positive ($\Gamma = .49$, $t = 5.45$, $p < .01$). This indicated that a knowledge-sharing climate affected knowledge quality positively.

The second hypothesis predicted that a project team with a high level of information systems quality would have a high level of knowledge quality. The gamma coefficient from information systems quality to knowledge quality was significant and positive ($\Gamma = .24$, $t = 2.91$, $p < .01$). It indicated that information systems quality was directly related to knowledge quality.

The third hypothesis predicted that a project team with a high level of knowledge-sharing climate would have a high level of cognitive empowerment. The beta coefficient from knowledge-sharing climate to cognitive empowerment was significant and positive ($\beta = .82$, $t= 8.04$, $p < .01$). This showed that a knowledge-sharing climate had a substantial impact on cognitive empowerment.

The fourth hypothesis predicted that a project team with a high level of knowledge quality would have a high level of cognitive empowerment. The beta coefficient from knowledge quality and cognitive empowerment was positive but weak because it is significant at the level of 10% ($\beta = .15$, $t = 1.68$, $p < .10$). It indicated that knowledge quality might be related to cognitive empowerment in a weak way.

The fifth hypothesis predicted that a project team with a high level of cognitive empowerment would have a high level of perspective taking. The beta coefficient from cognitive empowerment and perspective taking was significant and positive ($\beta = .74$, $t = 8.29$, $p < .01$). It showed that cognitive empowerment might be directly related to perspective taking.

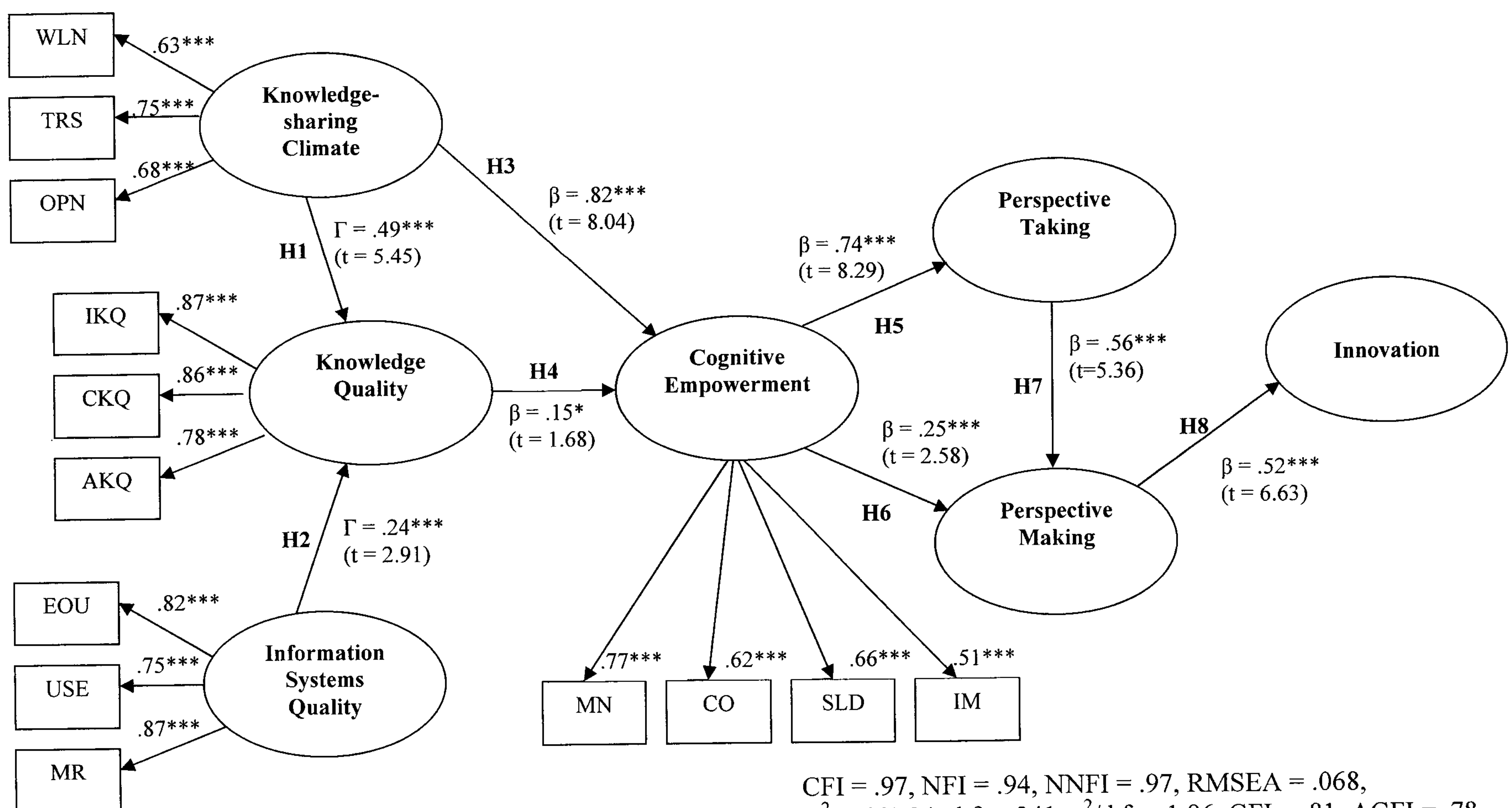
The sixth hypothesis predicted that a project team with a high level of cognitive empowerment would have a high level of perspective making. The beta coefficient from cognitive empowerment and perspective making was significant and positive ($\beta = .25$, $t = 2.58$, $p < .01$). It indicated that cognitive empowerment was directly related to perspective making.

The seventh hypothesis predicted that a project team with a high level of perspective taking would have a high level of perspective making. The beta coefficient from perspective taking to perspective making was significant and positive ($\beta = .56$, $t = 5.36$, $p < .01$). This meant that perspective taking might lead to perspective making.

The eighth hypothesis predicted that a project team with a high level of perspective making would have a high level of innovation. The beta coefficient from perspective making to innovation was significant and positive ($\beta = .52$, $t = 6.63$, $p < .01$). It indicated that perspective making might have a substantial impact on innovation.

To further examine the relationships, Table 5.2 shows the indirect effects of the research framework. Such relationships were not hypothesized, but may provide some insights on the relationships among the variables. A knowledge-sharing climate had an indirect impact on perspective taking and perspective making. In the case of knowledge quality, it showed an indirect impact on perspective taking and perspective making at the significance level of 10%. A knowledge-sharing climate, cognitive empowerment, and perspective taking had indirect impacts on innovation.

Figure 5.1: Structural model of the research framework



CFI = .97, NFI = .94, NNFI = .97, RMSEA = .068,
χ^2 = 661.94, d.f. = 341, χ^2/d.f. = 1.96, GFI = .81, AGFI = .78
* Significant at $\alpha < .10$ (two-tailed test, df = ∞)
** Significant at $\alpha < .05$ (two-tailed test, df = ∞)
*** Significant at $\alpha < .01$ (two-tailed test, df = ∞)

Table 5.1: Hypotheses testing

Relationship			Hypothesis	Standardized Coefficient (t-value)
Knowledge-sharing Climate	→	Knowledge Quality	H1	.49 (5.45***)
Information Systems Quality	→	Knowledge Quality	H2	.24 (2.91***)
Knowledge-sharing Climate	→	Cognitive Empowerment	H3	.82 (8.04***)
Knowledge Quality	→	Cognitive Empowerment	H4	.15 (1.68*)
Cognitive Empowerment	→	Perspective Taking	H5	.74 (8.29***)
Cognitive Empowerment	→	Perspective Making	H6	.25 (2.58***)
Perspective Taking	→	Perspective Making	H7	.56 (5.36***)
Perspective Making	→	Innovation	H8	.52 (6.63***)

* Significant at $\alpha < .10$ (two-tailed test, $df = \infty$)
** Significant at $\alpha < .05$ (two-tailed test, $df = \infty$)
*** Significant at $\alpha < .01$ (two-tailed test, $df = \infty$)

Table 5.2: Indirect effects of the research framework

Relationship			Standardized Coefficient (t-value)
Knowledge-sharing Climate	→	Perspective Taking	.66 (7.94***)
Knowledge Quality	→	Perspective Taking	.11 (1.67*)
Knowledge-sharing Climate	→	Perspective Making	.59 (7.61***)
Knowledge Quality	→	Perspective Making	.10 (1.66*)
Knowledge-sharing Climate	→	Innovation	.31 (5.53***)
Cognitive Empowerment	→	Innovation	.35 (5.64***)
Perspective Taking	→	Innovation	.29 (4.47***)

* Significant at $\alpha < .10$ (two-tailed test, $df = \infty$)
** Significant at $\alpha < .05$ (two-tailed test, $df = \infty$)
*** Significant at $\alpha < .01$ (two-tailed test, $df = \infty$)

CHAPTER 6: DISCUSSION

What factors influence the dynamics of knowledge management and thus result in innovation? In answer to this question, this study presents a research framework that examines knowledge management to support distributed cognition and behavior in knowledge-intensive and computer-mediated work. In the following sub-sections, theoretical and managerial implications are discussed.

6.1 THEORETICAL IMPLICATIONS

A first challenge in conducting the research of knowledge management is an understanding of what knowledge is, given a myriad of definitions and conceptualizations to describe knowledge in the literature. To better explore the dynamics of knowledge management, there is a need for a more in-depth understanding of differences between data and information, and differences between information and knowledge. This study reviews the literature on data, information, and knowledge extensively. Going a step further, this study compares and contrasts their differences and provides relationships among the three entities. They study may be particularly useful in explaining how data, information, knowledge, information systems, and people interact.

Over the past decades, considerable emphasis and attention have been placed on quality issues – product quality, service quality, data quality, and information quality. However, knowledge quality remains a vaguely defined concept. It is a research challenge to find dimensions and measures for knowledge quality. This study uses a conceptually based, empirically tested model to examine knowledge quality by proposing and validating a second-order factor model of knowledge quality with the three first-order factors. The results from this study indicate that knowledge quality may be broken down into intrinsic knowledge quality, contextual knowledge quality, and actionable knowledge quality. These findings are consistent with an understanding that high-quality knowledge is intrinsically right, contextually appropriate, and practically actionable. Knowledge quality enhances the understanding of problem definitions and facilitates alternative generations/evaluations/choices. The second-order factor model of knowledge quality with the three first-order factors may ignite a new stream of research.

This study also reveals two determinants of knowledge quality (i.e., a knowledge-sharing climate and information systems quality). The first hypothesis indicates that a team with a high level of knowledge-sharing climate will have a high level of knowledge quality. The second hypothesis suggests that a team with a high level of information systems quality will have a high level of knowledge quality. Both of them are statistically significant. They show that a knowledge-sharing climate and information systems quality are critical determinants of knowledge quality. A knowledge-sharing climate with the three first-order factors (i.e., willingness, trust, and openness) improves the integration of knowledge. Information systems quality with the three first-order factors (i.e., perceived ease of use, perceived usefulness, and perceived media richness) enhances the transferability of knowledge. As a matter of fact, it is consistent with the literature that people are the most effective media with which to acquire tacit knowledge (Nonaka, 1994; Polanyi, 1962, 1967; Alavi & Leidner, 2001), and technology is the best means to manage explicit knowledge (Griffith et al., 2003; Inkpen & Dinur, 1998). It implies that by a knowledge-sharing climate the aspect of tacitness of knowledge may contribute to knowledge quality, and by information systems the aspect of explicitness of knowledge may contribute to knowledge quality. This study finds two variables that affect knowledge quality. Potential determinants of knowledge quality need to be addressed further.

Although cross-functional teams bring a number of benefits, the literature on functional diversity shows a mixed picture – both positive and negative. This paper addresses the shortfall and fills the gap by presenting a knowledge-sharing climate. Functionally diverse teams cross functional, cultural, and geographical lines. As the knowledge-sharing climate runs high, their efficiency of work processes will be improved. A knowledge-sharing climate develops cohesion, consensus, and communication on a team. Bock et al. (2005) define climate as a contextual situation at a point in time and its link to the thoughts, feelings and behaviors of team members. Relatively little research on a knowledge-sharing climate has been conceptually and empirically conducted. The proposed and validated second-order factor model of a knowledge-sharing climate with the first three factors (i.e., willingness, trust, and openness) will build on the literature.

Information technology initiated knowledge management, but both academicians and practitioners recognize that people should be included for successful dynamics of knowledge management (Massey et al., 2002). In light of this argument, it is noteworthy to see the results of the third and fourth hypotheses. The third hypothesis indicates that a team with a high level of knowledge-sharing climate will have a high level of cognitive empowerment. The fourth hypothesis indicates that a team with a high level of knowledge quality will have a high level of cognitive empowerment. The third hypothesis is statistically significant at the significance level of 1%, whereas the fourth hypothesis is weakly supported. It implies that a knowledge-sharing climate is more critical than knowledge quality in terms of cognitive empowerment. It also indicates that a culture on a team has an influence on cognitive empowerment. Teams are more likely to be empowered by a knowledge-sharing climate that is composed of willingness, trust, and openness. This finding would give some managerial implications for successful dynamics of knowledge management.

The fifth and sixth hypotheses indicate that cognitive empowerment will have an impact on perspective taking and perspective making, which are statistically significant. It implies that cognitive empowerment is an important variable to escalate knowledge transfer. Cognitive empowerment is an intrinsic task motivation that is cognitively stimulated by new beliefs and paradigms. It has been shown that motivational depositions are a barrier to knowledge transfer (Levinthal & March, 1993; Simon, 1991; Szulanski, 1996). When teams are empowered, their motivation depositions will facilitate knowledge transfer in a group of experts. In fact, the results are consistent with the literature that cognitive empowerment motivates teams to behave actively, seek continuous improvement, revise work processes, and search out innovative solutions (Crant, 2000; Hyatt & Ruddy, 1997, Locke & Schweiger, 1979; Thomas & Velthouse, 1990; Spreitzer, 1995; Bandura, 1977; Doll et al., 2002; Tushman & O'Reilly, 1996; Edmondson, 1999). In addition, this study confirms that cognitive empowerment escalates knowledge transfer in a group of experts.

The seventh hypothesis predicts that perspective taking will lead to perspective making, which is statistically significant. Knowledge transfer is difficult (Lessard & Zaheer, 1996; Ruggles, 1998; Szulanski, 1996; Miner & Meziah, 1996). But perspective taking and perspective making are a new way of transferring knowledge, especially in a group of experts. Cross-functional team members may not understand some aspects of knowledge due to specialty, or they may have insufficient backgrounds to render their communication meaningful. Accordingly, understanding and combining inter-disciplines are fundamental to cross-functional teams. The coordination may be carried out through perspective taking and perspective making. On a cross-functional team, members do not have to master knowledge of other disciplines. However, they may adopt the perspectives of other disciplines on problems and solutions to reach the best alternative. This research takes a first step in the empirical evolution of these important variables. The dynamics of knowledge sharing (i.e., perspective taking and perspective making) enriches the literature of knowledge transfer.

The eighth hypothesis indicates that a team with a high level of perspective making will have a high level of innovation. Results support this proposition statistically. The integration of divergent perspectives is critical to produce innovation. As team members efficiently leverage specialized knowledge, they may converge their core knowledge and make perspectives of the team as a whole.

It is also noteworthy to discuss indirect impacts of this research framework. The results show that a knowledge-sharing climate and knowledge quality affect perspective taking and perspective making indirectly. In the case of knowledge quality, it is supported at the significance level of 10%. A knowledge sharing climate may develop the environment in which team members appreciate and utilize their expertise. Knowledge quality may increase a team's competence and increase its activities to transfer knowledge. Gupta and Govindarajan (2000) address factors to enhance knowledge transfer (e.g., willingness to share and acquire knowledge, and value of knowledge). The results of this study are consistent with the findings of their research. A knowledge-sharing climate and knowledge quality may be critical factors in the facilitation of knowledge transfer. This study shows indirect impacts of these variables.

The results of the indirect impacts also show that a knowledge-sharing climate, cognitive empowerment, and perspective taking are important variables that affect innovation indirectly. Innovation is knowledge-embedded products, services, systems, and structures and it may be a result of knowledge management. By a knowledge-sharing climate, teams may attain close and frequent interactions, which may lead to innovation. By cognitive empowerment, teams are motivated to challenge innovative tasks. By perspective taking, teams compare and contrast various information and knowledge, which may arrive at new insights. This study shows that innovation may be facilitated by a knowledge-sharing climate, cognitive empowerment, and perspective taking in an indirect way.

6.2 MANAGERIAL IMPLICATIONS

To survive and prosper in the rapidly changing business environment, firms have an interest in knowledge management. Firms strive to collect what organizational members, suppliers, customers, and competitors know; organize, store, retrieve, and transfer knowledge; enable the effective application of knowledge; and facilitate the firm's ability to create knowledge. Management also strives to keep the dynamic processes of knowledge management, decreasing the firm's dependency on a few individuals. This study may provide managerial implications to practitioners.

This study presents a 14-item instrument to measure knowledge quality. A valid, reliable, and robust instrument of knowledge quality will provide practitioners with a tool to assess knowledge quality and improve it. In addition, the magnitude of path coefficients provides useful insights into the relative importance of each dimension of knowledge quality. Contextual knowledge quality has the highest loading, and then actionable knowledge quality follows. It indicates that quality of knowledge should be appropriate to the context of the task and then be actionable. Practitioners may use these findings and better target future knowledge quality. Teams may better understand its attributes with the three dimensions of knowledge quality (i.e. intrinsic knowledge quality, contextual knowledge quality, and actionable knowledge quality). The developed measures also provide a useful benchmark to examine the quality of knowledge beyond a team.

A number of firms employ cross-functional teams because various functions enable them to tap into a broad array of knowledge and thus produce innovation. To facilitate dynamics of knowledge management, it is worth mentioning that a knowledge-sharing climate and information systems quality are critical determinants of knowledge quality. Teams need to achieve a knowledge-sharing climate, which may allow them to find right knowledge contextually and actionably. To achieve a knowledge-sharing climate, teams need to develop a set of shared understandings about providing access to information and building or using necessary knowledge. Rapport-building on a team will make a significant difference. Management also needs to establish information systems quality by enhancing perceived ease of use, perceived usefulness, and perceived media richness. This will enable team members to navigate a vast amount of knowledge bases and communicate new developments in a timely manner.

Knowledge resides in people and people create knowledge. As a team perceives that they are empowered, their performance will improve. This study shows that a knowledge-sharing climate is more important than knowledge quality to empower teams. Team performance is not a function of having right expertise, but of coordinating it on a team. It is important to make high quality of knowledge available. However, it is more important to cultivate a culture in which various experts work together. Empowerment is a requirement for behavior initiatives that involve flexible adaptability, problem recognition, and knowledge generation. Building a knowledge-sharing climate on a team is essential.

People's cognition and behavior are of fundamental importance in knowledge management. Firms are represented by the process of distributed cognition and behavior in which multiple specialized knowledge workers deal with one part of organizational problems, and interact with others to find the best solution. Effective knowledge management should involve the element of cognition (i.e., developing understanding) and behavior (i.e., using knowledge). For the element of cognition, cross-functional teams should be empowered through providing meaning, competence, self-determination, and impact. For the element of behavior, cross-functional teams may transfer knowledge by perspective taking and perspective making. A perspective taking experience occurs when team members open their horizons to other functions. A perspective-making process occurs as a team constructs, revises, or comments on emerging representations. Additionally, the perspective making process needs to nurture emergent knowledge and respect distinctive ways of knowing (Boland & Tenkasi, 1995). Without a proper nurturing of great ideas and concepts, they may be abandoned prematurely and so never transformed into successful products or services (Von Krough, 1998). Perspective making enables teams to incorporate and advance knowledge. Teams need to encourage perspective making, which in turn promotes learning and innovation.

Knowledge management does not lie in simply making knowledge available to teams. Knowledge management to support distributed cognition and behavior enhances expertise coordination because team members have the same cognitive maps and share their perspectives. Management may apply the findings of this study to plan for the successful implementation of knowledge management and innovation-related activities. This study may help practitioners understand how the important components interact to influence the overall performance of knowledge management.

CHAPTER 7: CONCLUSION

This research began by exploring five objectives – (1) identifying differences and relationships among data, information, and knowledge; (2) providing a research framework that emphasizes distributed cognition and behavior in knowledge management; (3) validating a second-order factor model of a knowledge-sharing climate, knowledge quality, and information systems quality; (4) introducing perspective taking and making as part of knowledge transfer; and (5) developing instruments of a knowledge-sharing climate, knowledge quality, and perspective taking and perspective making. This Chapter provides an overview of each objective.

It is critical to understand data, information, and knowledge prior to discussing knowledge management. Although data, information, and knowledge have similar characteristics, it is believed that they show unique aspects. This research explores the literature on data, information, and knowledge, and highlights their differences. Furthermore, information systems and people should be included to discuss their relationships. Information systems convert data into information. People transform information into knowledge.

The business environment is characterized as an unforeseen and radical pace of changes. To deal with the atmosphere, the sense-making view of knowledge management is more efficient than the information-processing view. The sense-making view of knowledge management emphasizes the impact of distributed cognition and behavior. Critical success factors for knowledge management require a rich understanding of human cognition and behavior (Malhotra, 2000; Ruppel & Harrington, 2001). This study presents a research framework that examines the relationships among a knowledge-sharing climate, knowledge quality, information systems quality, cognitive empowerment, and perspective taking, perspective making, and innovation. These are all essential elements for successful knowledge management.

A knowledge-sharing climate is critical on cross-functional teams. Various functions may lead to better performance, whereas they may cause conflicts. A knowledge-sharing climate may reconcile the different impacts. As a team has various functional areas, members are subject to their disciplines in examining problems and creating knowledge. In this environment, a knowledge-sharing climate becomes increasingly important. A knowledge-sharing climate is composed of three dimensions, namely, willingness, trust, and openness, and it is empirically tested and validated in this study.

Quality management has its roots in the manufacturing and service sectors. The scope has been extended to data quality and information quality. This research takes another step in exploring the concept of knowledge quality. Knowledge quality has a substantial impact on project teams. However, it remains a vaguely defined concept. This study proposes and validates a second-order factor model of knowledge quality with the three first-order factors. According to the empirical results, quality of knowledge should have intrinsic correctness. In addition, it should be appropriate in the context of the task and should be able to be acted upon. The finding of this research will shed light on describing knowledge quality, and open a new avenue by providing insights to researchers.

Information technology plays a critical role in knowledge management by extending teams' reach beyond formal communications (Alavi & Leidner, 2001). The Technology Acceptance Model (TAM) theorizes that perceived ease of use and perceived usefulness are important to increase information systems quality (Davis, 1989; Davis et al., 1989; DeLone & McLean, 1992, 2003; Taylor & Todd, 1995; Doll et al., 1998; Ventatesh & Davis, 2000; Gefen et al., 2003). This study adds perceived media richness to the information systems quality. Perceived media richness is an information systems quality in which team members express their knowledge and receive feedback in a timely manner. In short, information system should allow teams to communicate their knowledge easily, usefully, and flexibly.

Knowledge transfer is described as the communication of knowledge from a source so that it is learned and applied by a recipient (Ko et al., 2005). To successfully complete their projects, teams must capitalize on members' resources by discerning and applying relevant knowledge (Littlepage et al., 1997; Henry, 1995). However, functionally diverse teams may lack a common ground, which in turn limits the team's ability to transfer knowledge. Perspective taking and perspective making may be a good way of knowledge transfer on cross-functional teams. The team members do not have to master specialized knowledge, but instead each member may take the perspective of others into account and strengthen a team's perspective as a whole.

Items were developed for a knowledge-sharing climate, knowledge quality, perspective taking, and perspective making. Teams may be able to test the level of knowledge-sharing climate, knowledge quality, and knowledge transfer (i.e., perspective taking and perspective making) by using the instruments.

Researchers explore the outcomes of knowledge management in the context of new product development (Ferdor et al., 2003, Brockman & Morgan, 2003; Yli-Renko et al., 2001), financial performance (Droge et al., 2003; McGee & Dowling, 1994; Yli-Renko et al., 2001), innovation (Shan et al. 1994), electronic knowledge repositories usage (Kankanhalli et al., 2005), and intention to share knowledge (Bock et al., 2005). This study builds on the literature that explores the relationships between knowledge management and innovation.

7.1 LIMITATIONS

While our findings have implications, it is important to note the limitations of this study. This research used a single-method (i.e., survey) and a single response from each team, which may cause common method variance and informant bias. Additionally, the data collected is perceptual. This may be problematic, especially in innovation data, for respondents might be unwilling to admit their poor performance. The generalization of these results is also limited because the study is conducted on 208 firms. To understand more fully the empirical generalizability of this model, additional research with multiple responses may need to be conducted. More cultural and contextual variables may be included and refined as well. This research also includes an inability to conclusively determine causality, which is the typical limitation of cross-sectional survey-based research.

7.2 FUTURE STUDY

Organizational culture is regarded as an important part to facilitating knowledge management (Davenport & Prusak, 1998). Successful knowledge management needs a rich understanding of human cognition and behavior because knowledge resides in people and people create knowledge. Then, human cognition and behavior are deeply affected by a culture that sets expectations and boundaries for members. Culture involves cognitive structures and interpretive schemes that people use to perceive situation and make sense of ongoing events, activities, and relationships, thereby forming a basis for collective action (Leidner & Keyworth, 2006; Reichers & Schneider, 1990; Sackmann, 1992; Sapienza, 1985; Van Manner & Barley, 1985). Thus, organizational culture would have an impact on knowledge management. This study investigated the impact of a knowledge-sharing climate as an effort to analyze a cultural issue in knowledge management. Future study may measure organizational culture directly to explore the relationship between organizational culture and knowledge management.

In the knowledge-based economy, knowledge quality plays a critical role in decision-makings. As this study analyzed knowledge quality at the team level, the construct may be tested at the organizational level. It is meaningful to see the quality of organizational knowledge in the three dimensions (i.e., intrinsic knowledge quality, contextual knowledge quality, and actionable knowledge quality). Focal antecedents of knowledge quality may be researched and addressed more. This study presented a knowledge-sharing climate and information systems quality. In addition, functional diversity, absorptive capacity, and knowledge networks may affect the level of knowledge quality.

Szulanski (1996) finds that a lack of absorptive capacity is a major barrier to knowledge transfer in a firm. Teams differ in their capacity to assimilate and replicate new knowledge. In particular, cross-functional teams are less likely to have salient attributes or experiences in common, which significantly limit the ability to acquire and transfer knowledge. Even though perspective sharing facilitates knowledge transfer on a cross-functional team, it would depend on their absorptive capacity of the team members. Absorptive capacity is a cognitive structure that recognizes the value of knowledge, assimilates it, and applies it (Cohen & Levinthal, 1990; Massey & Montoya-Weiss, 2006). Accordingly, the relationship between absorptive capacity and perspective sharing may be tested.

Richer media enable greater socio-emotional communication, whereas leaner media result in a more negative socio-emotional communication. Perceived media richness enhances sending multiple cues, supporting the use of language variety, providing timely feedback, and representing a high degree of personalness. Because tasks and their contexts vary across time and people, it is a research challenge to pay attention to high contextual knowledge quality. Perceived media richness will enable organizational members to have a better understanding of contexts. It is worthwhile to illustrate the relationship between perceived media richness and contextual knowledge quality.

References:

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease-of-use, and usage of information technology: A replication. *MIS Quarterly*, 16(2), 227-247.

Aitsalia, F., Johnson, E., and Will, P. (1995). Is concurrent engineering always a sensible proposition? *IEEE Transactions on Engineering Management*, 42(2), 166-170.

Alavi, M., & Leidner, D. (1999). Knowledge management systems: Issues, challenges and benefits. *Communication of the Association for Information Systems*, 1(7), 1-28.

Alavi, M., & Leidner, D. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly,* 25(1), 107-136.

Allee, V. (1997). Chevron maps key processes and transfers best practices, Knowledge Inc., April.

Allen, T., Tushman, M., & Lee, D. (1979). Technology transfers as a function of position in the spectrum from research through development to technical services. *Academy of Management Journal*, 22(4), 694-708.

Alreck, P. L., & Settle, R. B. (1995). *The survey research handbook (2nd Eds.),* Homewood, IL: Richard D. Irwin, Inc.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron M. (1996). Assessing the work environment for creativity. *Academy of Management Journal*, 39(5), 1154-1184.

Ancona, D. G. (1990). Outward bound: Strategies for team survival in an organization. *Academy of Management Journal*, 33(2), 334-365.

Ancona, D. G., & Caldwell, D. F. (1987). Management issues facing new product teams in high technologies companies. In D. Lewin, D. Lipsky, & D. Sokel (Eds.), *Advances in industrial and labor relations*, Greenwich, CT: JAI Press, 191-221.

Anderson, J. C., Gerbing, D. W., & Hunter, J. E. (1987). On the assessment of unidimensional measurement: Internal and external consistency, and overall consistency criteria. *Journal of Marketing Research*, 24 (November), 432-437.

Anderson, T., & von Hellens, L. A. (1997). Information systems work quality. *Information and Software Technology*, 39 (12), 837-844.

Applegate, L., Cash, J., & Mills, D. Q. (1988). *Revolution in real time: Managing information technology in the 1990s, Boston*, MA: Harvard Business School Press.

Argote, L. (1999). *Organizational learning. Creating, retaining, and transferring knowledge*. Boston, MA; Kluwer Academic Publishers.

Argote, L., & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes*, 82(1), 150-169.

Argote, L., Gruenfeld, D., & Naquin, C. (1999). Group learning in organizations. In M. E. Turner (Ed.), *Groups at work: Advances in theory and research*. New York, NY: Erlbaum, 369-411.

Armstrong, C. P., & Sambamurthy, V. (1999). Information technology assimilation in firms: The influence of senior leadership and IT infrastructures. *Information Systems Research*, 10(4), 304-327.

Arthur, W. B. (1996). Increasing returns and the new world of business, *Harvard Business Review*, 74(4), 100-109.

Ashforth, B. E. (1989). The experience of powerlessness in organizations. *Organizational Behavior and Human Decision Processes*, 43(2), 207-242.

Babcock, P. (2004). Shedding light on knowledge management, *HR Magazine*, 49(5), 46-50.

Bagozzi, R. P., Yi, Y., Phillips, L. W. (1991). Assessing construct validity in organizational research. *Administrative Science Quarterly*, 36, 421-458.

Ballou, D. P., & Pazer, H. L. (1995). Designing data information systems to optimize the accuracy-timeliness tradeoff. *Information Systems Research*, 6(1), 51-72.

Ballou, D. P., Wang, R. Y., Pazer, H., & Tayi, G. K. (1998). Modeling information manufacturing systems to determine information product quality, *Management Science*, 44(4), 462-484.

Bandra, A. (1978). The self-system in reciprocal determination. *American Psychologies*, 33, 344-358.

Bandura, A. (1977). Self-efficacy toward a unifying theory of behavior change *Psychological Review*, 84, 191-215.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist,* 37(2), 122-147.

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, 44, 1175-1184.

Bantel, K. A. (1993). Strategic clarity in banking: Role of top management-team demography. *Psychological Reports*, 73(3), 1187-1201.

Bantel, K. A., & Jackson, S. E. (1989). Top management and innovations in banking: Does the demography of the top team make a difference? *Strategic Management Journal*, 10(2), 107-124.

Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120.

Batson, C. D. (1991). *The altruism question: Towards a social-psychological answer.* Hilsdale, NJ: Erlbaum.

Becerra-Fernandez, I., & Sabherwal, R. (2001). Organizational knowledge management: A contingency perspective, *Journal of Management Information Systems*, 18(1), 23-55.

Bell, N. E., & Staw, B. M. (1989). People as sculptors versus sculpture. In M. B. Arthur, D. T. Hall, & B. S. Lawrence (Eds.), *Handbook of career theory*: New York, NY: Cambridge University Press. 232-251.

Bennett, J. L. (1996). Building relationships for technology transfer. *Communications of the ACM*, 39(9), 35-37.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, 107(2), 238-246.

Bentler, P. M., & Bonnet, D. G. (1980). Significance tests and goodness of fit in analysis of covariance structures. *Psychological Bulletin*, 88(3), 588-606.

Blackburn, R. S., Furst, S. A., & Rosen, B. (2003). Building a winning virtual team. In C. B. Gibson & S. G. Cohen (Eds.), *Virtual teams that work: Creating the conditions for virtual team effectiveness,* San Francisco, CA: Jossey-Bass, 95-120.

Blau, J. R., & Alba, R. D. (1982). Empowering nets of participation. *Administrative Science Quarterly*, 27(3), 363-379.

Bock, G., Zmud, R. W., Kim, Y., & Lee, J. (2005). Behavior intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate. *MIS Quarterly*, 29(1), 87-111.

Boisot, M. H. (1998). *Knowledge assets – securing competitive advantage in the information economy.* Oxford: Oxford University Press.

Boland, R. J., Ramkrishnan, T. V. & Te'eni, D. (1994). Designing information technology to support distributed cognition. *Organization Science*, 5(3), 456-475.

Boland, R. J., Singh, J., Saliplante, P., Aram, J. D., Fay, S. Y., & Kanawattanachai, P. (2001). Knowledge representation and knowledge transfer. *Academy of Management Journa*l, 44(2), 393-417.

Boland, R. J., & Tenkasi, R. V. (1995). Perspective making and perspective taking in communities of knowing. *Organization Science*, 6(4), 350-372.

Bovee, M., Srivastava, R. P., & Mak, B. (2003). A conceptual framework and belief-function approach to assessing overall information quality. *International Journal of Intelligent Systems*, 18(1), 51-74.

Bowen, D. E, & Lawler, E. E. (1992). The empowerment of service workers: what, why, how and when. *Sloan Management Review*, 33(3), 31-39.

Bower, G. H., & Hilgard, E. R. (1981). *Theories of learning*, Englewood Cliffs, NJ: Prentice-Hall.

Bradshaw, G. I. (1992). The airplane and the logic of invention, In R. N. Giere (Ed.), *Cognitive models of science: Minnesota studies in the philosophy of science, XV*, Minneapolis, MN: University of Minnesota Press.

Bretschneider, S, & Wittmer, D. (1993). Organizational adoption of microcomputer technology: The role of sector. *Information Systems Research*, 4(1), 88-109.

Brief, A. P., & Nord, W. R. (1990). *Meanings of occupational work: A collection of Essays.* Lexington, MA: Lexington Books.

Brockman, B. K., & Morgan, R. M. (2003). The role of existing knowledge in new product innovativeness and performance, *Decision Sciences*, 34(2), 385-419.

Brown, J. S. & Duguid, P. (1991). Organizational learning and communities of practice. *Organization Science*, 2(1), 40-57.

Brown, S. L., & Eisenhardt, K. M. (1998). *Competing on the Edge*. Harvard Business School Press, Boston, MA.

Brown, S. L., & Eisenhardt, K. M. (1995). Product development: Past research, present findings, and future directions. *Academy of Management Review*, 20(2), 343-378.

Byrne, B. M. (1989). *A primer of LISREL: Basic applications and programming for confirmatory factor analysis analytic models*. New York, NY: Srpinger.

Bunderson, J. S., & Sutcliffe, K. M. (2002). Comparing alternative conceptualizations of functional diversity in management teams: Process and performance effects. *Academy of Management Journal*, 45(5), 875-893.

Burpitt, W. J., & Bigoness, W. J. (1997). Leadership and innovation among teams: The impact of empowerment. *Small Group Research*, 28(30), 414-423.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait -multimethod matrix. *Psychological Bulletin*, 56(1), 81-105.

Campion, M. A., Medsker, G. J., & Higgs, A. C. (1993). Relations between work group characteristics and effectiveness: Implications for designing effective work groups. *Personnel Psychology*, 46(4), 823-850.

Cappiello, C., Francalanci, C., and Pernici, B. (2003). Time-related factors of data quality in multichannel information systems. *Journal of Management Information Systems*, 20 (3), 71-91.

Carlson, J. R., & Zmud, R. (1999). Channel expansion theory and the experimental nature of media richness perceptions. *Academy of Management Journal*, 42(2), 153-170.

Carlson, P. J. & Davis, G. B. (1998). An investigation of media selection among directors and managers: From 'self' to 'other' orientation. *Management Information Systems Quarterly*, 22(3), 335-358.

Carmines, E. G., & McIver, S, P. (1981). Analyzing models with unobserved variables: Analysis of covariance structures. In G. W. Bohrnstedt & E. F. Borgatta (Eds.), *Social measurement: Current issues*. Beverly Hills, CA: Sage.

Carron, A. V. (1982). Cohesiveness in sport groups: Interpretations and considerations. *Journal of Sport Psychology*, 4, 123-138.

Chau, P. Y. K. (1997). Reexamining a model for evaluating information center success using a structural equation modeling approach. *Decision Sciences*, 28(2), 309-334.

Chin, W. W., & Todd, P. A. (1995). On the use, usefulness, and ease-of-use of structural equation modeling in MIS research: A note of caution. *MIS Quarterly*, 19(2), 237-246.

Christensen, C., & Rosenbloom, R. (1995). Explaining the attacker's advantage: Technological paradigms, organizational dynamics and the value network. *Research Policy*, 24, 233-257.

Churchill, G. A. (1979). A paradigm for developing better measures of marketing constructs, *Journal of Marketing Research*, 16(1), 64-73.

Churchman, C. W. (1971). *The Design of Inquiring Systems.* New York, NY: Basic Books.

Clark, H. H., & Wilkes-Gibbs, D. (1986). Referring as a collaborative process, *Cognition*, 22(1), 1-39.

Clark, K. B., & Fujimoto, T. (1991). *Product development performance: Strategy, organization, and management in the world auto industry*. Boston, MA: Harvard Business School Press.

Cohen, D. (1998). Toward a knowledge context: Report on the first annual U.C. Berkeley forum on knowledge and the firm. *California Management Review*, 40(3), 22-39.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychology Measurement*, 20(Spring), 37-46.

Cohen, J. & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), 128-152.

Conger, J. A., & Kanungo, R. N. (1988). The empowerment process: Integrating theory and practice. *Academy of Management Review*, 13(3), 471-482.

Conner, K. R. (1991). A historical comparison of the resource-based theory and five schools of thought within industrial organization economics: Do we have a new theory of the firm? *Journal of Management*, 17(1), 121-154.

Cooper, A., & Smith, A. (1992). How established firms respond to threatening technologies. *Academy Management Executives*, 6(2), 55-70.

Cooper, R. B., & Zmud, R. W. (1990). Information technology implementation research: A technological diffusion approach. *Management Science*, 36(2), 123-139.

Cooper, R. G., & Kleinschmidt, E. J. (1986). An investigation into the new product process: Steps, deficiencies, and impact. *Journal of Product Innovation Management*, 3(2), 71-85.

Crant, J. M. (2000). Proactive behavior in organizations. *Journal of Management*, 26(3), 435-462.

Cross, R., & Baird, L. (2000). Technology is not enough: Improving performance by building organizational memory. *Sloan Management Review*, 4(3), 69-78.

Daft, R. L. (1978). A dual-core model of organizational innovation. *Academy of Management Journal,* 21(2), 193-210.

Daft, R. L., & Lengel, R. H. (1984). Information richness: A new approach to managerial behavior and organization design. *Research in Organizational Behavior*, 6, 191-233.

Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management Science*, 32(5), 554-571.

Daft, R. L., Lengel, R. H., & Trevino, L. (1987). Message equivocality, media selection, and manager performance: Implications for information systems. *MIS Quarterly,* 17, 355-366.

Damanpour, F. & Evan, W. M. (1984). Organizational innovation and performance: The problem of organizational lag, *Administrative Science Quarterly*, 29(3), 392-409.

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, 34(3), 555-590.

Damanpour, F. (1996). Organizational complexity and innovation: Developing and testing multiple contingency models. *Management Science*, 42(5), 693-716.

Darr, E., & Kurtzberg, T. (2000). An investigating of partner similarity dimensions on knowledge transfer. *Organizational Behavior and Human Decision Processes*, 82(1), 28-44.

Davenport, T. H, & Klahr, P. (1998). Managing customer support knowledge. *California Management Review*, 40(3), 43-57.

Davenport, T. H., & Prusak, L. (1998). *Working knowledge: How organizations manage what they know.* Boston, MA: Harvard Business School Press.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly,* 13(3), 313-339.

Davis, F. D., Bagozzi, R., & Warsaw, P. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, 35(8), 982-1003.

Davenport, T. H., & Prusak, L. (1998). *Working knowledge: How organizations manage what they know.* Boston, MA: Harvard Business School Press.

Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of Marketing*, 58(4), 37-52.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior*. New York, NY: Plenum.

Deci, E. L., Connell, J. P., & Ryan, R. M. (1989). Self-determination in a work organization. *Journal of Applied Psychology*, 74, 580-589.

DeLone, W. H., & McLean E. R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research,* 3(1), 60-96.

DeLone, W. H., & McLean E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Information Systems,* 19(4), 9-30.

Demarest, M. (1997). Understanding knowledge management. *Long Range Planning*, 30(3), 374-384.

Deming, W. E. (1986). *Out of the Crisis.* Cambridge, MA: Center for Advanced Engineering Study, MIT.

Deming, W. E. (1994). *The new economics for industry, education, government* (2nd ed.). Cambridge, MA: MIT Press.

Dennis, A. R., & Kinney, S. T. (1998). Testing media richness theory in the new media: The effects of cues, feedback and task equivocality. *Information System Research*, 9(3), 256-274.

DeTienne, K. B., & Jackson, L. A. (2001). Knowledge management: Understanding theory and developing strategy. *Competitiveness Review*, 11(1), 1-11.

Devlin, K. (1999). *Inforsense – turning information into knowledge.* New York, NY: Freeman and Co.

Dewar, R. D., & Dutton, I. E. (1986). The adoption of radical and incremental innovations: An empirical analysis. *Management Science*, 32(11), 1422-1433.

Dobyns, L., & Crawford-Masson, C. (1991). *Quality or else: The revolution in world business*. Boston, MA: Houghton Mifflin.

Doll, W. J., & Torkzadeh, G. (1998). Developing a multidimensional measure of system-use in an organizational context. *Information & Management*, 33(4), 171-185.

Doll, W. J., Deng, X., & Metts, G. (2002). User empowerment in computer-mediated work. *Working Paper.*

Doll, W.J., Hendrickson, A., & Deng, X. (1989). Using the perceived usefulness and ease of use instruments in decision making: A confirmatory multi-group invariance analysis. *Decision Sciences*, 29(4), 839-869.

Donnellon, A. (1996). *Team talk: The power of language in team dynamics.* Boston, MA: Harvard Business School Press.

Dooley, D. (2001). *Social research methods.* Upper Saddle River, NJ: Prentice-Hall.

Dougherty, D. (1992). Interpretive barriers to successful product innovation in large firms. *Organization Science*, 3(2), 179-202.

Downs, G. W., & Mohr, L. B. (1976). Conceptual issues in the study of innovation. *Administrative Science Quarterly*, 21(4), 700-714.

Dretske, F. (1981). *Knowledge and the flow of information.* Cambridge, MA: MIT Press.

Droge, C., Claycomb, C., & Germain R. (2003). Does knowledge mediate the effect of context on performance? Some initial evidence. *Decision Sciences*, 34(3), 541-568.

Drucker, P. F. (1988). The coming of the new organization. *Harvard Business Review*, 66(1), 45-53.

Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly*, 44(2), 350-383.

Eisenhardt, K., & Tabrizi, B. (1995). Accelerating adaptive processes: Product innovation in the global computer industry. *Administrative Science Quarterly*, 40(1), 84-110.

Epple, D., Argote, L., & Devadas, R. (1991). Organizational learning curves: A method for investigating intraplant transfer of knowledge acquired through learning by doing. *Organization Science*, 2, 58-70.

Ettlie, J. E., Bridget, W. P., & O'Keefe, R. D. (1984). Organization strategy and structural differences for radical versus incremental innovation. *Management Science*, 30(6), 682-695.

Evered, R. D., & Selman, J. C. (1989). Coaching and the art of management. *Organizational Dynamics*, 18(2), 16-32.

Faraj, S. & Sproull, L. (2000). Coordinating expertise in software development teams. *Management Science*, 46(12), 1554-1568.

Fedor, D. B., Ghosh, S., Caldwell, S. D., Maurer, T. J., & Singhal, V. R. (2003). The effects of knowledge management on Team members' ratings of project success and impact. *Decision Sciences*, 34(3), 513-539.

Feldman, M. S., & March, J. G. (1981). Information in organization as signal and symbol, *Administrative Science Quarterly*, 26(5), 171-186.

Ferry, D. L., Kydd, C. T., & Sawyer, J. E. (2001). Measuring facts of media richness. *Journal of Computer Information Systems*, 69-78.

Fichman, R. G. (2000). The diffusion and assimilation of information technology innovations. In R. B. Zmud (Ed.), *Framing the Domains of IT Management: Projecting the Future Through the Past.* Cincinnati, OH: Pinnaflex Educational Resources, Inc.

Fichman, R. G. (2001). Aggregation in the measurement of IT-related innovation. *MIS Quarterly,* 25(4), 427-455.

Fichman, R. G., & Kemerer, C. F. (1997). The assimilation of software process innovations: An organizational learning perspective. *Management Science*, 43(1), 1345-1363.

Fiol, C. M., & Lyles, M. A. (1985). Organizational learning, *Academy of Management Review*, 10(4), 803-813.

Fisher, C. W., & Kingma, B. R. (2001). Critically of data quality as exemplified in two disasters. *Information & Management*, 39(2), 109-116.

Flynn, B. B., Sakakibara, S., Schroeder, R. G., Bates, K., & Flynn, J. (1990). Empirical research methods in operations management. *Journal of Operations Management*, 9(2), 250-284.

Ford, R. C., & Fottler, M. D. (1995). Empowerment: A matter of degree. *Academy of Management Executive*, 9(3), 21-31.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39-50.

Foster, R. (1986). *Innovation: The attacker's advantage*. New York, NY: Summit Books.

Fulk, J. (1993). Social construction of communication technology. *Academy of Management Journal*, 36(5), 921-950.

Fulk. J., Schmitz, J. & Ryu, D. (1995). Cognitive elements in the social construction of communication technology. *Management Communication Quarterly*, 8(3), 259-288.

Garvin, D. A. (1993). Building a learning organization. *Harvard Business Review*, 71(4), 78-91.

Gatingnon, H., & Robertson, T. S. (1989). Technology diffusion: An empirical test of competitive effects. *Journal of Marketing*, 53(1), 35-49.

Gatingnon, H., Tushman, M., Smith, W., & Anderson, P. (2002). A structural approach to assessing innovation: Construct development of innovation locus, type, and characteristics, *Management Science,* 48(9), 1103-1122.

Gefen, D, Karahanna, E., & Straub, D. W. (2003). Trust and TAM in online shopping: An integrated model, *MIS Quarterly*, 27(1), 51-90.

Gerbing, D. W., & Anderson, J. C. (1988). An updated paradigm for scale development incorporating unidimensionality and its assessment. *Journal of Marketing Research*, 25(May), 186-192.

Gerwin, D., & Moffat, L. (1997). Withdrawal of team autonomy during concurrent engineering. *Management Science*, 43(9), 1275-1287.

Ghemawat, P. (1991). Market incumbency and technological inertia. *Marketing Science*, 10(2), 161-171.

Gibbert, M., & Krause, H. (2002). Practice exchange in a best practice market place. In. T. H. Davenport & G. J. B. Probst (Eds.), *Knowledge management case book*, Erlangen, Germany: Publics Corporate Publishing, 89-105.

Gist, M. E. (1987). Self-efficacy: Implications for organizational behavior and human resource management. *Academy of Management Review*, 12, 472-485.

Goerzen, A., & Beamish, P. W. (2005). The effect of alliance network diversity on multinational enterprise performance. *Strategic Management Journal*, 26(4), 333-354.

Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge management: An organizational capabilities perspective. *Journal of Management Information Systems*, 18(1), 185-214.

Goodhue, D. L. (1995). Understanding user evaluations of information systems. *Management Sciences*, 41 (12), 1827-1844.

Grant, R. M. (1996a). Prospering in dynamically competitive environments: Organizational capability as knowledge integration. *Organization Science*. 74(4), 375-387.

Grant, R. M. (1996b). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, 17(10), 109-122.

Gray, P. H., & Meister, D. B. (2004). Knowledge sourcing effectiveness. *Management Science*, 50(6), 821-834.

Green, S., Garvin, M., & Smith L. (1995). Assessing a multidimensional measure of radical innovation. *IEEE Transactions on Engineering Management*, 42(3), 203-214.

Griffith, T. L., Sawyer, J. E., & Margaret, A. N. (2003). Vritualness and knowledge in teams: managing the love triangle in organization, individuals, and information technology, MIS Quarterly, 27(2), 265-287.

Grover, V., & Davenport, T. H. (2001). General perspectives on knowledge management: Fostering a research agenda. *Journal of Management Information Systems*, 18(1), 5-21.

Grover, V., & Goslar, M. D. (1993). The initiation, adoption and implementation of telecommunications technologies in U.S. organizations. *Journal of Management Information Systems*, 10(1), 141-163.

Grover, V., Fiedler, K., & Teng, J. (1997). Empirical evidence on Swanson's tri-core model of Information Systems Innovation. *Information Systems Research* 8(3), 1997, 273-287.

Gupta, A., & Govindarajan, V. (2000). Knowledge flows within multinational corporations. *Strategic Management Journal,* 21(4), 2000, 473-496.

Guzzo, R. A., Yost, P. R., Campbell, R. J., & Shea, G. P. (1993). Potency in groups: Articulating a construct. *British Journal of Social Psychology*, 32, 87-106.

Hackman, J. R. (1987). The design of work teams. In J. Lorshe (Ed.), *Handbook of organizational behavior,* Englewood Cliffs, NJ: Prentice-Hall, 315-342.

Hackman, J. R., & Oldham, G. R., (1980). *Work design Reading*, MA: Addison-Wesley

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1995). *Multivariate data analysis with readings* (4th Ed). Englewood Cliffs, NJ: Prentice Hall.

Hambrick, D. C., Cho, T., & Chen, M. (1996). The influence of top management team heterogeneity on firms' competitive moves. *Administrative Science Quarterly*, 41, 659-684.

Hansen, M. T. (1999). The search-transfer problem: The role of weak times in sharing knowledge across organization subunits. *Administrative Science Quarterly*, 44, 82-111.

Harrison, D. A., Price, K. H., Gavin, J. H., & Florey, A. T. (2002). Time, teams, and task performance: Changing effects of surface- and deep-level diversity on group functioning. *Academy of Management Journal*, 45(5), 1029-1045.

Harrison, R (1983). Strategies for a new age. *Human Resource Management*, 22(3), 209-235.

Hart, P. J., & Saunders, C. S. (1998). Emerging electronic partnerships: Ancedents and dimensions of EDI use from supplier's perspective. *Journal of Management Information Systems*, 14(4), 87-111.

Heck, R. H. (1998). Factor analysis: exploratory and confirmatory approaches, In. G. A. Marcoulides (Ed.), *Modern methods for business research*. Mahwah, NJ: Lawrence Erlbarum Associates, 177-215.

Hedlund, G. (1994). A model of knowledge management and the N-form corporation. *Strategic Management Journal*, 15(3), 73-91.

Henderson, J. C., & Lee, S. (1992). Managing I/S design teams: A control theories perspective. *Management Science*, 38(6), 757-777.

Henderson, R. M. (1994). Managing innovation in the information age. *Harvard Business Review*, 72(1), 100-105.

Henderson, R. M., & Clark, K. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of existing firms. *Administrative Science Quarterly*, 35(1), 9-30.

Henderson, R. M., & Cockburn, I. (1994). Measuring competence? Exploring firm effects in pharmaceutical research. *Strategic Management Journal*, 15(Winter Special Issue), 63-84.

Hendrickson, A., Massey, P., & Cronan, T. (1993). On the test-retest reliability of perceived usefulness and perceived ease-of-use scales. *MIS Quarterly*, 17(2), 227-230.

Henry, R. A. (1995). Improving group judgment accuracy: Information sharing determining the best member. *Organizational Behavior and Human Decision Processes,* 62(2), 190-197.

Hinds, P. J. & Weisband, S. P. (2003). Knowledge sharing and shared understanding in virtual teams. In C. B. Gibson and S. G. Cohen (Eds.), *Virtual Teams That Work: Creating Conditions for Virtual Team Effectiveness.* San Francisco, CA: Jossey-Bass, pp. 21-36.

Hoegl, M., Parboteeah, K. P., & Munson, C. (2003). Team-level antecedents of Individuals' knowledge networks. *Decision Sciences*, 34(4), 741-770.

Hong, P., Vonderembse, M., Doll, W., & Nahm, A. (2005). Role change of design engineers in product development. *Journal of Operations Management*, 24(1), 63-79.

Hollingshead, A. B. (1998). Communication, learning, and retrieval in transactive memory system. *Journal of Experimental Social Psychology,* 34(5), 601-606.

Hu, J., Huang, K., Kuse, K., Su G., & Wang, K. (1998). Customer information quality and knowledge management: a case study using knowledge cockpit. *Journal of Knowledge Management*, 1(3), 225-236.

Hu, L. T., & Bentler, P. (1995). Evaluating model fit. In. R. H. Hoyle (Ed.) Structural equation modeling: Concepts, issues, and application. Thousand Oaks, CA: Sage, 76-99.

Huang, K. T., Lee, Y. W., & Wang, R.Y. (1999). *Quality information and knowledge.* New York, NY: Prentice-Hall.

Huber, G. (1991). Organizational learning: The contributing processes and the literatures. *Organization Science,* 2(1), 88-115.

Hult, G. (2003). An integration of thoughts on knowledge management, *Decision Sciences*, 34(2), 89-195.

Hutchins, E. (1991). The social organization of distributed cognition," in L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), *Perspective of socially shared cognition*, Washington, DC: American Psychological Association.

Hyatt, D. E., & Ruddy, T. M. (1997). An examination of the relationship between work group characteristics and performance: Once more into the breech. *Personnel Psychology*, 50(3), 553-585.

Ibarra, H. (1993). Network centrality, power, and innovation involvement: Determinants of technical and administrative roles. *Academy of Management Journal*, 36(3), 471-501.

Igbaria, M., Guimaraes, T., & Davis, G. (1995). Testing the determinants of microcomputer usage via a structured equation model. *Journal of Management Information Systems*, 11(4), 87-114.

Inkpen, A. & Dinur, A. (1998). Knowledge management processes and international joint ventures, *Organization Science*, 9(4), 454-468.

Janz, B. D. (1999). Self-directed teams in IS: Correlates for improved systems development work outcomes. *Information and Management*, 35(3), 171-192.

Janz, B. D., & Prasarnphanich, P. (2003). Understanding the antecedents of effective knowledge management: The importance of a knowledge-centered culture. *Decision Sciences*, 34(2), 351-384.

Jehn, K. A. (1997). A qualitative analysis of conflict types and dimensions in organizational groups. *Administrative Science Quarterly*, 42, 530-557.

Jones, G. R. (1986). Socialization tactics, self-efficacy, and newcomers' adjustments to organizations. *Academy of Management Journal*, 29, 262-279.

Jöreskog, K. G., & Sörbom, D. (1986). *LISREL VI: Analysis of linear structural relationships by maximum likelihood, instrumental variables, and least squares methods.* Moorsville, IN: Scientific Software International, Inc.

Jöreskog, K. G., & Sörbom, D. (1993). *LISREL 8 user's reference guide*. Chicago: Scientific Software International, Inc.

Juran, J. M. (1989). *Juran on leadership for quality an executive handbook*. New York, NY: The Free Press.

Juran, J. M., & Gryna, F. M. (1980). *Quality planning and analysis* (2nd ed.). New York, NY: McGraw-Hill.

Kahn, B. K., Strong, D. M., & Wang, R. Y. (2002). Information quality benchmarks: Product and service performance. *Communications of the ACM*, 45(4), 184-192.

Kalay, Y. E. (1989). *Modeling objects and environments.* New York, NY: Wiley.

Kankanhalli, A., Tan, B. C., & Wei, K. (2005). Contributing knowledge to electronic knowledge repositories: an empirical investigation. *MIS Quarterly*, 29(1), 113-143.

Kanter, R. M. (1968). Commitment and social organization A study of commitment mechanisms in utopian communities *American Sociological Review*, 33(4), 499-517.

Kanter, R. M. (1983). *The change masters.* New York, NY: Simon & Schuster.

Kanter, R. M. (1988). When a thousand flowers bloom: structural, collective, and social conditions for innovation in organizations. In L. L. Cummings & B. Staw (Eds.), *Research in Organizational Behavior.* Greenwich, CT: JAI Press, Vol. 10.

Kanter, R. M. (1989). The new managerial work. *Harvard Business Review*, 67(6), 85-92.

Keller, R. T. (2001). Cross-functional project groups in research and new product development: Diversity, communications, job stress, and outcomes. *Academy of Management Journal*, 44(3), 547-555.

Kessler, E. H., & Chakrabarti, A. K. (1996). Innovation speed: A conceptual model of context, antecedents, and outcomes. *Academy of Management Review*, 21(4), 1143-1191.

Kieras, D. E., & Polson, P. G. (1985). An approach to the formal analysis of user complexity, International Journal of Man Machine Studies, 22(4), 365-394.

Kirkman, B. L., & Rosen, B. (1997). A model of work team empowerment. In R. W. Woodman & W. A. Pasmore (Eds.), *Research in organizational change and development*, Greenwich, CT: JAI Press, 131-167.

Kirkman, B. L. & Rosen, B. (1999). Beyond self-management: The antecedents and consequences of team empowerment. *Academy of Management Journal*, 42(1), 58-74.

Kirkman, B. L., & Rosen, B. (2000). Powering up teams. *Organizational Dynamics*, 28, (3), 48-65.

Kirkman, B. L., Tesluk, P. E., & Gibson, C. B. (2004). The impact of team empowerment on virtual team performance: The moderating role of face-to-face interaction. *Academy of Management Journal*, 47(2), 175-192.

Knight, D., Pearce, C. L., Smith, K. G., Olian, J. D., Sims, H. P., Smith, K. A., & Flood, P. (1999). Top management team diversity, group process, and strategic consensus. *Strategic Management Journal*, 20(5), 445-465.

Knight, K. E. (1967). A descriptive model of the intra-firm innovation process. *Journal of Business*, 40, 478-496.

Ko, D., Kirsch, L. J., & King, W. R. (2005). Antecedents of knowledge transfer from consultants to clients in enterprise system implementations, *MIS Quarterly*, 29(1), 59-85.

Koberg, C. S., Boss, R. W., Senjem, J. C., & Goodman, E. A. (1999). Antecedents and outcomes of empowerment: Empirical evidence from the health care industry. *Group & Organization Management*, 24(1), 71-91.

Kogut, B., & Zander, U. (1992). Knowledge of the firm. Combinative capabilities, and the replication of technology. *Organization Science*, 3(3), 383-397.

Koufteros, X. (1999). Testing a model of pull production: a paradigm for manufacturing research using structural equation modeling. Journal of Operations Management, 17(4), 467-488.

Koufteros, X., Vonderembse, M. A., Doll, W. J. (1998). Developing measures of time-based manufacturing. *Journal of Operations Management*, 16(1), 21-41.

KPMG Management Consulting (1998a). *Case Study: Building a Platform for Corporate Knowledge.*

KPMG Management Consulting. (1998b). *Knowledge Management: Research Report.*

Landis, J. R., & Koch, C. G. (1977). The measurement of observed agreement for categorical data. *Biometrics*, 33 (March), 159-174.

Lawler, E. E. (1992). *The ultimate advantage*. San Francisco, CA: Jossey-Bass.

Lee, Y. W. (2003). Crafting rules: Context-reflective data quality problem solving. Journal of Management information systems, 20(3), 93-119.

Lee, Y. W., & Strong, D. M. (2003). Knowing-why about data processes and data quality. *Journal of Management Information Systems*, 20(3), 13-39.

Lee, Y. W., Strong, D. M, Kahn, B. K, & Wang R. Y. (2002). AIMQ: A methodology for information quality assessment. *Information & Management*, 40 (2), 133-146.

Leidner, D. (2000). Editorial. *Journal of Strategic Information Systems* 9(2-3), 101-105.

Leidner, D. E, & Kayworth, T. (2006). Review: a review of culture in information systems research: toward a theory of information technology culture conflict, *MIS Quarterly*, 30(2), 357-399.

Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal*, 13(Summer), 111-125.

Leonard-Barton, D. (1995). *Wellsprings of knowledge: Building and sustaining the source of innovation*. Boston, MA: Harvard Business School Press.

Leonard-Barton, D., & Sinha, D. K. (1993). Developer-user interaction and user satisfaction in internal technology transfer. *Academy of Management Journal*, 36(5), 1125-1139.

Lessard, D. R., & Zaheer, S. (1996). Breaking the silos: Distributed knowledge and strategic responses to violate exchange rates. *Strategic Management Journal*, 17(7), 513-534.

Levinthal, D. A. & March, J. G. (1993). The myopia of learning, *Strategic Management Journal*, 14(Winter Special Issues), 95-112.

Liang, D. W., Moreland, R. L., & Argote, L. (1995). Group versus individual training and group performance: The mediating role of transactive memory. *Personality and Social Psychology Bulletin, 21(4),* 384-393.

Liden, R. C., Wayne, S. J., & Sparrowe, R. T. (2000). An examination of the mediating role of psychological empowerment on the relations between the job, interpersonal relationships, and work outcomes. *Journal of Applied Psychology*, 85(5), 407-416.

Lillrank, P. (2003). The quality of information. *International Journal of Quality and Reliability Management*, 20(6), 691-703.

Lin, L., Geng, X., & Whinston, A. (2005). A sender-receiver framework for knowledge transfer, *MIS Quarterly*, 29(2), 197-219.

Linderman, K., Schroeder, R. G., Zaheer, S., Liedtke, C., & Choo, A. S. (2004). Integrating quality management practices with knowledge creation processes. *Journal of Operations Management*, 22, 589-607.

Lindsay, P. H., & Norman, D. A. (1977). *Human information processing*, Orlando, FL: Academic Press.

Lipnak, J., & Stamps, J. (1993). *The teamnet factor: brining the power of boundary crossing into the heart of your business*. Exxex Junction, VT: Oliver Wright Co.

Lippman, S. A., & Rumelt, R. P. (1982). Uncertain limitability: An analysis of interfirm differences in efficiency under competition, *Bell Journal of Economics*, 13(2), 418-438.

Littlepage, G., W., Robinson, K., & Reddington, K. (1997). Effects of task experience and group experience on group performance, member ability, and recognition of expertise. *Organizational Behavior and Human Decision Processes*, 69(2), 133-147.

Lovelace, K., Shapiro, D, L., Weingart, L. R. (2001). Maximizing cross-functional new product teams' innovativeness and constraint adherence. *Academy of Management Journal*, 44(4), 779-793.

Machlup, F. (1983). Semantic quirks in studies of information. In F. Machlup, & U. Mansfield (Eds.), *The Study of Information*, New York, NY: John Wiley.

Madnick, S., Richard, W. Y, & Xian, X. (2003). The design and implementation of a corporate householding knowledge processor to improve data quality. *Journal of Management Information Systems*, 20, 41-69.

Mainiero, L. A. (1986). Coping with powerlessness: The relationship of gender and job dependency to empowerment-strategy usage. *Administrative Science Quarterly*, 31(4), 633-653.

Malhotra, A., Majchrzak, A., Carman, R., & Lott, V. (2001). Radical innovation without collocation: A case study at Boeing-Rocketdyne. *MIS Quarterly*, 25(2), 229-249.

Malhotra, Y. (2000). Knowledge management and new organization forms: A framework for business model innovation," In Y. Malhotra (Ed.), *Knowledge management and virtual organizations*, Hershey, PA: Idea Group Publishing, 177-179.

Mark, G. (2002). Conventions for coordinating electronic distributed work: A longitudinal study of groupware use, In. P. J. Hinds & S. Kiesler (Eds.), *Distributed work,* Cambridge, MA: MIT Press.

Markus, M. L., Majchrzak, A., & Gasser, L. (2002). A design theory for systems that support emergent knowledge processes. *MIS Quarterly*, 26(3), 179-212.

Marsche, H. W., & Hocevar, D. (1985). Application of confirmatory factor analysis of the study of self-concept: first and higher order factor models and their invariances across groups. *Psychological Bulletin*, 97(3), 562-582.

Massetti, B., & Zmud, R. W. (1996). Measuring the extent of EDI usage in complex organizations: Strategies and Illustrative Examples. *MIS Quarterly*, 20(3), 331-345.

Massey, A. P., Montoya-Weiss, M. M, & O'Driscoll, T. (2002). Knowledge management in pursuit of performance: Insights from Nortel networks. *MIS Quarterly,* 26(3), 269-289.

Massey, A. P., & Montoya-Weiss, M. M. (2006). Unraveling the temporal fabric of knowledge conversion: A model of media selection and use, *MIS Quarterly*, 30(1), 99-114.

Mathieson, K. (1991). Predicting user intentions: Comparing the technology acceptance model with the theory of planned behavior. *Information Systems Research*, 2(3), 173-191.

McDermott, R. (1999). Why information technology inspired but cannot deliver knowledge management. *California Management Review*, 41(4), 103-117.

McDonough, E. F., III (1993). Faster new product development: Investigating the effects of technology and characteristics of the project leader and team. *Journal of Product Innovation Management*, 10(3), 241-250.

McGee, J. E, & Dowling, M. J. (1994). Using R&D cooperative agreements to leverage managerial experience: a study of technology-intensive new ventures. *Journal of Business Venturing*, 9, 33-48.

Meynyk, S. A., Sroufe, R. P., & Calantone, R. (2003). Assessing the impact of environmental management systems on corporate and environmental performance. *Journal of Operations Management*, 21(3), 329-351.

Menon, T., & Pfeffer, J. (2003). Valuing internal vs. external knowledge: Explaining the preference for outsiders. *Management Science*, 49(4), 497-513.

Meyer, A. D., & Goes, J. B. (1988). Organizational Assimilation of innovations: A multilevel contextual analysis, *Academy of Management Journal*, 31(4), 897-923.

Mikkelsen, A., Ogaard, T., & Lovrich, N. (2000). Modeling the effects of organizational setting and individual coping style on employees subjective health, job satisfaction, and commitment. *Public Administration Quarterly*, 24(3), 371-397.

Miller, D., & Friesen, P. H. (1982). Innovation in conservative and entrepreneurial firms: Two models of strategic momentum. *Strategic Management Journal*, 3(1), 233-250.

Miner, A. S. & Meziah, S. J. (1996). Ugly duckling no more: Pasts and futures of organizational learning research. *Organization Science*, 7(1), 88-100.

Miner, A. S., Bassoff, P., & Moorman, C. (2001). Organizational improvisation and learning: A field study, *Administrative Science Quarterly,* 46(2), 304-337.

Mistzal, B. A. (1996). *Trust in modern societies*. Cambridge, England: Polity Press.

Monoya-Weiss, M. M., & Calantone, R. (1994). Determinants of new product performance: A review and meta-analysis. *Journal of Product Innovation Management*, 11(5), 397-417.

Moreland, R. L. (1999). Transactive memory, In L. L. Thomson, J. M. Levine, & D. M. Messick (Eds), *Shared cognition in organizations: The management of knowledge,* Hillsdale, NJ: Erlbaum, 245-265.

Moreland, R. L., & Myaskovsky, L. (2000). Exploring the performance benefits of group training: Transactive memory or improved communication? *Organizational Behavior and Decision Process,* 82(1), 117-133.

Mumford, M., & Gustafson, S. (1988). Creativity syndrome: Integration, application, and innovation. *Psychological Bulletin*, 103(1), 27-43.

Murray, A. I. (1989). Top management group heterogeneity and firm performance. *Strategic Management Journal*, 10, 125-141.

Nahm, A., Vonderembse, M., & Koufteros, X. (2003). The impact of organizational structure on time-based manufacturing and plant performance. *Journal of Operations Management*, 21(3), 281-306.

Neilsen, E. H. (1986). Empowerment strategies: Balancing authority and responsibility. In S. Strivastva & Associates (Eds.), *Executive Power,* San Francisco, CA: Jossey-Bass, 78-110.

Nelson, R. (1995). Recent evolutionary theorizing about economic change. *Journal of Economic Literature,* 33(1), 48-90.

Nelson, R. R., Todd, P. A., & Wixom, B. H. (2005). Antecedents of information and system quality: An empirical examination within the context of data warehousing. *Journal of Management Information Systems*, 21(4), 199-235.

Nilakanta, S., & Scamell, R. W. (1990). The effect of information sources and communication channels on the diffusion of an innovation in a data base environment. *Management Science*, 36(1), 24-40.

Nonaka, I. (1988). Toward middle-up-down management: Accelerating information creation. *Sloan Management Review*, 29(3), 9-18.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science,* 5(1), 14-37.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: how Japanese companies create the dynamics of innovation.* New York, NY: Oxford University Press.

Nonaka, I. & Teece, D.J. (Eds.) (2001). *Managing industrial knowledge: creating, transfer, and utilization*. London: Sage.

Nunnally, J. C. (1967). *Psychometric Theory*, New York, NY: McCraw-Hill.

Nunnally, J. C. (1978). *Psychometric Theory*, New Yokr, NY: McCraw-Hill.

O'Dell, C., & Grayson, C. J. (1998). If only we knew what we know: Identification and transfer of internal best practices. *California Management Review*, 40(3), 154-174.

Oldham, G. R., & Cummings, A. (1996). Employee creativity: personal and contextual factors at work. *Academy of Management Journal*, 39(3), 607-634.

Orlikowski, W. J. (1996). Learning from notes: Organizational issues in groupware implementation. In R. Kling (Ed.), *Computerizing and Controversy*. New York, NY: Academic Press, 173-189.

Orr, K. (1998). Data quality and systems theory. *Communications of the ACM*. 41(2), 66-71.

Osterloh, M., & Frey, B. (2000). Motivation, knowledge transfer, and organizational forms. *Organization Science*, 11(5), 538-550.

Parker, S. K., & Axtell, C. M. (2001). Seeing another viewpoint: Antecedents and outcomes of employee perspective taking. *Academy of Management Journal*, 44(6), 1085-1100.

Pava, C. (1983). *Managing New Office Technology*. New York, NY: Free Press.

Pelled, L. H., Eisenhardt, K. M., & Xin, K. R. (1999). Exploring the black box: An analysis work group diversity, conflict, and performance. *Administrative Science Quarterly*, 44, 1-28.

Penrose, E. T. (1959). *The Theory of the Growth of the Firm*. New York, NY: Wiley.

Pentland, B. T. (1995). Information systems and organizational learning: The social epistemology of organizational knowledge systems, *Accounting Management and Information Technologies*, 5(1), 1-21.

Pfeffer, J., & Sutton, R. I. (2000). *The knowledge-doing gap: How smart companies turn Knowledge into action*. Boston, MA: Harvard Business School Press.

Piaget, J. & Inhelder, B. (1973). *Memory and intelligence*. New York, NY: Basic Books.

Piaget, J. (1932). *The moral judgement of the child*. London: Paul Kegan.

Pipino, L. L, Lee, Y. W., & Wang, R. Y. (2002). Data quality assessment. *Communications of the ACM*, 45 (4), 211-218.

Pitman, B. (1994). How to build a learning culture to cope with rapid change. *Journal of Systems Management*, 45(7), 27.

Polanyi, M. (1962). *Personal knowledge.* (2nd ed.) Chicago, IL: University of Chicago Press.

Polanyi, M. (1967). *The tacit dimension*, London: Routledge and Keoan Paul.

Polanyi, M. (1975). *Personal knowledge*, In M. Polayni & H. Prosch (Eds.), Chicago, IL: University of Chicago Press, 22-45.

Polson, P. G. (1987). A quantitative theory of human-computer interaction. In J. M. Carroll (Ed), *Interfacing Thought*. Cambridge, MA: MIT Press, 184-235.

Poston, R. S., & Speier, C. (2005). Effective use of knowledge management systems: A process model of content ratings and credibility indicators. *MIS Quarterly*, 29(2), 221-244.

Premkumar, G., & King, W. R. (1994). Organizational characteristics and information systems planning: An empirical study. *Information Systems Research*, 5(2), 75-109.

Pressman, R. S. (1997). *Software engineering: A practitioner's approach* (4th ed.). New York, NY: McGraw-Hill.

Preston, A. M. (1991). The 'problem' in and of management information systems, *Accounting, Management and Information Technologies*, 1(1), 43-69.

Purser, R. E., Pasmore, W. A., & Tenkasi, R. V. (1992). The influence of deliberations on learning in new product development teams. *Journal of Engineering and Technology Management*, 9(1), 1-28.

Rai, A., & Howard, G. S. (1994). Propagating CASE usage for software development: An empirical investigation of key organizational correlates, *Omega*, 22(2), 133-147.

Rai, A., Lang, S. S., & Welker, R. B. (2002). Assessing the validity of IS success models: An empirical test and theoretical analysis. *Information Systems Research*, 13(1), 50-69.

Redman, T. C. (1996). *Data quality for the information age*. Boston, MA: Artech House.

Reichers, A. E., & Schneider, B. (1990). Climate and culture: an evolution of constructs. In B. Schneider (Ed.), *Organizational Climate and Culture*. San Francisco, CA: Jossey-Bass.

Resnick, L. B. (1991). Shared cognition: Thinking as social practice, in L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), *Perspective of socially shared cognition*, Washington, DC: American Psychological Association.

Robey, D. (1979). User attitudes and management information use. *Academy of Management Journal,* 22(3), 527-538.

Rogers, E. M. (1995). *Diffusion of Innovations* (4^{th} ed.), New York, NY: The Free Press.

Rose, G & Straub, D. W. (1998). Predicting general IT use: Applying TAM to the Arabic world. *Journal of Global Information Management,* 6(3), 39-46.

Ruggles, R. (1998). The state of the notion: Knowledge management in practice. *California Management Review.* 40(3), 80-89.

Ruppel, C. P., & Harrington, S. J. (2001). Spreading knowledge through intranet: An analysis of the organizational culture leading to intranet adoption and use. *IEEE Transactions on Professional Communications*, 44(1), 37-52.

Sackmann, S. A. (1992). Culture and sub-cultures: an analysis of organizational knowledge. *Administrative Science Quarterly*, 37(1), 141-161.

Sabherwal, R., & Becerra-Fernandez, I. (2003). An empirical study of the effect of knowledge management processes at individual, group, and organizational levels. *Decision Sciences*, 34(2), 225-260.

Safoutin, M. J., & Thurston, D. L. (1993). A communication-based technique for interdisciplinary design team management. *IEEE Transaction on Engineering Management,* 40(4), 360-372.

Saga, V. L., & Zmud, R. W. (1993). The nature and determinants of IT acceptance, routinization, and infusion. In L. Levine (Ed.), *Diffusion, Transfer and Implementation of Information Technology*, Amsterdam: Elsevier Science.

Sage, A. P. (1992). *Systems Engineering*, New York, NY: John Wiley & Sons.

Salancik, G. R., & Pfeffer, J. (1982). Who gets power – and how they hold on to it: A strategic-contingency model of power, In M. L. Tushman, & W. L. Moore (Eds.), *Readings in the Management of Innovation*, Boston, MA: Pitman.

Sanderson, S., & Uzumeri, M. (1995). Product platforms and dominant designs: The case of Sony's Walkman. *Research Policy*, 24, 583-607.

Sapienza, A. M. (1985). Believing is seeing: how cultures influence the decision top managers make. In R. H. Kilmann, M. J. Saxton, R. Serpa, and Associates (Eds.), *Gaining Control of the Corporate Culture*. San Francisco, CA: Jossey-Bass.

Schultz, R. L. & Slevin, D. P. (1975). Implementation and organizational validity: An empirical investigation, In R. L. Schultz and D. P. Slevin (Eds.), *Implementing operations research / management science*, New York, NY: American Elsevier, 153-182.

Schulz, M. (2001). The uncertain relevance of newness: Organizational learning and knowledge flows. *Academy of Management Journal*, 44(4), 661-681.

Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal*, 37(3), 580-607.

Segars, A. H., & Grover, V. (1993). Re-examining perceived ease-of-use and usefulness: A confirmatory factor analysis. *MIS Quarterly*, 17(4), 517-525.

Sen, K. (2001). Does the measure of information quality influence survival bias? *International Journal of Quality and Reliability Management*, 18(9), 967-981.

Shan, W., Walker, G., & Kogut, B. (1994). Interfirm cooperation and startup innovation in the biotechnology industry, *Strategic Management Journal*, 15(5), 387-394.

Silver, M. S. (1991). *Systems that Support Decision Makers. Description and Analysis,* Chichester, England: John Wiley and Son.

Simon, H. A. (1991). Bounded rationality and organizational learning. *Organization Science*, 2(1), 125-134.

Sjoberg, I., Olsson, G., & Salay, F. (1983). Cathectic orientation, goal setting and mood *Journal of Personality Assessment*, 47(3), 307-313.

Slater, S. F., & Narver, J. C. (1995). Market orientation and the learning organization. *Journal of Marketing*, 59(3), 63-74.

Souder, W. E., & Moenaert, R. K. (1992). Integrating marketing and R&D project personnel within innovation projects: An information uncertainty model. *Journal of Management Studies*, 29(4), 485-512.

Spector, P. E. (1986). Perceived control by employees: A meta-analysis of studies concerning autonomy and participation at work. *Human Relations*, 39(11), 1005-1016.

Spender, J. C. (1996a). Making knowledge the basis of a dynamic theory of the firm, *Strategic Management Journal,* 17(4), 45-62.

Spender, J. C. (1996b). Organizational knowledge, learning, and memory: Three concepts in search of a theory, *Journal of Organizational Change Management* 9(1), 63-78.

Spreitzer, G. M. (1995). Psychological empowerment in the workplace: dimensions, measurement, and validation. *Academy of Management Journal,* 38(5), 1442-1465.

Spreitzer, G. M. (1996). Social structural characteristics of psychological empowerment. *Academy of Management Journal*, 39(2), 483-504.

Spreitzer, G. M., De Janasz, S. C., & Quinn, R. E. (1999). Empowered to lead: The role of psychological empowerment in leadership. *Journal of Organizational Behavior,* 20(4) 511-526.

Spreitzer, G. M., Kizilos, M. A., & Nason, S. W. (1997). A dimensional analysis of the relationship between psychological empowerment and effectiveness, satisfaction, and strain. *Journal of Management*, 23(5), 679-704.

Steiger, J. H., & Lind, J. C. (1980). Statistically based tests for the number of common factors. Paper presented at the *Psychometric Society Annual Meeting*, Iowa City, IA.

Stevens, M. J., & Campion, M. A. (1994). The knowledge, skill, and ability requirements for teamwork: implications for human resource management. *Journal of Management*, 20(2), 503-529.

Straub, D. W., Keil, M., & Brennan, W. (1997) Testing the technology acceptance model across cultures: A three country study. *Information and Management*, 33(1), 1-11.

Strong, D. M., Lee Y. W., & Wang, R. Y. (1997). Data quality in context. *Communications of the ACM*, 40(5), 103-110.

Subramanian, G. H. (1994). A replication of perceived usefulness and perceived ease-of-use measurement. *Decision Sciences*, 25(5/6), 863-874.

Sundstrom, E. (1999). The challenges of supporting work team effectiveness. In E. Sundstrom & Associates (Eds.) *Supporting work teak effectiveness: Best management practices for fostering high performance*, San Francisco, CA: Jassey-Bass, 3-23.

Swamidass, P. M., & Aldridge, M. D. (1996). Ten rules for timely task completion in cross-functional teams. *Research-Technology Management*, 39(4), 12-13.

Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm, *Strategic Management Journal*, 17(Winter Special Issue), 27-43.

Tayi, G. K., & Ballou, D. P. (1998). Examining data quality – Introduction. *Communication of the ACM*, 41(2), 54-57.

Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research,* 6(2), 144-176.

Teece, D. J. & Pisano, G. (1994). Dynamic capabilities of firms. *Industrial and Corporate Change*, 3(3), 537-556.

Teece, D. J. (1998). Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets. *California Management Review*, 40(3), 55-79.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.

Thomas, K. W., & Tymon, W. G. Jr. (1993). Empowerment Inventory, Tuxedo, NY: Xicom.

Thomas, K. W., & Velthouse, B. A. (1990). Cognitive elements of empowerment: An "interpretive" model of intrinsic task motivation. *Academy of Management Review*, 15(4), 666-681.

Thomas-Hunt, M. C., & Gruenfeld, D. H. (1998). A foot in two worlds: The participation of demographic boundary spanners in work groups. In M. A. Neale, E. A. Mannix, & D. H. Gruenfeld (Eds), *Research on managing groups and teams*, Stanford, CT: JAI Press, 39-57.

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management,* 29(1), 28-45.

Tozer, G. (1999). *Metadata management for information control and business success.* Norwood, MA: Artech House.

Trafimow, D., & Sniezek, J. A. (1994). Perceived expertise and its effect on confidence. *Organizational Behavior and Human Decision Processes,* 57(2), 290-302.

Tu, Q., Vonderembse, M., & Ragu-Nathan, T.S. (2001). The impact of time-based manufacturing practices on mass customization and value to customer. *Journal of Operations Management*, 19(2), 201-217.

Tu, Q., Vonderembse, M., Ragu-Nathan, T.S., & Ragu-Nathan, B. (2004). Measuring modularity-based manufacturing practices and their impact on mass customization capability: A customer-driven perspective. *Decision Sciences*, 35(2), 147-168.

Tushman, M. L. & O'Reilly, C. A., III (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, 38(4), 8-30.

Tushman, M. L. (1979). Work characteristics and sub-unit communication structure. *Administrative Science Quarterly*, 22, 82-98.

Tyre, M. J., & von Hippel, E. (1997). The situated nature of adaptive learning in organizations, *Organization Science*, 8(1), 71-83.

Utterback, J. M. & Abernathy, W J (1975). A dynamic model of process and product innovation. *Omega*, 3(6), 639-656.

Van Mannen, J., & Barley, S. R. (1985). Cultural organization: fragments of a theory. In P. J. Frost, L. F. More, M. R. Louis, C. C. Lundberg, and J. Martin (Eds.), *Organizational Culture*, London: Sage Publications.

Venkatesh, V., & Davis, F. D., (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management Science*, 46(2), 186-204.

Venzin, M., von Krough, G., & Roose, J. (1998). Future research into knowledge management. In G. von Krough, J. Roos, & D. Kleine (Eds.), *Knowing in firms: understanding, managing and measuring knowledge*. Thousand Oaks, CA: Sage Publications, 26-66.

von Hellens, L. A. (1997), Information systems quality versus software quality. A discussion from a managerial, an organizational and an engineering viewpoint. *Information and Software Technology*, 39(12), 801-808.

Von Krogh, G. (1998). Care in knowledge creation. *California Management Review*, 40(3), 133-153.

Vroom, V. H. (1964). *Work and motivation*. New York, NY: Wiley.

Walton, R. E. (1985). From control to commitment in the workplace. *Harvard Business Review*, 63(2), 77-84.

Wang, R. Y. (1998). A production perspective on total quality management. *Communications of the ACM*, 41(2), 58-65.

Wang, R. Y, Lee, Y. W., Pipino, L. L., & Strong, D. M. (1998). Manage your information as a product. *Sloan Management Review*, 39(4), 95-105.

Wang, R. Y., & Strong, D. M. (1996). Beyond accuracy: What data quality means to data consumers. *Journal of Management Information Systems*, 12(4), 5-34.

Wasko, M. M., & Faraj, S. (2005). Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *MIS Quarterly*, 29(1), 35-57.

Watson, R. T. (1999). Data management; Databases and organizations (2nd ed.), New York, NY: John Wiley.

Webster, J. & Trevino, L. K. (1995). Rational and social theories as complementary explanations of communication media choices: Two policy capturing studies. *Academy of Management Journal*, 38(6), 1544-1572.

Weick, K. E., & Meader, D. K. (1993). Sensemaking and group support systems. In. L. Jessup & J. S. Valachich (Eds.), *Group support systems: New perspectives*. New York, NY: Macmillian.

Weick K. E., & Roberts, K. H. (1993). Collective minds in organizations: Heedful interrelating on flight decks. *Administrative Science Quarterly*, 38(3), 357-381.

Weick, K. E. (1993). The collapse of sensemaking in organizations: The Mann Gulch disaster. *Administrative Science Quarterly*, 38(4) , 628-652.

Weiss, D. J. (1970). Factor analysis in counseling research. *Journal of Counseling Psychology*, 17, 477-485.

Wellins, R. S., Byham, W. C., & Wilson, J. M. (1991). *Empowered teams: Creating self-directed work groups that improve quality, productivity, and participation.* San Francisco, CA: Jossey-Bass.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5(2), 171-180.

Wernerfelt, B. (1985). A resource-based view of the firm: Ten years later. *Strategic Management Journal* 16(2), 171-174.

Williams, R. J., Hoffman, J. J., & Lamont, B. T. (1995). The influence of top management team characteristics on M-form implementation time. *Journal of Managerial Issues*, 7(4), 466-480.

Wings, K. M. (1993). *Knowledge management foundations: Thinking about thinking – how people and organizations create, represent, and use knowledge*. Arlington, TX: Schema Press.

Woodman, R., Sawyer, J., & Griffin, R. (1993). Toward a theory of organizational creativity. *Academy of Management Review*, 18(2), 293-321.

Wrzesniewski, A. & Dutton, J. (2001). Crafting a job: Revisioning employees as active crafters of their work. *Academy of Management Review*, 28(2), 179-201.

Yang, W. L. (2003). Crafting rules: Context-reflective data quality problem solving. *Journal of Management Information Systems*, 20(3), 93-119.

Yin, R. K. (1979). *Changing urban bureaucracies*, Lexington, MA: Lexington Books.

Yli-Renko H, Autio E., & Sapienza, H. J. (2001). Social capital, knowledge acquisition, and knowledge exploitation in young technology-based firms. *Strategic Management Journal* 22(6), 587-613.

Young, G. J., Charns, M. P., & Shortell, S. M. (2001). Top management and network effects on the adoption of innovative management practices: A study of TQM in a public hospital system. *Strategic Management Journal*, 22(10), 935-951.

Zander, U., & Kogut, B. (1995). Knowledge and the speed of the transfer and imitation of organizational capabilities: an empirical test. *Organization Science*, 6(1), 76-92.

Zellmer-Bruhn, M. E. (2003). Interruptive events and team knowledge acquisition. *Management Science*, 49(4), 514-528.

Zirger, B. J., & Maidique, M. A. (1990). A model of new product development: An empirical test. *Management Science*, 36(7), 867-893.

Zmud, R. W. (1982). Diffusion of modern software practices: Influence of centralization and formalization. *Management Science*, 28(12), 1421-1431.

Zmud, R. W., & Apple, L. E. (1992). Measuring technology incorporation/infusion, *Journal of Product Innovation Management*, 9(2), 148-155.

Zuboff, S. (1982). New worlds of computer-mediated work. *Harvard Business Review*, 60(5), 142-152.

APPENDIX A: Measurement items entering Q-sort

KNOWLEDGE QUALITY

Intrinsic Knowledge Quality

- Knowledge possessed by my team is accurate.
- Knowledge possessed by my team is reliable.
- Knowledge possessed by my team is objective.
- Knowledge possessed by my team is unbiased.
- Knowledge possessed by my team is believable.
- Knowledge possessed by my team is current.
- Knowledge possessed by my team is updated.

Contextual Knowledge Quality

- Knowledge possessed by my team adds value for decision-making.
- Knowledge possessed by my team adds value to team's operations.
- Knowledge possessed by my team gives my team competitive advantage.
- Knowledge possessed by my team is relevant to our tasks.
- Knowledge possessed by my team is appropriate to our jobs.
- Knowledge possessed by my team is context-specific.

Actionable Knowledge Quality

- Knowledge possessed by my team is actionable.
- Knowledge possessed by my team is adaptable.
- Knowledge possessed by my team is expandable.
- Knowledge possessed by my team is applicable to our tasks.
- Knowledge possessed by my team increases effective actions.
- Knowledge possessed by my team provides the capacity to react to circumstances.

APPENDIX A: Measurement items entering Q-sort (continued)

INFORMATION SYSTEMS QUALITY

Perceived Ease of Use

- My team finds it easy to access the information systems to support decision-making.
- My team finds it easy to understand the information systems.
- My team finds it easy to become skillful at using the information systems.
- My team finds it easy to use the information systems.
- My team finds the information systems to be easily adaptable to conditions and requirements.
- My team finds interaction with the information systems to be clear and understandable.

Perceived Usefulness

- Using the information systems makes it easier for my team to do our tasks.
- Using the information systems improves team performance.
- Using the information systems increases team productivity.
- Using the information systems enhances team effectiveness.
- Using the information systems makes it useful for my team to implement our jobs.
- Using the information systems enables my team to accomplish tasks quickly.

Perceived Media Richness

- The information systems allow my team to give and receive timely feedback.
- The information systems allow my team to reduce message ambiguity.
- The information systems allow my team to use a variety of methods to communicate messages (text, graphics, and videos).
- The information systems allow my team to sense the presence of communication partners.
- The information systems allow my team to tailor messages to meet our needs.
- The information systems allow my team to communicate a variety of different cues (emotional tone, attitude, formality).

APPENDIX A: Measurement items entering Q-sort (continued)

COGNITIVE EMPOWERMENT

Meaning

- The work my team does is important to us.
- The work my team does is meaningful to us.
- The work requirements are consistent with the beliefs of my team.
- The work requirements are consistent with the values of my team.
- The work requirements are consistent with the behaviors of my team.

Competence

- My team is very confident about its ability to do work.
- My team has mastered the skills necessary for our tasks.
- My team believes that we can successfully complete our tasks.
- My team believes that we have the required abilities to perform tasks competently.
- My team expects to do the job well.

Self-determination

- My team has significant autonomy in determining how work is done.
- My team has the opportunity for independence and freedom in work execution.
- My team has a sense of choice in initiating work.
- My team has a sense of choice in planning work.
- My team makes decisions about how tasks are undertaken.
- My team makes decisions about when tasks are undertaken.

Impact

- My team's project has a significant impact on my organization.
- My team's project has a significant influence on what happens in my organization.
- My team's project has an influence on strategic outcomes in my organization.
- My team's project has an influence on administrative outcomes in my organization.
- My team has an influence on operating outcomes in my organization.

APPENDIX A: Measurement items entering Q-sort (continued)

KNOWLEDGE-SHARING CLIMATE

- Team members are willing to share their ideas among team members.
- Team members are willing to acquire knowledge from team members.
- Team members are willing to acquire knowledge from sources.
- Team members have abilities to interact with each other.
- Team members trust the value of knowledge possessed by other team members.
- Team members are encouraged to express their ideas even when they are contrary to their knowledge.
- Team members are encouraged to develop their ideas even when they are contrary to their knowledge.

APPENDIX A: Measurement items entering Q-sort (continued)

PERSPECTIVE TAKING

- Team members appreciate inter-disciplinary knowledge of other team members.
- Team members compare and contrast inter-disciplinary expertise in their group decisions.
- Team members take points of view of the rest of the team into account.
- Team members take useful perspectives from inter-disciplinary knowledge.
- Team members surface and reconcile different points of view.
- Team members consider unique perspectives of team members.

APPENDIX A: Measurement items entering Q-sort (continued)

PERSPECTIVE MAKING

- My team nurtures its potential perspectives.
- My team advances its unique perspectives.
- My team seeks to strengthen its knowledge.
- My team applies its perspectives to team's tasks.
- My team makes inter-disciplinary knowledge relevant to its tasks.
- My team makes sense of inter-disciplinary perspectives to team's tasks.
- My team makes inter-disciplinary perspectives to team's useful practices.

APPENDIX A: Measurement items entering Q-sort (continued)

INNOVATION

- Novel and useful systems, processes, products, or services are developed by my team.
- Novel and useful systems, processes, products, or services are produced by my team.
- Novel and useful systems, processes, products, or services are adopted from an outside organization by my team.
- Novel and useful systems, processes, products, or services are successfully implemented by my team.
- Novel and useful systems, processes, products, or services have become a stable and regular part of the organization.
- Time until novel and useful systems, processes, products, or services are adopted by my team is short.

APPENDIX B: Measurement items entering the pilot test

Construct	Sub-construct	Item	Acronym
Knowledge-sharing Climate	Willingness	My team members are willing to	
		access ideas from other team members	WLN1
		share their information among team members	WLN2
		use resources provided by team members	WLN3
		acquire knowledge from other team members	WLN4
	Trust	My team members trust	
		data possessed by other team members	TRS1
		information possessed by other team members	TRS2
		knowledge possessed by other team members	TRS3
		resources possessed by other team members	TRS4
	Openness	My team members are encouraged to	
		produce their ideas even when they differ from their knowledge	OPN1
		express their ideas even when they differ from their knowledge	OPN2
		develop their ideas even when they differ from their knowledge	OPN3
		Implement their ideas even when they differ from their knowledge	OPN4

APPENDIX B: Measurement items entering the pilot test (continued)

Construct	Sub-construct	Item	Acronym
Knowledge Quality	Intrinsic Knowledge Quality	Knowledge possessed by my team	
		is accurate	IKQ1
		is reliable	IKQ2
		is objective	IKQ3
		is unbiased	IKQ4
		is believable	IKQ5
		is current	IKQ6
		is updated	IKQ7
	Contextual Knowledge Quality	Knowledge possessed by my team	
		adds value for decision-making	CKQ1
		adds value to team's operations	CKQ2
		gives my team competitive advantage	CKQ3
		is relevant to our tasks	CKQ4
		is appropriate to our jobs	CKQ5
		is context-specific	CKQ6
	Actionable Knowledge Quality	Knowledge possessed by my team	
		is actionable	AKQ1
		is adaptable	AKQ2
		is expandable	AKQ3
		is applicable to our tasks	AKQ4
		increases effective actions	AKQ5
		provides the capacity to react to circumstances	AKQ6

APPENDIX B: Measurement items entering the pilot test (continued)

Construct	Sub-construct	Item	Acronym
Information Systems Quality	Perceived Ease of Use	My team finds	
		it easy to access the information systems	EOU1
		it easy to understand the information systems	EOU2
		it easy to use the information systems	EOU3
		it easy to become skillful at using the information systems	EOU4
		the information systems to be easily adaptable to requirements	EOU5
		interaction with the information systems to be clear and understandable	EOU6
	Perceived Usefulness	Using information systems	
		makes it easier for my team to do our tasks	USE1
		improves team performance	USE2
		increases team productivity	USE3
		enhances team effectiveness	USE4
		enables my team to accomplish tasks quickly	USE5
		makes it useful for my team to implement our jobs	USE6
	Perceived Media Richness	The information systems allow my team to	
		give and receive timely feedback	MR1
		reduce message ambiguity	MR2
		tailor concepts to meet our needs	MR3
		sense the presence of communication partners	MR4
		use a variety of methods to communicate messages (text, graphics, videos)	MR5
		communicate a variety of different cues (emotional tone, attitude, formality)	MR6

APPENDIX B: Measurement items entering the pilot test (continued)

Construct	Sub-construct	Item	Acronym
Cognitive Empowerment	Meaning	The work my team does	
		is important to us	MN1
		is meaningful to us	MN2
		The work requirements are consistent with	
		the beliefs of my team	MN3
		the values of my team	MN4
		the behaviors of my team	MN5
	Competence	My team	
		is very confident about its ability to do work	CO1
		has mastered the skills necessary for our tasks	CO2
		believes that we can successfully complete our tasks	CO3
		believes that we have the required abilities to perform tasks competently	CO4
		expects to do the job well	CO5
	Self-determination	My team	
		has significant autonomy in determining how work is done	SLD1
		has the opportunity for independence and freedom in work execution	SLD2
		has a sense of choice in initiating work	SLD3
		has a sense of choice in planning work	SLD4
		makes decisions about how tasks are undertaken	SLD5
		makes decisions about when tasks are undertaken	SLD6
	Impact	My team's project has a(n)	
		significant impact on my organization	IM1
		significant influence on what happens in my organization	IM2
		influence on strategic outcomes in my organization	IM3
		influence on administrative outcomes in my organization	IM4
		influence on operating outcomes in my organization	IM5

APPENDIX B: Measurement items entering the pilot test (continued)

Construct	Item	Acronym
Perspective Taking	My team members	
	appreciate inter-disciplinary knowledge of other team members	PT1
	compare and contrast inter-disciplinary expertise in their group-decisions	PT2
	take points of view of the rest of the team into account	PT3
	take useful perspectives from inter-disciplinary knowledge	PT4
	surface and reconcile different points of view	PT5
	consider unique perspectives of team members	PT6

APPENDIX B: Measurement items entering the pilot test (continued)

Construct	Item	Acronym
Perspective Making	My team	
	nurtures its potential perspectives	PM1
	advances its unique perspectives	PM2
	seeks to strengthen its knowledge	PM3
	applies its perspectives to team's tasks	PM4
	makes inter-disciplinary knowledge relevant to its tasks	PM5
	makes sense of inter-disciplinary perspectives to team's tasks	PM6
	makes inter-disciplinary perspectives to team's useful practices	PM7

APPENDIX B: Measurement items entering the pilot test (continued)

Construct	Item	Acronym
Innovation	Novel and useful systems, processes, products, or services	
	are developed by my team	IN1
	are produced by my team	IN2
	are adopted from an outside organization by my team	IN3
	are successfully implemented by my team	IN4
	have become a stable and regular part of the organization	IN5
	Time until novel and useful systems, processes, products, or services are adopted by my team is short	IN6

APPENDIX C: List of contextual variables for the pilot test

Please indicate the SIC code for your dominant product line:
- ___ Fabricated Metal Products (34)
- ___ Machinery, except Electrical (35)
- ___ Electric and Electronic Equipment (36)
- ___ Transportation Equipment (37)
- ___ Instruments and Related Products (38)

Please indicate team's primary goal: ______________________________

Please indicate the name of your team's project: ______________________________

How long had you been on the project team? ______________ Months

How long had the project team been working? ______________ Months

Please indicate average annual sales of your company in millions of $:

___ Less than 10	___ 50 – 99.9	___ 500 – 1 billion
___ 10 – 49.9	___ 100 – 499.9	___ Over 1 billion

Please indicate the average age of your team members: ______________________

Please indicate your gender: ______ Male ______ Female

The extent of	Very Low	Low	Medium	High	Very High	Not Applicable
computer usage on your team	1	2	3	4	5	NA
competition in your industry	1	2	3	4	5	NA
innovativeness on your project	1	2	3	4	5	NA
the results of your team's project	1	2	3	4	5	NA
geographical distances among team members	1	2	3	4	5	NA
finishing the project within a planned time frame	1	2	3	4	5	NA
PRODUCT complexity in your dominant product line	1	2	3	4	5	NA
PROCESS complexity in your dominant product line	1	2	3	4	5	NA

APPENDIX C: List of contextual variables for the pilot test (continued)

Please indicate the number of employees in your company:

___ 100 – 249 ___ 500 – 999 ___ 2,500 and over
___ 250 – 499 ___ 1,000 – 2,499

How long have you been at this organization? __________ Years __________ Months

How many members on the project team? _________________

Please indicate the number of functional representatives for each discipline on your team.

___ Engineering ___ Marketing ___ Manufacturing
___ Purchasing ___ Finance ___ Information Systems
___ Human Resource ___ Executives ___ Accounting
___ R&D ___ Distribution ___ General Management
___ Other (Please indicate ___________________________________)
___ Other (Please indicate ___________________________________)

What percentage of time did your team spend on the project each week? ____________%

Please indicate the average education level of your team:

___ High School ___ Bachelor's ___ Ph.D.
___ Associate Degree (2 Years) ___ Master's

Please indicate your job title.

___ CEO/President ___ Project Leader ___ Team Leader
___ Vice President ___ Project Manager ___ Team Manager
___ Director ___ Other (Please indicate ________________________)

Please indicate your ethnic group:

___ White, non-Hispanic ___ Black, non-Hispanic
___ Hispanic ___ Native American or Alaskan Native
___ Asian or Pacific Islander ___ Other (Please indicate ______________)

Please indicate your primary production system (choose the most appropriate one)

___ Engineer to Order ___ Make to Order
___ Assemble to Order ___ Make to Stock
___ Other (Please indicate ________________________)

Please select the type of operation that best describes your plant:

___ Projects ___ Batch processing ___ Job shop
___ Assembly line ___ Manufacturing cells ___ Flexible manufacturing
___ Continuous flow process
___ High volume, discrete part production
___ Other (Please indicate ________________________________)

APPENDIX D: Measurement items for the large scale survey

Note: The questionnaire asked respondents to rate each question on a scale from 1 to 5, where 1 was strongly disagree, 3 was neutral, and 5 was strongly agree. Respondents had an option to choose "Not Applicable." Definitions of data, information, and knowledge are given at the beginning of the questionnaire.

Construct	Sub-construct	Acronym	Measurement Item	Mean	SD
Knowledge Quality	Intrinsic Knowledge Quality		Knowledge possessed by my team		
		IKQ1	is accurate	4.06	.66
		IKQ2	is reliable	3.98	.76
		IKQ3	is objective	3.83	.86
		IKQ4	is believable	4.04	.73
		IKQ5	is current	3.92	.81
	Contextual Knowledge Quality		Knowledge possessed by my team		
		CKQ1	adds value for decision-making	4.27	.75
		CKQ2	adds value to team's operations	4.30	.71
		CKQ3	gives my team competitive advantage	4.05	.91
		CKQ4	is relevant to our tasks	4.28	.67
		CKQ5	is appropriate to our jobs	4.27	.73
	Actionable Knowledge Quality		Knowledge possessed by my team		
		AKQ1	is actionable	3.97	.75
		AKQ2	is adaptable	3.90	.81
		AKQ3	is expandable	4.07	.81
		AKQ4	is applicable to our tasks	4.27	.64
		AKQ5	increases effective actions	4.10	.75
		AKQ6	provides the capacity to react to circumstances	4.10	.82

APPENDIX D: Measurement items for the large scale survey (continued)

Note: The questionnaire asked respondents to rate each question on a scale from 1 to 5, where 1 was strongly disagree, 3 was neutral, and 5 was strongly agree. Respondents had an option to choose "Not Applicable." Definitions of data, information, and knowledge are given at the beginning of the questionnaire.

Construct	Sub-construct	Acronym	Measurement Item	Mean	SD
Knowledge-sharing Climate	Willingness		My team members are willing to		
		WLN1	access ideas from other team members	4.14	.84
		WLN2	share their information among team members	4.08	.86
		WLN3	use resources provided by team members	4.16	.79
		WLN4	acquire knowledge from other team members	4.22	.82
	Trust		My team members trust		
		TRS1	data possessed by other team members	3.78	.87
		TRS2	information possessed by other team members	3.76	.79
		TRS3	knowledge possessed by other team members	3.87	.79
		TRS4	resources possessed by other team members	3.92	.75
	Openness		My team members are encouraged to		
		OPN1	produce their ideas even when ideas differ from their knowledge	3.91	.88
		OPN2	express their ideas even when ideas differ from their knowledge	4.09	.87
		OPN3	develop their ideas even when ideas differ from their knowledge	3.88	.89
		OPN4	implement their ideas even when ideas differ from their knowledge	3.67	.96

APPENDIX D: Measurement items for the large scale survey (continued)

Note: The questionnaire asked respondents to rate each question on a scale from 1 to 5, where 1 was strongly disagree, 3 was neutral, and 5 was strongly agree. Respondents had an option to choose "Not Applicable." Definitions of data, information, and knowledge are given at the beginning of the questionnaire.

Construct	Sub-construct	Acronym	Measurement Item	Mean	SD
Information Systems Quality	Perceived Ease of Use		My team finds		
		EOU1	it easy to access the information systems	3.47	1.03
		EOU2	it easy to use the information systems	3.37	1.05
		EOU3	it easy to become skillful at using the information systems	3.30	1.03
		EOU4	the information systems to be easily adaptable to requirements	3.04	1.09
		EOU5	interaction with the information systems to be clear and understandable	3.25	1.03
	Perceived Usefulness		Using the information systems		
		USE1	makes it easier for my team to do our tasks	3.87	.91
		USE2	improves team performance	3.93	.93
		USE3	increases team productivity	3.88	.97
		USE4	enables my team to accomplish tasks quickly	3.66	1.04
		USE5	makes it useful for my team to implement our jobs	3.79	.94
	Perceived Media Richness		The information systems allow my team to		
		MR1	give and receive timely feedback	3.55	1.13
		MR2	reduce message ambiguity	3.38	.99
		MR3	tailor concepts to meet our needs	3.33	1.03
		MR4	sense the presence of communication partners	3.15	1.05
		MR5	communicate messages in a variety of methods (text, graphics, or videos)	3.61	1.15

APPENDIX D: Measurement items for the large scale survey (continued)

Note: The questionnaire asked respondents to rate each question on a scale from 1 to 5, where 1 was strongly disagree, 3 was neutral, and 5 was strongly agree. Respondents had an option to choose "Not Applicable." Definitions of data, information, and knowledge are given at the beginning of the questionnaire.

Construct	Sub-construct	Acronym	Measurement Item	Mean	SD
Cognitive Empowerment	Meaning		The work my team does		
		MN1	is important to us	4.54	.65
		MN2	is meaningful to us	4.42	.70
			The work requirements are consistent with		
		MN3	the beliefs of my team	4.02	.88
		MN4	the values of my team	4.06	.83
		MN5	the behaviors of my team	4.00	.87
	Competence		My team		
		CO1	is very confident about its ability to do work	4.30	.77
		CO2	has mastered the skills necessary for our tasks	3.97	.84
		CO3	believes that we can successfully complete our tasks	4.14	.81
		CO4	believes that we have the required ability to perform tasks competently	4.24	.75
		CO5	expects to do the job well	4.38	.78
	Self-determination		My team		
		SLD1	has the opportunity for independence and freedom in work execution	3.82	.99
		SLD2	has a sense of choice in initiating work	3.65	1.01
		SLD3	has a sense of choice in planning work	3.76	.96
		SLD4	makes decisions about how tasks are undertaken	3.95	.86
		SLD5	makes decisions about when tasks are undertaken	3.67	.94
	Impact		My team's project has a(n)		
		IM1	significant impact on my organization	4.29	.82
		IM2	significant influence on what happens in my organization	4.01	.92
		IM3	influence on strategic outcomes in my organization	3.96	1.04
		IM4	influence on administrative outcomes in my organization	3.54	1.10
		IM5	influence on operating outcomes in my organization	3.94	1.01

APPENDIX D: Measurement items for the large scale survey (continued)

Note: The questionnaire asked respondents to rate each question on a scale from 1 to 5, where 1 was strongly disagree, 3 was neutral, and 5 was strongly agree. Respondents had an option to choose "Not Applicable." Definitions of data, information, and knowledge are given at the beginning of the questionnaire.

Construct	Acronym	Measurement Item	Mean	SD
		My team members		
Perspective Taking	PT1	appreciate inter-disciplinary knowledge of other team members	3.99	.86
	PT2	compare and contrast inter-disciplinary expertise in their group-decisions	3.78	.92
	PT3	take points of view of the rest of the team into account	3.88	.84
	PT4	take useful perspectives from inter-disciplinary knowledge	3.86	.81
	PT5	understand the different points of view	3.81	.87
	PT6	consider the different perspectives of team members	3.84	.84
		My team		
Perspective Making	PM1	nurtures its potential perspectives	3.52	.92
	PM2	advances its unique perspectives	3.60	.86
	PM3	applies its perspectives to team's tasks	3.77	.82
	PM4	makes inter-disciplinary knowledge relevant to its tasks	3.78	.83
	PM5	makes sense of inter-disciplinary perspectives to team's tasks	3.70	.81
	PM6	makes inter-disciplinary perspectives to team's useful practices	3.67	.86
		Novel and useful systems, processes, products, or services		
Innovation	IN1	are developed by my team	4.02	1.02
	IN2	are produced by my team	3.91	1.04
	IN3	are adopted from an outside organization by my team	3.55	1.03
	IN4	are successfully implemented by my team	3.99	.88
	IN5	have become a stable and regular part of the organization	3.77	1.00

APPENDIX E: Contextual Variables for the large scale survey

Note: The questionnaire asked respondents to rate each question on a scale from 1 to 5, where 1 was strongly disagree, 3 was neutral, and 5 was strongly agree. Respondents had an option to choose "Not Applicable." Definitions of data, information, and knowledge are given at the beginning of the questionnaire.

My team members have the ability to
- use existing knowledge
- recognize the value of new information or knowledge
- link their knowledge to others' expertise
- integrate various opinions from team members
- apply prior knowledge into new knowledge creation

My team
- is functionally diverse
- is composed of specialists from different functional areas
- has representatives from all functions that affect the project
- has representatives from all functions that are affected by the project

My team
- easily acquires team-external knowledge
- easily accesses team-external resources
- has useful contacts outside the team
- coordinates team-external work contributions
- seeks feedback outside the team

Please indicate the SIC code for your dominant product line:
___ Fabricated Metal Products (34)
___ Machinery, except Electrical (35)
___ Electric and Electronic Equipment (36)
___ Transportation Equipment (37)
___ Instruments and Related Products (38)

Please indicate team's primary goal: ____________________________________

Please indicate the name of your team's project: ____________________________

How long had you been on the project team? ______________ Months

How long had the project team been working? ______________ Months

Please indicate average annual sales of your company in millions of $:

___ Less than 10	___ 50 – 99.9	___ 500 – 1 billion
___ 10 – 49.9	___ 100 – 499.9	___ Over 1 billion

APPENDIX E: Contextual Variables for the large scale survey (continued)

Note: The questionnaire asked respondents to rate each question on a scale from 1 to 5, where 1 was strongly disagree, 3 was neutral, and 5 was strongly agree. Respondents had an option to choose "Not Applicable." Definitions of data, information, and knowledge are given at the beginning of the questionnaire.

Please indicate **the number** of functional representatives for each discipline on your team.

___ Engineering ___ Marketing ___ Manufacturing
___ Purchasing ___ Finance ___ Information Systems
___ Human Resource ___ Executives ___ Accounting
___ R&D ___ Distribution ___ General Management
___ Other (Please indicate ________________________________)
___ Other (Please indicate ________________________________)

The extent of
computer usage on your team
competition in your industry
innovativeness on your project
the results of your team's project
geographical distances among team members
finishing the project within a planned time frame
PRODUCT complexity in your dominant product line
PROCESS complexity in your dominant product line

Please indicate the number of employees in your company:
___ 100 – 249 ___ 500 – 999 ___ 2,500 and over
___ 250 – 499 ___ 1,000 – 2,499

How long have you been at this organization? __________ Years __________ Months

How many members on the project team? ________________

Please indicate the average education level of your team:
___ High School ___ Bachelor's ___ Ph.D.
___ Associate Degree (2 Years) ___ Master's

Please indicate your gender: ______ Male ______ Female

Please indicate your job title.
___ CEO/President ___ Project Leader ___ Team Leader
___ Vice President ___ Project Manager ___ Team Manager
___ Director ___ Other (Please indicate ______________________)

APPENDIX E: Contextual Variables for the large scale survey (continued)

Note: The questionnaire asked respondents to rate each question on a scale from 1 to 5, where 1 was strongly disagree, 3 was neutral, and 5 was strongly agree. Respondents had an option to choose "Not Applicable." Definitions of data, information, and knowledge are given at the beginning of the questionnaire.

What percentage of time did your team spend on the project each week? ___________%

Please indicate your ethnic group:

___ White, non-Hispanic
___ Black, non-Hispanic
___ Hispanic
___ Native American or Alaskan Native
___ Asian or Pacific Islander
___ Other (Please indicate ____________)

Please indicate the average age of your team members: ______________________

Please indicate your primary production system (choose the most appropriate one)

___ Engineer to Order
___ Make to Order
___ Assemble to Order
___ Make to Stock
___ Other (Please indicate ______________________)

Please select the type of operation that best describes your plant:

___ Projects
___ Batch processing
___ Job shop
___ Assembly line
___ Manufacturing cells
___ Flexible manufacturing
___ Continuous flow process
___ High volume, discrete part production
___ Other (Please indicate ______________________________)