THE IMPACT OF PROACTIVE PERSONALITY, ECONOMIC REWARDS, AND SOCIAL EXCHANGE PERCEPTIONS ON KNOWLEDGE SHARING AMONG ENGINEERS IN A SOUTH KOREAN IT COMPANY

BY

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DISSERTATION

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ABSTRACT

Over the decades, scholars have acknowledged the importance of knowledge sharing in organizational performance and innovation. Despite the importance of individual factors of knowledge sharing between employees, far too less attention has been paid to individual factors to promote individuals' intention to share knowledge within organizations. The present study, focusing on the impacts of proactive personality, social and economic exchange perceptions on knowledge sharing, will have theoretical implications for researchers in human resource development (HRD) and management, as well as implications for practicing managers and administrators in organizations. This study examines whether impacts of individuals' proactive personality and perceptions of social and economic exchange on sharing of knowledge between R&D engineers, which has been rarely explored in the literature.

A mixed method using survey research and case study were conducted to test the study hypotheses. For a quantitative study, data were collected from 432 engineers engaged in R&D work at the high performance IT company in South Korea. The nature of their work required a significant reliance on co-workers. Multiple regression analysis, among other statistical techniques, was used to test the hypotheses and determine significant relationships. Of the factors examined in the study, the two factors found to have the strong effect on engineers' knowledge sharing were proactive personality and social exchange perception. On the other hands, economic rewards was found to have a negative effect on knowledge sharing.

For a qualitative study, case study was conducted through interview with selected R&D engineers. Two research questions were answered: (1) How do R&D engineers describe their knowledge sharing? And (2) What influence their knowledge sharing at work? Of the

themes from the interview, the four found to show evidence in support of the results of quantitative study were social interaction, sense of duty, trust, and enjoyment. Several implications of these findings, limitations, and future research suggestions are discussed.

Keywords: knowledge sharing, proactive personality, economic rewards, social exchange, mixed methods, South Korea

Dedicated to my wife Sun Hee Kim,

my daughter Kate Eun-jin Han,

and

my parents, Dr. Myung Bok Han and Eun Sook Kim

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CHAPTER 1

INTRODUCTION

Knowledge is the foundation of a firm's competitive advantage and, ultimately, the primary driver of its value (Grant, 1996; Spender & Grant, 1996; Teece, 2000). The nature of competition among firms and the sources of competitive advantage are heavily dependent on how effectively knowledge is shared among individuals, teams, and organizations (Alavi & Leidner, 2001; Argote, McEvily, & Reagans, 2003; Davenport & Grover, 2001). Knowledge sharing facilitates opportunities for mutual learning, which may result in improved performance and cooperation. Potentially, sharing stimulates new knowledge and organizational innovation (Huber, 1991; Spencer, 2003; Zhou & Li, 2012). Growing evidence suggests that organizations are more productive when able to successfully create conditions for knowledge to be shared by potential providers and for it to be used by recipients of new knowledge (Cabrera & Cabrera, 2005; Chen, Hsu, Wang, & Lin, 2011; Choi, Poon, & Davis, 2008; Davenport, 2005).

Over the past two decades, scholars and practitioners emphasized how an organization's ability to utilize and implement knowledge sharing is critical for organizational success (Jackson, DeNisi, & Hitt, 2003; Kogut & Zander, 1992; Nahapiet & Ghoshal, 1998). As organizational competition intensifies, the sources of competitive advantage increasingly rely on intellectual resources and emphasize knowledge-based practices (Gourlay, 2001; Prahalad & Hamel, 1990; Wiig, 1997). Further, Govindarajan and Gupta (2001) argue that organizations today must consider each business as a knowledge-based one operated by human capital. Indeed, a widespread notion in knowledge management is that one should perceive an individual as a knowledge set (Frappaolo, 2006; Grant, 1996; Nonaka & Takeuchi, 1995; Spender, 1996).

Polanyi (1966) defined this notion as "personal knowledge," which is internalized by an individual and is not easily transferred to the remainder of an organization.

Sources of firms' competition shifted toward knowledge-based properties derived from physical resources, such as land, labor, and financial capital (Boisot, 1998; Sveiby, 1997; 2001). This is particularly the case for knowledge-intensive industries, such as the high technology industry, wherein a firm's competitive advantage is highly dependent on its ability to leverage what employees know (Argyres & Silverman, 2004; Feinberg & Gupta, 2004; Fey, 2005; Oxley & Sampson, 2004). Since the 1990s, the concept of knowledge and its managerial practices emerged into the business world via academia (e.g., Drucker, 1999; Nonaka & Takeuchi, 1995; Senge, 1990). In academia, knowledge management was regarded as the engine of an organization's sustainable growth. According to a recent industry survey of management tools and trends, knowledge management is ranked fourth for highest increase (31%) in the usage of management tools (Rigby & Bilodeau, 2012). In Korea, 72.4% of Korean companies have adopted a knowledge management system to create and share intellectual resources (Paik, 2010).

During a period of economic growth,[1] South Korea remains highly dependent on human capital as its primary source of national wealth. The Korean government enacted a Basic Law on Intellectual Property in 2011 and established the Presidential Council on Intellectual Property in order to protect industrial intellectual assets and to promote the creation, protection, and exploitation of knowledge property in the industry (Kang & Shin, 2012). Support at the

[1] Since 1962, South Korea's real gross domestic product (GDP) has expanded by an average of more than 8 percent per year along with four times five-year economic development plans. South Korea ranks 15th largest in the world market by nominal GDP and 11th by purchasing power parity (PPP), positioning it as one of the G-20 major economies. South Korea is regarded as a high-income developed country with a high technology industry, and it is a member of OECD (World Bank, 2013).

national level for knowledge management majorly impacted private-sector organizations. With a well-established national intellectual property system and infrastructure, many Korean Chaebul companies, such as Samsung, Hyundai, SK, and LG, have successfully promoted management practices. These companies show bottom line differences in today's organizational performance (Choi, 2007).

Confucian culture is deeply rooted in South Korea. As Confucianism values the concept of a group, there are, consequently, strong group-oriented characteristics in the industrial area of Korean companies. Moreover, the socio-cultural infrastructure advocates for the characteristics of individual behavior in organizations (Choi, Kang, & Lee, 2008). Confucian values promote a group-oriented ideology that forms relationship characteristics among individuals that are hierarchical and vertical (Choi, 1996). Such characteristics, described categorically by Hoefstede's collectivism, form a social pattern that consists of closely linked individuals who see themselves as belonging to collectives, such as coworkers and in-groups. They are also motivated by the norms and obligations imposed by the collectives (Triandis, 1995). This culture strongly influences ways of thinking and behaving and influences how group members process, interpret, and make use of information and knowledge (Bhagat, Kedia, Harveston, & Triandis, 2002). In a vertical culture of collectivism, the processing of information and knowledge takes place according to hierarchical arrangements within an organization. As such, a superior member of staff has access before others to important pieces of information and knowledge derived from external sources (Kagitcibasi, 1997; Triandis, 1995). Bae, Chen, David, Wan, Lawler, and Walumbwa (2003) classify South Korea according to vertical collectivism because of its motive to serve for the benefit of collectives. Accordingly, it behaves in a way that

strongly conforms to the expectations of an in-group and regards people as differing in social and economic status.

The Korean government made an effort to overcome the Asian financial crisis by opening public discourse, revising labor laws, and publishing the white book, *New Industrial Relations Ideas* (2008). By forcing external environment changes and regulations, Korean companies experienced broad and fundamental transformations in Human Resource (HR) practices. For example, a practice that characterized lifelong employment and high organizational commitment is disturbed by employee flexibility. Formerly, employee compensation was primarily based on seniority. Now, however, performance is the most important factor for firms looking to increase productivity through reward incentives. After the financial crisis, Korean companies aggressively introduced a large portion of individual incentives into the base salary, so-called "Yeon-bong Je." Traditional bonus compensations, which were fixed pay, were transformed according to a performance-based system, including personal incentives, profit sharing, and stock options based on performance. The rapid proliferation of "Yeon-bong Je" and performance-based pay influenced individual behaviors within organizations.

The pace and complexity of change created a high degree of uncertainty for high technology companies and forced them to innovate continually in order to be competitive. In such an environment, sharing knowledge is particularly important because employees' sharing provides opportunities for mutual learning, which may result in performance improvements (Cummings, 2004; Kogut & Zander, 1992; Li, Wei, & Lin, 2010; Tsai, 2000; Tsai & Ghoshal, 1998). Literature about organizational learning highlighted how to create knowledge by increasing research and development (R&D) intensity (Cohen & Levinthal, 1990; Huang, 2009).

Nevertheless, organizations are often limited in their abilities to produce intellectual resources through R&D alone (Birkinshaw, Nobel, Ridderstrale, 2002; Hagedoorn, 1993). To create and accumulate the knowledge necessary for success, many organizations rely on internal activities among individuals, such as knowledge sharing (Wadhwa & Kotha, 2006).

Research and development activities include an extensive and interpersonal exchange of intellectual resources within teams and organizations (Demirbag & Glaister, 2010). Existing scholarship on R&D proved that these informal exchanges are in fact major learning processes that lead to positive consequences for innovation and performance (e.g., Kreiner & Schultz, 1993; von Hippel, 1987). Allen (1977) describes these exchanges as solely interpersonal, ad hoc, and independent of organizational structure and policy. Knowledge sharing tends to occur on the basis of individual decisions, and a tension builds between fostering innovation and retaining intellectual capital (Bouty, 2000). As such, these exchanges require particular attention.

No longer valued only for what they have achieved, organizations are scrutinized for their potential to achieve success in the future (López, Peón, & Ordás, 2005; Von Krogh, 1998). In this regard, knowledge sharing between individuals serves a pivotal role for increasing the potential and competitive advantage of an organization (Drucker, 1993). The promise and interest of knowledge management lies in knowing and the ability to share and behave on the basis of employee knowledge. In other words, organizations are valued and succeed because of their ability to leverage what their employees know creatively and proactively (Pfeffer & Sutton, 2000). A successful establishment of knowledge sharing could improve the business process and facilitate its application of research and development (Collins & Smith, 2006; Smith, Collins, & Clark, 2005).

Problem Statement

Scholars from various fields actively studied knowledge sharing and its influence on organizational effectiveness (e.g., Davenport & Prusak, 1998; Foss, Husted, Michailova, 2010; Foss & Pedersen, 2004; Spender & Grant, 1996). A number of studies showed that knowledge sharing leads to positive organizational outcomes, such as improved performance (e.g., Collins, & Smith, 2006; Goll, Johnson, & Rasheed, 2007; López et al., 2005; McEvily, Das, & McCabe, 2000; Thornhill, 2006; Uzzi & Gillespie, 2002; Wiig & Jooste, 2004), innovation (e.g., Bogers, 2011; Enkel, Gassmann, & Chesbrough, 2009; Dyer & Nobeoka, 2000; Perkman, 2002; Schulze & Hoegl, 2006), productivity (e.g., Haas & Hansen, 2007; Lapré & van Wassenhove, 2001; van Buren, 1999), and sales growth (e.g., Arthur & Huntley, 2005). Therefore, it is critical that organizations promote an organizational culture that supports knowledge sharing and also design knowledge management initiatives that are aligned with working norms and linked to organizational goals and values (Cabrera & Cabrera, 2005; Fey & Furu, 2008).

Given that knowledge sharing is important for organizational success and superior performance, the main challenge is to identify mechanisms for what makes employees share their knowledge and how they do so. It is increasingly difficult to ignore the determinants of knowledge sharing. Several attempts have been made to explain the determinants of knowledge sharing in different ways. For example, economic theorists suggested that individuals weigh their decisions about knowledge exchange solely against the economic benefits they will receive (Carter, 1989; Schrader, 1995; von Hippel, 1987). According to these studies, an individual will not exchange a resource if s/he thinks that others could harm his/her economic interests by using an intellectual asset. Human Resource Management (HRM) and the field of labor economics

inform individual perceptions of economic exchange and managerial control, focusing on transaction-based HR practices and individual short-term exchange relationships.

Relatedly, theories of sociology provide substantial evidence of individual behaviors embedded in a social context and with ongoing social relations (Davenport & Prusak, 1998; Granovetter, 1985). Theorists argue that individuals control their interactions with other individuals based on a self-interest analysis of costs and benefits, which are not tangible, as individuals may engage in an interaction with an expectation of reciprocity in the future regulated by trust (Gouldner, 1960). Blau (1964) argues that social exchange differs from classical economic exchange: "only social exchange tends to engender feelings of personal obligation, gratitude and trust; purely economic exchange as such does not" (p. 94). That is, the relational approach in a social dimension matters (Davenport & Prusak, 1998). Sociological views emphasize mutual and long-term exchange relationships (Tsui, Pearce, Porter, & Hite, 1995).

Psychologists hold a different perspective on knowledge sharing, instead focusing on individual differences and emphasizing the role of personal dynamics in knowledge sharing (e.g., Bartol & Srivastava, 2002; Moreland & Myaskovsky, 2000; Stasser & Titus, 2003). For example, an employee inclined to share knowledge relates to his/her personal disposition (Matzler, Renzl, Mueller, Herting, & Mooradian, 2008; Matzler, Renzl, Mooradian, von Krogh, & Mueller, 2011). Assuming that different employees have different information and knowledge related to their work, proactive employees tend to interact with others to actively exchange knowledge (Crant, 1995; 2000). Since proactive employees are less bound by situational factors and have motivation to learn (Bateman & Crant, 1993; Campbell, 2000), they may seek knowledge sharing with others (Major, Turner, & Fletcher, 2006).

This growing body of literature provides necessary insight on various factors underlying knowledge sharing within organizations. Extant research findings, however, are incomplete because they lack the explanatory properties that have a positive or negative effect on knowledge sharing in organizations. Despite the fact that knowledge sharing is a complex and overarching process among individuals, scholars often overlook the extent to which different factors explain knowledge sharing.

Further, research on knowledge sharing focused on causal relationships and indicated organizational performance as the major dependent variable of interest at the organizational level (e.g., Ahuja, 2000; Collins & Smith, 2006; Goodman & Darr, 1998; Hansen, 1999; Kogut & Zander, 1996; Nonaka & Takeuchi, 1995; Spender & Grant, 1996) and team level (e.g., De Dreu, 2007; De Dreu & Carnevale, 2003; Hinsz, Tindale, & Vollrath, 1997; Srivastava, Bartol, & Locke, 2006). Despite the fact that knowledge is derived from individuals and generated and shared by them in certain behavioral contexts, the variables at an individual level received minimal critical attention. One reason that the individual level approach remains largely ignored in present scholarship is because researchers in organizational studies, who support the importance of macro-level performance (e.g., Lawler, 1992), argue that individuals are not a unit operating in organizations. As such, they contend that analysis should be examined at the organizational rather than the individual level. Although this argument may provide a reason for supporting an emphasis on macro-level studies, it may contribute to the lack of progress in expanding the scope of knowledge sharing studies as well. Thus, there is a need to explore knowledge sharing among individuals as an outcome of various determinants because knowledge sharing is regarded as a means for improving organizational effectiveness.

In academia, significant contributions to knowledge sharing have been made. However, existing empirical studies on knowledge sharing have been overly focused on American companies, especially manufacturing companies (e.g., Appleyard, 1996; Collins & Smith, 2006; Smith et al., 2005; Wadhwa & Kotha, 2006). In response to such literature, the present study recognizes that the philosophical concepts of knowledge and theoretical framework have been developed in Western countries, and that most extant studies of knowledge sharing have been conducted empirically in such countries, which tends to emphasize individualistic orientations. However, compared to the many successful cases and best practices in South Korea, there have been a paucity of academic interests and empirical studies in knowledge sharing conducted (e.g., Bock, Zmud, Kim, & Lee, 2005; Yoo & Torrey, 2002). Thus, this study shifted its focus to South Korea and targeted a high performance IT company and its research and development center.

Purpose of Study

The overall purpose of this study is to explore various determinants of knowledge sharing at the individual level, including proactive personality, economic exchange, and social exchange perceptions as antecedents. Additionally, to more thoroughly understand the personal dynamics of knowledge sharing, this study seeks to investigate the extent to which those dimensions lead to increased knowledge sharing at the individual level. By focusing on the relationships of individuals' dispositions and perceptions toward social/economic exchange with their knowledge sharing, this study will have theoretical implications for researchers in Human Resource Development (HRD) and management, as well as implications for practicing managers and administrators in organizations.

Theoretical Framework

Various disciplines have responded to the question "what leads to knowledge sharing between individuals?" in different ways. Proactive personality, economic rewards, and social exchange perceptions were employed to investigate their influence on knowledge sharing among individuals. Unfortunately, these elements have not yet been considered collectively in a single study. Thus, the extent to which different factors explain knowledge sharing remains unclear. In an effort to address such gaps in our understanding, this study will explore all above determinants of knowledge sharing at the individual level.

Researchers suggested that individuals are predisposed to certain work attitudes and behaviors (e.g., Judge & Bono, 2001). As such, personality influences knowledge sharing between individuals (Matzler et al., 2008). There are few empirically-conducted research studies on the influence of knowledge sharing. Indeed, empirical results have been mixed (e.g., Cabrera et al., 2006). Frese and Fay (2001) argue that proactive employees tend to interact with others to identify learning opportunities. Also, proactive employees build interpersonal relationship in an effort to accumulate social resources and social networks in advance to the achievement of a goal (Grant & Ashford, 2008). Proactivity enables a person to more easily identify opportunities and build trusting relationships (Dirks & Ferrin, 2002).

In a concept of economic exchange, economic rewards will be the most basic motivator for employees to share their knowledge (Yao, Kam, & Chan, 2007). Simply put, individuals make a decision on their resource exchange against economic interests. Kim and Lee (2006) found that an organizational strategy on "pay for performance" contributed to knowledge sharing. For example, employees who anticipate a higher level of pecuniary rewards and

incentives to knowledge sharing are more likely to share their knowledge. Knowledge sharing occurs when perceived rewards exceed costs.

Contrary to economic rewards, social exchange theory assumes that individual behaviors are embedded in a social contract based on ongoing social relations. Socio-psychologists argue that knowledge sharing is a predominantly social process that exists as a reciprocal arrangement (e.g., Wu, Hsu, & Yeh, 2007). This perception of social exchange entails a high level of trust and long-term relationships as an antecedent of knowledge sharing (Butler, 1999; Lin, 2007; Wu et al., 2007). Therefore, individuals decide on whether or not to share knowledge based on a perceived benefit-to-cost ratio in a social relationship.

A model representing the theoretical relationships to be examined in this study is presented in Figure 1-1.

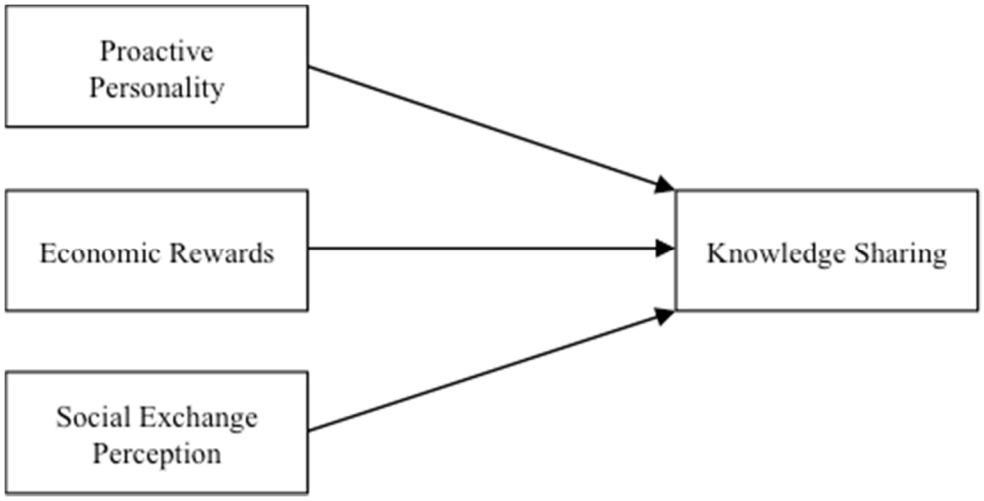

Figure 1-1. A Basic Conceptual Framework

Research Questions and Hypotheses

Based on a theoretical and literature review of extant knowledge sharing studies, the major framework for this study is associated with proactive personality, economic exchange perception, social exchange perception, and the intention of knowledge sharing. In this regard, Bateman and Crant's (1993) scale, used to measure proactive personality, perceived economic rewards (Siemson, Balasubramanian, & Roth, 2007), social exchange perception (Shore, Tetrick, Lynch, & Barksdale, 2006), and the intention to knowledge sharing (Bock, Zmud, Kim, & Lee, 2005) were used as the primary research instruments. Along with this theoretical background, the following research questions guide the entire study.

Research Questions

1. Does an individual's proactive personality relate to knowledge sharing?
2. Do individual's economic rewards relate to knowledge sharing with others?
3. Does an individual's social exchange perception relate to knowledge sharing with others?
4. How do research engineers in R&D centers describe their knowledge sharing with colleagues?
5. What facilitators and barriers influences research engineers to share their knowledge?

This study investigates several hypotheses that are described more closely in the literature review. Each hypothesis addresses variations between exogenous and endogenous variables as follows:

Hypothesis 1: Proactive personality will be positively associated with the intention to share knowledge.

Hypothesis 2: Economic rewards will be positively associated with the intention to share knowledge.

Hypothesis 3: Social exchange will be positively associated with the intention to share knowledge.

Significance of the Study

The competitive pressures facing organizations today require organizations to identify appropriate knowledge and information, and to recognize whose skills and abilities can deliver results (Drucker, 1999; Pfeffer & Sutton, 2000). As organizations fiercely compete to survive in the market, informal learning processes among coworkers become more critical than ever (Marsick & Watkins, 1994; 2001; Watkins & Marsick, 1993). A primary goal of human resource development (HRD) is to enhance the capabilities of an individual employee and to improve organizational performance overall. These goals are typically based on the belief that learning will result in performance improvement. In this regard, knowledge sharing plays a key role in increasing the mutual learning capacity for the purpose of organizational effectiveness.

Over the past two decades, knowledge management and sharing have been mostly discussed from an economic and management based perspective. As such, knowledge sharing has been overly focused on a supply dimension of knowledge regulated by management and organizational tools. However, the present study, focusing on demand – what determines

individual knowledge sharing – will have theoretical implications for researchers in HRD and management, as well as implications for practicing knowledge managers and instructional designers of learning module in organizations.

There are several important reasons to conduct the present research. First, the present study attempts to integrate the various determinants of knowledge sharing into a single model. Most studies have reviewed only one dimension based on a different theoretical background to understand knowledge sharing within an organization. Even though a few studies have integrated various dimensions (e.g., Bock, Zmud, Kim, & Lee, 2005; Wang & Noe, 2010), no empirical research has been conducted to determine whether the dimensions are distinct constructs. Thus, the present study will integrate the various dimensions, such as individual disposition, economic rewards, and social exchange perception, and then conduct empirical research to examine whether they are distinctly different influences on knowledge sharing. These efforts may contribute to our understanding of knowledge sharing by integrating the various dimensions and explaining the determinants of knowledge sharing.

Second, the present study explores the determinants of knowledge sharing at the individual level. Most researchers have primarily studied knowledge sharing at the macro level such as the organizational and group levels (e.g., Ahuja, 2000; Collins & Smith, 2006; De Dreu, 2007; Srivastava et al., 2006), while far less attention has been given to the individual level of knowledge sharing. This study provides a unique contribution by investigating whether individual factors differently influence interpersonal knowledge sharing.

Third, the current study attempts to examine the influence of various antecedents on knowledge sharing in a non-American culture by investigating a sample from South Korea. There is a potential contribution to be made by examining this unexplored area that asks whether

the suitability of a knowledge-sharing concept may be influenced by different contexts. Examining the determinants of knowledge sharing with quantitative and qualitative data will contribute to further theoretical developments by focusing on the importance of contextual factors in implementing knowledge sharing in different cultures.

The practical implications of this study for HRD professionals will provide insight as to which determining factors influence individuals' decisions to share their knowledge. As HRD professionals' roles have shifted from transactional and operational functions to transformational and strategic roles (Ruona & Gibson, 2003), HRD professionals have become strategic partners and change agents for leading organizations by promoting formal and informal learning processes within organizations. Dixon (1992) argues that HRD professionals, acting as learning specialists, need to help employees enhance their learning capacity and develop learning infrastructures for that purpose. Understanding how to maximize knowledge sharing among employees may contribute to formal employee education programs for promoting knowledge sharing between knowledge providers and recipients, as well as facilitating informal and mutual learning among coworkers in the workplace.

Limitation of the Study

Knowledge sharing is a complex and fragile process that exposes conflicts of interest that exist among individuals (von Krogh, 1998). Thus, unmeasured exogenous variables may affect the relationships with knowledge sharing. As Wang and Noe (2010) proposed, for example, leadership characteristics, organizational diversity, and group identification can be antecedents that influence employees' knowledge sharing. Literature related to knowledge sharing suggests that researchers should undertake a critical consideration of an individual's intrinsic benefit as a motivator when examining the knowledge sharing process. Indeed, Kalling

and Styhre (2003) recognized a relative lack of scholarly attention to the role of intrinsic motivational factors that affect knowledge sharing. In practice, such benefits as self-interest and recognition could be critical variables for encouraging members to share their knowledge (Wasko & Faraj, 2000). This research, however, does not include those variations regarding intrinsic motivators, but instead focuses on individual perception of economic and social exchange, and personality traits that align with the major purpose and range of the current study.

Second, this study adopted a single-subject design, which targeted one organization. It applied a quantitative and a qualitative approach. A sample of R&D employees may not be representative of most organizations. Factors unique to our target may limit the applicability of the results to other settings. However, this study assures that its sample is representative of knowledge workers engaged in R&D activities who actively shared their expertise. It used a case study and quantitative analysis of a survey measurement on knowledge sharing.

Third, the data set in this study did not allow for a direct consideration of the quality of knowledge sharing. Evidence is missing on the quality of knowledge being shared. It is also uncertain how knowledge sharing would exist under conditions of harsh competition or hostility among individuals. However, this study indirectly captured the quality of knowledge shared because it measured self-responded knowledge sharing in a qualitative study. In other words, this study implicitly asks employees about which type of knowledge has been shared with others and the extent to which knowledge sharing has been useful for their work.

Finally, this study included a quantitative study that adopted a survey method using Likert-scale answers. Respondents in the target sample might interpret the scale differently from one another. For example, an individual’s answer four might not be equal to another's answer

four. Also, participants may base their answers on their feelings toward the survey; thus, those answers may not be completely accurate.

Definition of Terms

While operational definitions of the constructs and associated sub-dimensions of this study are stated in Chapters 2 and 3, the following definitions of terms help readers understand specific terms used in the literature review and methods sections.

Knowledge. A shared set of justified true beliefs based on human socialized interaction (Nonaka & Takeuchi, 1995, p. 3; Polanyi, 1966, p. 6). In this study, knowledge is regarded as a combination of experience, values, contextual information, and expert insight that help incorporate new experiences. The potential of an activity, situated within a socially constructed domain and bounded by the developmental capacity of an individual. From a management perspective, knowledge is regarded as the foundation of an organization's competitive advantage and, ultimately, the primary driver of its value (Grant, 1991; Spender, 1996; Teece, 2000).

Explicit knowledge. Knowledge that is easily codified and can be shared, or it can be embedded in processes or systems (DeLong, 2004, p. 83). It can be readily transmitted to others. The most common forms of explicit knowledge are manuals, documents, procedures, and how-to videos.

Tacit knowledge. Knowledge that a person carries in the mind, which is difficult to access for this reason. People are not aware of the knowledge they possess or how it can be valuable to others. Tacit knowledge is considered more valuable than other forms of knowledge because it provides context for people, places, ideas, and experiences (Polanyi, 1996).

Knowledge sharing. The movement of knowledge across individual and organizational boundaries, into and from repositories, and into organizational routines and practices (Bock, Zmud, Kim, & Lee, 2005). It concerns the willingness of individuals in an organization to share with others the knowledge they have acquired or created (Gibbert & Krausse, 2002).

Personality traits. A dynamic and organized set of characteristics possessed by a person that uniquely influences his or her cognitions, motivations, and behaviors in various situations (Ryckman, 2007, p. 4).

Proactive personality. A stable disposition toward proactive behavior. Individuals with a proactive personality are relatively not constrained by situational forces, and they effect environmental change (Bateman & Crant, 1993).

Economic rewards. Incentive that motivates individuals to perform an action. It is short-term and close-ended relationships based on well-defined obligations. The emphasis is on narrow financial obligations (e.g., pay and incentives) without any long-term investments relative to employment (Blau, 1964).

Social exchange. It entails a high level of trust, provides extensive investment in the employment based on a long-term relationship and socio-emotional aspects of the relationship (Shore et al., 2006). Social exchange relationships evolve when employee take care of each other, engendering beneficial consequences (Cropanzano & Mitchell, 2005).

Summary

This chapter has articulated the rationale and the need for this study by reviewing previous research on knowledge sharing and a discussion of its limitations. Based on the limitations, this chapter developed the problem statement and presented the significance of the

present study. Finally, this chapter briefly provided the organization of the proposal. The following chapter describes the literature review and research hypotheses.

CHAPTER 2

LITERATURE REVIEW

This literature review includes major concepts relevant to examining the relationship among proactive personality, economic rewards, social exchange, and knowledge sharing. This chapter proposes three themes related to this area of inquiry. In the first section, definitions of "knowledge" are given, and the conceptual frameworks of "knowledge sharing" are discussed. The review provides theoretical insight for understanding what is knowledge and why knowledge sharing is important for maintaining and increasing organizational competitiveness. The second section reviews personality traits that are unique to an individual's cognitions, motivations, and behaviors that are present in organizational settings. The subsequent section addresses the idea of economic exchange as an individual's perception of extrinsic rewards, and social exchange as an interpersonal variable. This variable is associated with employee knowledge sharing as an antecedent to an individual level. The chapter concludes with a discussion of relationships among variables based on previous studies that examine the determinants of knowledge sharing.

The research began by summarizing selected books about knowledge management and synthesizing relevant information from the summaries. Also, the University of Illinois' online library system, which provides access to major journals, was used to identify relevant scholarly publications. This search includes the following: *Academy of Management Journal, Academy of Management Review, Administrative Science Quarterly, Human Resource Development International, Human Recourse Development Quarterly, Human Resource Development Review, Journal of Applied Psychology, Journal of Knowledge Management, Journal of Management, Journal of Management Studies, Management Science, Organization*

Science, Organizational Behavior and Human Decision Processes, Strategic Management Journal, Long Range Planning.

A literature search was conducted to identify studies related to the topics of knowledge sharing and its determinants. The literature review first identified key search words for accessing relevant research. Particular keywords included "knowledge," "knowledge sharing," and "knowledge management." These terms were applied to electronic library searches via Searching the Web of Science and EBSCO for full peer-reviewed papers from 1994 to 2014. Using those keywords, a total of 1,709 articles were retrieved. After reviewing the titles, 562 articles were chosen for the abstract review. From the abstract review of the articles in total, 238 articles were filtered for the full paper review. In addition to this selection process, related papers were added by reviewing sources in the selected literature. In doing so, the researchers reviewed how the source would enhance the contribution of this study to the literature in general and categorized the articles accordingly.

Review of Knowledge Sharing Literature

The Concept of Knowledge

Knowledge is increasingly recognized by business organizations as the key to long-term business growth, competitive advantage, and organizational effectiveness (Davenport & Prusak, 1998; Drucker, 1968; Toffler, 1990; Nonaka, 1994). In particular, it is linked with the growth of knowledgeable workers as well as the rapid flow of global information in corporate environments (Davenport & Prusak, 1998). As such, knowledge is regarded as a critical resource that should be cultivated, exploited, and shared among organizational members in an effort to create and maintain a sustainable competitive advantage (Aliaga, 2000). The process of managing knowledge is a noteworthy phenomenon, and Drucker (1964) was the first person to

coin the phrase *knowledge economy*. A number of practices and research programs demonstrated how a business was driven by intensive production and uses of knowledge (Powell & Snellman, 2004). Also, evidence suggests that individual and organizational performance is increasingly dependent on knowledge production and sharing (Furman, Porter, & Stern, 2002). Companies in global settings, for example, indicated knowledge shortages and a lack of talented employees as its primary concerns (Michaels, Handfield-Jones, & Axelrod, 2001).

Prior to the 1990s, the idea of "knowledge" was largely overlooked in management studies (Phelps, Heidl, & Wadhwa, 2012). Classical theories of value are resource-based with minimal focus on the role of knowledge. Moreover, land, labor, and physical factors of production constituted the basis of this conventional approach (Smith, 1776). The labor theory of value explains that the value of a product is dependent on the labor used in its production. However, organizations are no longer valued today solely for what they have accomplished, but are recognized for potential output in the future (Drucker, 1999). The promise of and interest in knowledge management (KM) for companies and its employees involves an investigation of the possibilities for learning effectively and taking action based on what is learned (Pfeffer & Sutton, 1996).

The concept of knowledge is rooted in Plato's definition, "justified true belief," which has been accepted by most Western philosophers. According to his book, *Theaetetus*, knowledge originates in the minds of individuals. Plato had much to say about the nature of knowledge, and he began with the proposition that "knowledge is perception" (Brown & Duguid, 2001). Most literature adopts this traditional definition of knowledge (e.g. Cook & Brown, 1999; Kingston & Macintosh, 2000; Nonaka, Byosiere, Borucki, & Konno, 1994; Nonaka, Toyama, & Nagata, 2000). Belief is critical to this concept of knowledge because it is closely tied to an individual's

values. Over the past two decades, a considerable amount of literature has been published on knowledge management. These studies have provided many different definitions and perspectives on knowledge (e.g. Alavi & Leidner, 2001; Alazmi & Zairi, 2003; Davenport, DeLong, & Beers, 1998; Kulkarni, Ravindran, & Freeze, 2007; Maier & Remus, 2003; Schultze & Leidner, 2002).

Definitions of "knowledge" have multiple roots in different disciplines. How the field of Knowledge Management (KM) is defined is dependent on the definition of knowledge that it adopts. Over a hundred definitions of KM may be classified according to three distinct perspectives on knowledge: (1) Cognitive science—identify the distinctive characteristics of experts in information processing and problem-solving (e.g. Collins, 1993); (2) Business—focus on the capture and documentation of knowledge to enhance performance (e.g. Wiig, 1993); (3) Process-technology—information technology and virtual repository for relevant information that is critical to tasks performed daily (e.g. Sveiby, 1997). Various efforts to classify and define "knowledge" can be summarized as follows:

Table 2-1

A summary of knowledge categories

Researcher	Categories
Polanyi (1966)	• Tacit knowledge: difficult to articulate and put into text • Explicit knowledge: captured in some tangible form
Collins (1993)	• Embedded knowledge: experience, internalization, common practice • Embodied knowledge: routines, habits, tasks unconsciously practiced • En-cultured knowledge: embedded in context, social product
Wiig (1993)	• Public knowledge: explicit, taught, and routinely shared knowledge • Shared expertise: held by knowledge worker, shared in work • Personal knowledge: mostly tacit, used unconsciously in work
Davenport and Prusak (1998)	• Data: a set of discrete facts • Information: A message, usually in the form of a document • Knowledge: A mixing of experiences, values, and expert insight
Zack (1999)	• Data: observations out of context, and not directly meaningful • Information: results from placing data within a meaningful context • Knowledge: as a thing to be stored and manipulated and as a process of simultaneously knowing and acting
Chua (2002)	• Individual knowledge: harbored by an individual • Collective knowledge: held commonly by a group/organization
Yang (2003)	• Technical knowledge: what to do • Practical knowledge: how to do it • Affectual knowledge: values, or why it is done this way

The multidisciplinary nature of knowledge management has its merits and demerits. KM is an advantage to almost any discipline that can build a research foundation on its understanding and practice. Such benefits appear in fields that range from cognitive science to information management. These benefits, however, may prompt challenges with respect to boundaries. Similar to the skepticism and definition debates regarding Human Resources Development (HRD) (e.g., Kuchinke, 2001), KM is, arguably, not a separate discipline with a unique body of knowledge structures. Despite this fact, KM literature has mainly adopted Polanyi's distinction. His original idea of tacit dimension found resonance with many models (e.g., Boisot, 1998; Davenport & Prusak, 1998; Nonaka, 1994; Wiig, 1993). Based on his idea, two approaches were generally accepted: (1) the constructivist approach—knowledge as a subjective state of individuals' minds, embedded in organizations (Davenport & Prusak, 1998), and (2) the objectivist approach—knowledge as an objective state of things encoded in written forms (Spender, 1998). These perspectives may be summarized as follows:

Table 2-2

Perspectives regarding knowledge

Constructivist perspective	Objectivist perspective
• Knowledge is the state of knowing • Knowledge as experience—rooted in practice, action, and social relationships • Knowledge is dynamic—a process • Knowledge emerges through the interplay between individual and collective levels • Knowing occurs via social processes • KM as a way of facilitating knowledge creation and sharing	• Knowledge is justified true belief • Knowledge as perception—a discrete cognitive entity • Knowledge is objective and static • Knowledge is a resource existing at the individual and collective levels • Knowledge is created via social process • KM as a management tool for handling existing knowledge

Source: Svetlik & Stavrou-Costea (2007)

This comprehensive review identifies several different approaches used in the study of knowledge sharing; however, two patterns emerge from these various definitions. The first approach is the effort to distinguish between two different types of knowledge: tacit and explicit. Explicit knowledge is knowledge that can be codified and is easy to communicate. Tacit knowledge, which is highly personal, is difficult to articulate and is rooted primarily in contextual experiences. Tacit knowledge tends to reside within a person; whereas explicit knowledge is usually contained by concrete media. The definition of tacit knowledge originated with Polanyi's (1966) concept of tacit knowing. In Polanyi's discussion of personal knowledge, he stated, "we know more than we can tell." He considered tacit knowledge to be more valuable

than explicit knowledge because it provides the context for people, places, ideas, and experiences. Table 2-3 compares the properties of tacit knowledge and explicit knowledge.

Table 2-3

Summary of comparison between tacit knowledge and explicit knowledge

Tacit knowledge	Explicit knowledge
• Ability to handle new and exceptional situations	• Ability to disseminate, reproduce, access throughout a team and organization
• Expertise, know-how, know-where, and know-why	• Ability to teach, to train
• Ability to cooperate, to transmit a culture	• Ability to organize, systematize, to translate a vision into a mission
• Coaching and mentoring to transfer experiential knowledge	• Transfer knowledge via products and services

Source: Dalkir (2011), p. 10.

Nonaka (1994) expanded the concept of a tacit dimension of knowledge. The study described it as consisting partly of technical skills and as the key to corporate innovation. For example, he pointed out that Japanese companies in the1980s were highly innovative because they were able to successfully collectivize each expert's tacit knowledge for the company. Later, Nonaka and Takeuchi (1995) published *The Knowledge Creating Company*, emphasizing that tacit and explicit knowledge are critical for an SECI model of knowledge dimensions. Specifically, the interaction of tacit knowledge and explicit knowledge forms the four stages of knowledge conversion. These stages include socialization, externalization, combination, and internalization. Each results in different knowledge content.

In contrast to a dichotomy approach – tacit knowledge and explicit knowledge – there have been hierarchical views of data, information, and knowledge. Some authors (Alavi & Leidner, 2001; Earl, 2001) argue that the terms "information" and "knowledge" can be used interchangeably due to slight practical distinction. This approach draws from a computer science background. Although it might prove to be easily quantifiable and measurable, it does not reflect significant distinctions. Data, information, and knowledge are considered as constituent elements of a continuum (Nonaka & Takeuchi, 1995; Nonaka, 2002; Boisot, 1998, 2002; Leonard & Sensiper, 2002). Nonaka and Takeuchi (1995) view that "information is a flow of meanings, while knowledge is created by that very flow of information, anchored in the beliefs and commitment of its holder" (Nonaka & Takeuchi, 1995, pp.58-9). Boisot (1998) argues that "knowledge builds on information that is extracted from data" (p. 12). Leonard and Sensiper (2002) state that "knowledge is a subset of information" (p. 485). In addition, Nonaka (2002) explains that "information is a necessary medium or material for initiating and formalizing knowledge" (p. 439).

Miller and Morris (1999) suggest that knowledge is obtained when theory, information, and experience are integrated, interactively. Knowledge management researchers generally accept this definition: "the result of cognitive processing triggered by the inflow of new stimuli" (Alavi & Leidner, 2001, p. 109). Bohn (1994) distinguishes between knowledge and information or data as follows: (1) knowledge "allows the making of predictions, causal associations, or prescriptive decisions about what to do" (p. 62), and (2) information is based on "raw data which are simple facts and endowed with meaning" (p .62). In other words, all information is a sufficient condition of knowledge, but knowledge is more than just information (Machlup, 1980). Miller and Morris (1999) defined knowledge as the intersection of information,

experience, and theory. Finally, knowledge can be extended to include wisdom, defined as successfully applied knowledge, which will often be tacit in nature. The description of this knowledge concept is depicted in Figure 2-1.

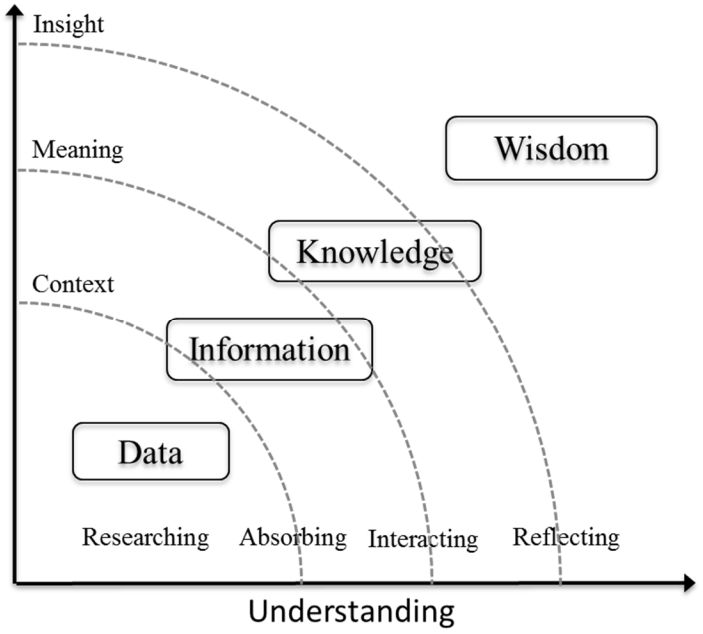

Figure 2-1. Hierarchy of data, information, knowledge, and wisdom (Miller & Morris, 1999)

Another perspective, containing two different levels - individual and group - helps to explain knowledge in terms of corporate innovation. Cook and Brown (1999) recommend a combined use of tacit and explicit knowledge and individual and group knowledge. They argue that innovation is the result of a generative interaction between knowledge and knowing, which underlies the various forms of knowledge that must be shared for effective organizational collaboration. Figure 2.2 depicts these four types that interact with knowing and provides an example for each.

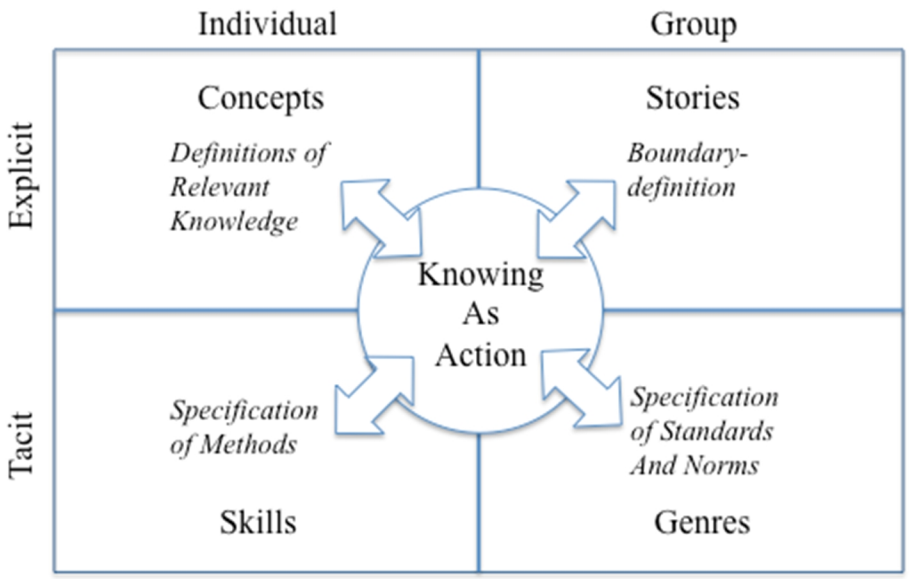

Figure 2-2. Types of knowledge and generative interaction (Cook & Brown, 1999).

From the review of definitions, this study adopts the following: "knowledge is the whole set of insights, experiences, contextual information, and procedures that are considered correct and true and that therefore guide the thoughts, behaviors, and communications of people" (van der Spek & Spijkervet, 1997, p. 1). That is, knowledge is a reason-based processing of information and data intended to actively enable performance, problem-solving, decision-making, learning, and teaching (Dalkir, 2013). Recently, it has been argued that all information can be considered knowledge (Wang & Noe, 2010) and that there is minimal practical utility in distinguishing knowledge from information when studying knowledge sharing (Bartol & Srivastava, 2002).

Research on Knowledge Sharing

To date there has been little agreement on a single definition of knowledge sharing. As definitions of knowledge vary, approaches to knowledge sharing vary as well, depending on the different perspectives of economics, sociology, psychology, and management views (e.g., Alavi & Leider, 2001; Argote et al., 2003; Dixon, 2000; Nonaka, 1994; Tsoukas &

Mylonopoulos, 2004; von Krogh, 1998; von Krogh, Ichijo, & Nonaka, 2000). An examination of the different perspectives regarding the process of knowledge sharing brings to attention a fundamental ontological difference (Small & Sage, 2005). This difference rests on the role of individuals in the process of knowledge sharing. In other words, organizational knowledge as a source of competitiveness originates in the minds of the individual knowledge worker and emerges as individual knowledge workers interact with other knowledge workers and their environments. Nonaka and Takeuchi (1995, p. 59) described this phenomenon as follows:

> Knowledge is created only by individuals. An organization cannot create knowledge, without individuals. The organization supports creative individuals or provides contexts for them to create knowledge. Organizational knowledge creation, therefore, should be understood as a process that "organizationally" amplifies the knowledge created by individuals and crystalizes it as part of the knowledge network of the organization.

Many agree with this notion, proposed by Nonaka and Takeuchi (1995), that knowledge is a dynamic mix of individual, group, organizational and inter-organizational experiences, values, information, and expert insights (e.g., Cook & Brown, 1999; Crossan, Lane, & White, 1999; Davenport & Prusak 1998; Miller & Morris, 1999). The basic concept of knowledge conversion, developed by Nonaka and Takeuchi (1995), is based on how two types of knowledge, tacit and explicit knowledge, interact to create new organizational knowledge.

The interaction of tacit and explicit knowledge forms the four stages of knowledge conversion—i.e., socialization, externalization, combination, and internalization—identified by these authors and results in different knowledge content. Thus, organizational knowledge creation, depending on the individuals' knowledge sharing, is a synthesized dialectical process that occurs through dynamic interrelationships among individuals as well as contextual factors

(Nonaka, Takeuchi, & Umemoto, 1996; Nonaka, Toyama, & Nagata, 2000; Nonaka & Toyama, 2003; von Krogh, Ichijo, & Nonaka, 2000).

Many researchers defined knowledge sharing from their own points of view. These terms are often used interchangeably: "knowledge sharing," "knowledge flows," and "knowledge transfer." For example, Alavi and Leidner (2001) used "knowledge sharing" mixed with "knowledge transfer" and defined them as the process of disseminating knowledge throughout an organization. Gupta and Govindarajan (2000) regarded knowledge sharing as a part of a knowledge flow that is comprised of five elements: value of the source knowledge, willingness of the source to share knowledge, media richness of the communication channel, willingness of the recipient to acquire knowledge, and the absorptive capacity of the recipient. Connelly and Kelloway (2003) define knowledge sharing as "a set of behaviors that involve the exchange of information or assistance to other. It is separate from information sharing, which typically involves management making information on the organization available to employees. Whereas knowledge sharing contains an element of reciprocity, information sharing can be unidirectional and unrequested" (p. 294).

Davenport and Prusak (1998) define knowledge sharing as a process that involves exchanging knowledge between individuals. Bartol and Srivastava (2002) extend their concept of knowledge sharing to "individual's sharing organizationally relevant information, ideas, suggestions, and expertise with one another" (p. 65). Knowledge sharing, which may be understood as the contributions made by individuals to the collective knowledge of an organization, is increasingly acknowledged as an important issue (Cabrera & Cabrera, 2005). Within an organization, knowledge is often shared among employees in the form of various job-related documents, organizational rules, working procedures, personal experience, and know-

how. Therefore, knowledge sharing is crucial because it helps organizations to promote best practices through learning and to maximize organizational values (Hansen, 1999; McDermott & O'Dell, 2001).

From a management standpoint, knowledge sharing is regarded as "extra-role behaviors." This phrase refers to positive behaviors that are helpful but not specified in advance, such as a formal job requirement (Van Dyne & LePine, 1998). One reason to consider knowledge sharing as fundamental to any organization is the fact that it is not readily apparent what knowledge individuals have to share. A number of studies demonstrated that knowledge sharing and the transformation of different kinds of knowledge are critical to gaining and strengthening competitive advantage (e.g. Leonard-Barton, 1992; Drucker 1993; Nonaka & Takeuchi, 1995; Grant, 1996).

As Polanyi (1966) described it, valuable knowledge is often tacit and cannot be easily coded into words or symbols for use by others. It is important to encourage knowledge sharing among individuals and to promote an organizational culture to stimulate knowledge sharing. Bartol and Srivastava (2002) state that companies with successful experience in motivating knowledge sharing treat employees well and recognize how their contributions are important components for achieving organizational success. In a knowledge economy, a key activity for organizations is to develop systematic processes for creating and leveraging knowledge. Although knowledge sharing is actively promoted, various reasons cause employees to be reluctant to share their knowledge with others (Davenport et al., 1998).

In an area of human resource development, researchers and practitioners focused on learning in organizations (e.g., Ardichvili, Page, & Wentling, 2003; Cho, Cho, & McLean, 2009; Daniels, 2013; Noe, 1986; Salas & Cannon-Bowers, 2001). Marsick and Watkins (2000) argue

that most knowledge acquisition occurs through informal learning opportunities at a workplace and not solely through training programs that offer a formal way to share knowledge. Such research established that interpersonal learning through knowledge sharing is important for the individual and the organization.

The majority of knowledge sharing studies examined a positive link between knowledge sharing and organizational performance. For example, Jiang and Li (2009) investigated the relationship between knowledge sharing and a firm's innovative performance in 127 German firms during the years 2000 to 2005. Results of this longitudinal study show that knowledge sharing contributes positively and significantly to a firm's performance ($\gamma = .228$, $p < .05$). The findings of Collins and Smith (2006) also indicate that knowledge exchange and a firm's performance are positively related in a sample of knowledge workers from 136 high-technology firms. In regression analyses, researchers found that knowledge exchange is significantly related to a firm's revenue ($\beta = .46$, $p < .01$) and sales growth ($\beta = .43$, $p < .01$). Tanriverdi (2005), for example, investigated the effects of information technology's relatedness to knowledge sharing capabilities, which led to a firm's superior performance.

Empirical results from 37,562 survey responses in 250 firms show that knowledge sharing positively links to the financial performance of the firm ($\gamma = .17$, $p < .01$). In a model of motivated information process (Hinsz, Tindale, & Vollrath, 1997), De Dreu (2007) examined the relationship between knowledge sharing and team effectiveness, using a sample of 368 individuals in 46 teams. His regression analysis indicates that knowledge sharing within teams is significantly related to a team's effectiveness ($\beta = 1.62$, $p < .001$) through the mediation of team learning ($\beta = .69$, $p < .05$). Moreover, the emphasis of these studies was on intellectual assets to

be captured, preserved, and utilized to the greatest extent possible by individuals and organizations.

In contrast, Ives and his colleagues (2003) argue that knowledge sharing is a human behavior that should be examined in the context of human performance as a complex activity that is influenced by multivarious factors. They suggest a human performance model that includes organizational and individual factors. Organizational factors include rewards, structures, processes, and physical work environments. Individual factors include disposition, values, means, and motivation. These factors are interrelated and interpersonally influence the success of knowledge sharing. Therefore, to better understand the reasons why individuals share their knowledge, this study focuses on individuals' dispositional traits and their perceptions of the treatment received from their organization when they share knowledge. While scholars have addressed one or two of these issues, this study, based on literature reviews, resolves disparate findings related to knowledge sharing (see Figure 2-3).

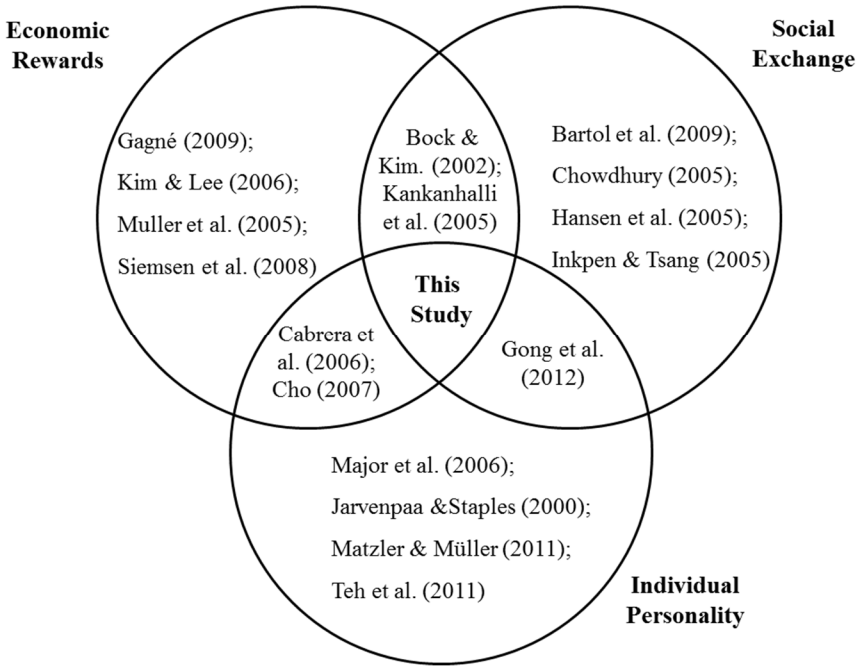

Figure 2-3. Convergence of this study based on determinant factors of knowledge sharing.

Knowledge sharing may be influenced by various factors that inhibit a process within the context of an organization (Andrew & Delahaye, 2000; Bock et al., 2005; Davenport & Prusak, 1998; Dyck, Starke, Mischke, & Mauws, 2005). That is, different people may react to knowledge sharing in different ways under the same conditions (Jarvenpaa & Staples, 2001). Numerous factors can influence an individual's decision to share knowledge or not. Based on different theoretical arguments, the current review identifies three types of influence on knowledge sharing among individuals. First, individuals are ultimately responsible for sharing their knowledge. Individual differences based on personality traits are a key dimension. Mooradian and his colleagues (2006) argued that an individual's personality plays a significant role in one's in-role behavior and out-role behavior, such as knowledge sharing. They highlight knowledge sharing as an essential component for the breadth of organizational members' and individual's skills and competencies.

Indeed, prior research found that personality traits predict one's attitudes and interpersonal relationships toward knowledge sharing (Bakker, Tims, & Derks, 2012; Cabrera et al., 2006; Lin, 2007). In addition, individuals' perceptions of economic and social exchange may be considered as the result of interactions between individuals and environments, and it is a motivation mechanism (Song, Tsui, & Law, 2009). Exchange theory explains that employees respond to their organization differently based on the treatment they receive (Blau, 1964). This involves economic rewards, such as a cash bonus and financial incentives, as well as a social exchange relationship that involves, for instance, reciprocity and perceived intrinsic benefits. The following table shows a detailed summary of existing literature with its constructs.

Table 2-4

Summary of relevant research on knowledge sharing at the individual level

Authors (Year)	**Constructs**	**Dependent variables**	**Context**	**Level phenomena**[2]
Constant, Kiesler, and Sproull (1994)	Self-interest reciprocity; Self-consistency; Work experience	Sharing expertise (computer program)	Between-subjects experimental design using different vignettes (485 students sample)	Micro-micro
Bouty (2000)	Confidentiality; Autonomy; Interaction dynamics	Information exchange	38 R&D researchers of 13 international organizations in France	Micro-micro
Jarvenpaa and Staples (2000)	Information culture; Information ownership; Propensity to share; Task independence; Computer comfort	Use of collaborative electronic media	A university that have a well-developed IT infrastructure including exchange, collaborative system, and web-board (1,125 academic staff sample)	Macro-micro
Bartol and Srivastava (2002)	Individual rewards; Team rewards	Knowledge sharing		Macro-micro
Bock and Kim (2002)	Expected rewards; Expected associations (social exchange); Expected contribution; Level of IT usage	Knowledge sharing behavior	Respondents from 4 large public firms in Korea, having various channels (e.g., BBS, email) to share knowledge (467 employees sample)	Macro-micro
Irmer, Bordia, and Abusah (2002)	Evaluation apprehension; Perceived benefits of knowledge sharing; Organization tenure	Knowledge sharing intentions	Respondents from 3 Australian regional offices of a large multi-national consulting firm (118 staff sample)	Macro-micro

[2] In order to examine whether the existing literature is primarily concerned with level phenomena, this study adopts Coleman's (1990) distinction between macro- and micro-levels of analysis and the resulting four types of links between them: macro-macro, macro-micro, micro-micro, and micro-macro links. This study primarily focuses on knowledge sharing at the individual level and therefore restrict attention to only micro levels.

Table 2-4 (Continue)

Authors	Constructs	Dependent variables	Context	Level phenomena
Kamdar, Nosworthy, Chia, and Chay (2002)	Monetary incentives; Self-monitoring	Willingness to share knowledge	A large Fortune 500 oil company in India (150 employees)	Macro-micro
Kolekofski and Heminger (2003)	Beliefs about information; Self-interest; Reciprocity; Norms; task-relevancy	Intentions toward sharing	Faculty and staff in Air Force Institute of Technology (249 sample)	Micro-micro
Ryu, Ho, and Han, (2003)	Attitude toward knowledge sharing (KS); Subjective norm to KS; Perceived behavioral control to KS	Intention to knowledge sharing; Knowledge sharing behavior	Physicians at tertiary hospitals in Korea (334 sample)	Micro-micro
Lin and Lee (2004)	Attitude toward KS; Subjective norm to KS; Perceived behavioral control to KS	Intention to knowledge sharing; Knowledge sharing behavior	Senior managers in Taiwanese companies among the top 2,000 firms (154 sample) * replicative study of Ryu et al. (2003)	Micro-micro
Chowdhury (2005)	Interpersonal relationship-social exchange; Affected-based; Cognition-based;	Subjective measure of knowledge sharing	part-time MBA students of 31 teams in East Michigan University (164 sample)	Micro-micro
Bock, Zmud, Kim, and Lee (2005)	Extrinsic rewards; Reciprocal relationships; Sense of self-worth; Organizational climate	Attitude toward knowledge sharing; Subjective norm; Intention to share knowledge	Respondents from 27 firms across 16 industries in Korea (259 sample)	Macro-micro
Hansen, Mors, and Lovas (2005)	Size; Strength; Competition; Perceived Costs	Knowledge sharing behavior	121 R&D teams in 27 different subsidiaries of high technology company	Macro-micro

Table 2-4 (Continue)

Authors	Constructs	Dependent variables	Context	Level phenomena
Kankanhalli, Tan, and Wei (2005)	Perceived costs; Extrinsic reward; Intrinsic benefits (social exchange)	Electronic knowledge repositories usage	Respondents from 10 firms in Singapore (150 sample)	Macro-micro
Müller, Spiliopoulou, and Lenz (2005)	Incentives; Organizational culture	Knowledge sharing	16,489 employees from 36 countries	Macro-micro
Wasko and Faraj (2005)	Individual motivations; Structural capital; Cognitive capital; Relational capital	Knowledge contribution	Electronic network of a national legal profession association (604 sample)	Macro-micro
Cabrera, Collins, and Salgado (2006)	Personality; Perceived support; Economic rewards; Intrinsic rewards; Job autonomy	Knowledge sharing behavior	Respondents from a large multinational company in IT industry (372 sample of 5,400 population)	Macro-micro
Major, Turner, and Fletcher (2006)	Proactive personality; Big Five factors	Motivation to learn; Sharing information; Development activity	Randomly selected participants from a midsized financial service organization in the U.S. (183 sample)	Micro-micro
Moorand, Renzl, and Matzler (2006)	Personality traits; Trust	Knowledge sharing	Enterprise Resource Planning software and consulting firm (64 sample)	Micro-micro

Table 2-4 (Continue)

Authors	Constructs	Dependent variables	Context	Level phenomena
Kim and Lee (2006)	Organizational culture; Performance-based reward systems; IT	Employee knowledge sharing capabilities	5 public-sector and 5 private-sector organizations in Korea (322 sample)	Macro-micro
Watson and Hewett (2006)	Self-efficacy; Trust; Value of knowledge (social exchange); Ease of access; Training	Frequency of knowledge sharing	All of non-clerical employees within a large division of the IT firm (430 sample)	Macro-micro
Cho (2007)	Personality; Perceived rewards; Self-efficacy	Knowledge sharing intention—moderated by knowledge type	A part-time MBA students working in Korean national Information Society Agency and Samsung (207 sample)	Macro-micro
Hsu, Ju, Yen, and Chang (2007)	Trust; Self-efficacy; Outcome expectations	Knowledge sharing behavior	9 virtual companies in Hong Kong, Taiwan, and China (274 sample)	Macro-micro
Lin (2007)	Organizational factor-support & reward; IT use; Individual factor -self-efficacy & helping others (social exchange)	Knowledge sharing process - donating & collecting; Innovation capability	Randomly selected 50 organizations from the top 1,000 firms in Taiwan (172 sample)	Macro-micro
Siemsen, Balasubramanian, and Roth (2007)	Rewards for sharing knowledge; Perceived benefits from KS; Usefulness	Knowledge sharing behavior	4 firms in service and manufacturing industries (280 sample)	Macro-micro

Table 2-4 (Continue)

Authors	Constructs	Dependent variables	Context	Level phenomena
Yao, Kam, and Chan (2007)	Organizational arrangements; Personal development; Performance assessment & reward compensation	Officer's knowledge sharing	Various divisions and offices in Hong Kong government* (40 sample) * qualitative study (interviews)	Macro-micro
Chow and Chan (2008)	Trust; Shared goal; Social network	Knowledge sharing	136 companies in Hong Kong (190 sample)	Micro-micro
Fey and Furu (2008)	Financial incentives; Shared vision; Role of host country	Knowledge sharing	164 foreign-owned subsidiaries in Finland and China (739 sample)	Macro-micro
Bartol, Liu, Zeng, and Wu (2009)	Perceived support (social exchange); Job security; Organizational tenure	Knowledge sharing behavior	12 IT companies in China (255 sample)	Macro-micro
Jo and Joo (2011)	Organizational culture; Commitment; Organizational citizenship behaviors	Knowledge sharing	31 companies in South Korea (452 sample)	Macro-micro
Joseph and Jacob (2011)	Extrinsic rewards; Reciprocal benefit; Organizational climate	Knowledge sharing; Subjective norms	IT company in India (125 sample)	Micro-micro

Table 2-4 (Continue)

Authors	Constructs	Dependent variables	Context	Level phenomena
Gong, Cheung, Wang, and Huang (2012)	Proactive personality; Interpersonal trust	Knowledge exchange; Creativity	174 specialty retail stores in Taiwan (375 sample)	Micro-micro
Papadopoulos, Stamati, & Nopparuch (2012)	Subjective norm; Social identity; Group norm; usefulness; ease of use; enjoyment; self-efficacy; altruism	Knowledge sharing	Thai firms registered in the Thai Stock Exchange (175 sample)	Micro-micro
Amayah (2013)	Rewards; Trust; Reciprocity; Organizational structure	Knowledge sharing activities	Mid-size public academic institution in Midwest (439 sample)	Macro-micro
Jadin, Gnambs, and Batinic (2013)	Personality traits	Knowledge sharing	German Wikipedia users (256 sample)	Micro-micro

Antecedent Variables for the Study

Prior research suggests psychological and organizational variables that may explain the variance of knowledge sharing among individuals. This study focuses on individual factors and individual perceptions of how an organization is managed. To examine the possible effects of each of these variables on knowledge sharing, this study includes proactive personality, economic exchange, and social exchange to explain individual's knowledge sharing. Concepts, definitions, and empirical results of previous studies are introduced for each antecedent variable.

Proactive Personality

"Personality" is defined as "the dynamic organization within the individual of those psychophysical traits that determine one's unique adjustments to the environment" (Allport, 1937, p. 48). It is the combination and interaction of various traits that form a personality, which makes people unique. It is generally understood that individuals are inclined toward certain attitudes and behaviors based on particular characteristics (Judge & Bono, 2001). Personality traits are important for understanding individual characteristics. Some research recognizes personality as the overall behavioral composition of a person that defines an individual, in physical, cognitive, and affective ways (McClelland, 1951). Cohen and his colleagues (1986) suggest that personality is "an individual's unique constellation of psychological traits and state" (p. 2) in which traits and states are psychological characteristics used to identity human behaviors.

Individual characteristics play a major role in learning behaviors (Hicks & Tochtermann, 2001). Since personality is a pattern of relatively consistent ways in which a person feels, thinks, and behaves, it is an important factor in accounting for patterns of behavior that employees engage in and why they have favorable or unfavorable attitudes toward their

organizations (Ryckman, 2012). Accordingly, personality has been shown to influence several work-related attitudes and behaviors, as well as individual career choice, job stress, leadership, and some aspects of job performance (e.g. Arvey, Bouchard, Segal, Abraham, 1989; Thompson, 2005). Considering organizational behaviors that employees exhibit in the workplace, knowledge sharing can be effected by the characteristics of someone's particular disposition (Jarvenpaa & Staples, 2001).

Exploring the personality traits of employees has encompassed more than half a century of interest in psychology, beginning with the landmark studies of Minnesota Multiphasic Personality Inventory (MMPI-2), Rorschach Inkblot Test (Rorschach test), and the Thematic Apperception Test (TAT). Among them, the Big Five is privileged over other models because evidence suggesting that it accounts for different traits in personality without overlap. This five-factor structure considered as consistent for predicting organizational behaviors across a wide range of participants from different ages and cultures (Schacter, Gilbert, & Wegner, 2011).

In recent years, few researchers have examined the implications of the Big Five model of individuals' dispositional orientations on knowledge sharing (e.g., Cabrera, Collins, & Salgado, 2006; Matzler & Mueller, 2011; Teh, Yong, Chong, & Yew, 2011). Openness to experience has been shown consistently to be positively associated with knowledge sharing between individuals (Matzler & Mueller, 2011). Extroversion is also along the lines of a positive influence on knowledge sharing (Ferguson, Paulin, & Bergeron, 2010). According to Abrams, Cross, Lesser, and Levin's study (2003), agreeableness represents interpersonal trust related to knowledge sharing and shows a high level of straightforwardness and compliance. Another research result shows that individuals with high conscientiousness are reported to possess competence, dutifulness, achievement striving, and affective commitment. These findings relate

to knowledge sharing; however, the results of previous studies that employed the Big Five personality inventory are mixed. They have provided inconsistent results in different settings.

Despite the widespread acceptance of the Big Five model, recent approaches for using personality focus on the specific trait of an individual rather than multi-dimensional types of personality. Hough and Schneider (1996) argue that specific aspects of personality that are tailored to an outcome require compound personality traits, considering criterion-related validity. A proactive personality proved to be predictive of knowledge sharing and motivation to learn (Major et al., 2006). Bateman and Crant (1993) developed the concept of proactive personality, considering a relatively stable individual tendency that differentiates people based on the extent to which they "identify opportunities and take action, and persevere until meaningful change occurs" (Crant, 2000, p. 439). The empirical study of Crant (1996) demonstrates that proactive personality has incremental validity over the Big Five factors in the prediction of job performance. According to Major and his colleagues' (2006) factor analyses, proactive personality is a more accurate predictor of learning motivation between individuals than are the Big Five factors ($\Delta R^2 = .10$, $\gamma = .33$, $p < .05$).

Research revealed that a positive consequence of a proactive personality on outcomes includes job performance (Crant, 1996), career success (Seibert, Crant, & Kramer, 1999; Seibert, Kraimer, & Crant, 2001), and creativity (Fuller & Marler, 2009; Fuller, Marler, & Hester, 2012). Following this logic, Grant and Ashford's work (2008) builds a proactivity process model, capturing an individual's natural tendency toward promoting constructive changes. They suggest that proactive individuals anticipate the effects of future actions and seize opportunities to promote desirable states and goal achievements. Proactive employees take steps to create resources for influencing constructive changes (Crant, 1996). Such employees accumulate

intellectual resources through exchanges with others and create social support by interacting with others (Grant & Ashford, 2008). According to Frese and Fay (2001), proactive personality captures an individual's inclination toward promoting constructive results by interacting with others to exchange knowledge and to identify opportunities for future improvement.

Empirical Results of Previous Research. In a longitudinal study involving 180 respondents across a two-year time period, Seibert and his colleagues (2001) found that proactive personality is positively related to knowledge sharing ($\gamma = .28$, $p < .01$). This leads to positive relationships and career satisfaction ($\gamma = .25$, $p < .01$). Another longitudinal research of four time periods in seven organizations examined proactive personality as an antecedent of knowledge sharing and organizational commitment (Kammeyer-Mueller & Wanberg, 2003). Based on the 589 responses from all time periods, findings showed that high proactivity newcomers were more likely to exchange work-related information than those low in proactivity ($\gamma = .36$, $p < .01$).

Gong and his colleagues (2012) proposed a proactive process for creativity. In a model of individual creativity, these researchers hypothesized that proactive employees seek intellectual capital by exchanging informational resources with others in the workplace. Knowledge sharing fosters trusting relationships that provide psychological safety for creative endeavors. To investigate the relationship among proactive personality, knowledge sharing, and individual creativity, Gong and his colleagues conducted three survey waves across 174 Taiwanese retail stores. Findings from a path analysis in a sample of 190 matched employee-manager pairs indicated that proactive personality had a significant and positive relationship with knowledge sharing ($\gamma = .31$, $p < .01$). The results also showed that knowledge sharing mediated the relationships of proactive personality with trust ($\gamma = .15$, $p < .01$) and individual creativity ($\gamma = .04$, $p < .05$).

Further, Yang, Gong, and Huo (2011) investigated the relationship of proactive personality with interpersonal assistance and turnover intention. They hypothesized that proactive personality is related to greater interpersonal helping and lower turnover intentions. Simply put, knowledge sharing and trust mediates the relationship between them. They collected longitudinal data in three waves from 174 individuals working at manufacturing companies. In a null model of structural equation modeling, knowledge sharing was positively related to proactive personality ($\gamma = .35$, $p < .01$), but it did not mediate between proactive personality and turnover intention ($\gamma = -.12$, $p > .05$). Rather, this study highlights the importance of having individuals with high proactivity and working relationships that nurture trust.

Lin (2007) conducted an empirical study to examine the influence of individual factors, organizational factors, and technological factors on knowledge sharing processes, which lead to superior firm innovation capabilities. For individual factors, she hypothesized that a highly self-efficacious and proactive staff will be more likely to engage in knowledge sharing processes. Based on a survey of 172 employees from 50 large organizations in Taiwan, research findings showed that individual self-efficacy and proactivity are positively associated with knowledge donating ($\gamma = .45$, $p < .01$) and collecting ($\gamma = .38$, $p < .01$). This individual factor was the strongest factor to have indirect effects on firm innovation capability ($\gamma_{donating} = .29$, $\gamma_{colecting} = .41$, $p < .01$).

Samad (2007) conducted a study to investigate contributions related to social structural characteristics, such as self-esteem, power distribution, rewards, and leadership on employee empowerment. Samad also considered the moderating role of proactive personality in employee empowerment and information sharing. From a telecommunication company in Malaysia, 581 employees participated in this research. The findings showed that proactive

personality and knowledge sharing are positively related ($\beta = .19$, $p < .05$), and the highest interaction effect of proactive personality with employee empowerment was from a variance of information sharing ($\beta = .66$, $p < .05$).

Economic Rewards for Knowledge Sharing

In economics, a widely accepted axiom of utilitarianism, including classical and neo-classical economics, is that people are rational and self-interested in social actions (Granovetter, 1985). From a socio-economic standpoint, individuals choose their courses of action in order to maximize utility in a given set of preferences (Boer, Berends, & van Baulen, 2011; Watson & Hewitt, 2006). Kohn (1993) state that employees are most likely to share knowledge when they perceive that economic rewards exceed the cost of knowledge sharing. Thus, the basic hypothesis of economics-based compensation mechanisms is that financial incentives motivate employees to share knowledge (Chng, Rodegers, Shih, & Song, 2012; Yang, 2010).

Over the last two decades, Davenport and his colleagues (1998) studied knowledge management, focusing on how organizations successfully manage what they know. Their research found that offering financial incentives is one of the most important ways to motivate people to share their knowledge with others (Davenport et al., 1998). HRM-based research established extrinsic rewards to be drivers of knowledge sharing (e.g. Kamdar, Nosworthy, Chia, & Chay, 2002; King & Marks, 2008; Osterloh & Frey, 2000; Rafaeli, Raban, & Ravid, 2007; Siemsen, Balasubramanian, & Roth, 2007). Their argument is that some people share their knowledge when receiving payment to do so. The offer of a high financial reward may increase one's extrinsic motivation for sharing knowledge. Müller, Spiliopoulou, and Lenz (2005) note that the impact of monetary incentives on knowledge sharing must be concerned with the common benefits of knowledge sharing when it is enhanced.

In business, practitioners have shown that financial reward systems are useful for encouraging employees to share knowledge with colleagues. For example, IBM started a knowledge-sharing platform – Lotus connections – consisting of Profiles, Blogs, Dogear, Communities, and Activities. IBM devotes 25% of performance reward evaluations on the extent of an employee's knowledge sharing activities. Employees receive monetary awards for their knowledge contribution to this platform (Davenport, 2005). Moreover, several professional consulting firms have knowledge management initiatives in place. For example, McKinsey & Company, Bain & Company, Ernst & Young, PricewaterhouseCoopers (PwC), and A.T. Kearney have Chief Knowledge Officers (CKO) in place and reward systems to encourage employees to participate in the knowledge sharing process. Ernst & Young show that one of the major evaluation dimensions of performance reviews is contribution to and utilization of the knowledge assets of the firm (Hansen et al., 1999). At Bain & Company, CKOs evaluate the extent to which partners help colleagues directly. The degree of high-quality knowledge sharing with others could account for as much as about 25% of annual compensation (Horwitch & Armacost, 2002). A case study of Samsung Life Insurance also suggested sustainable financial rewards as critical motivators for individuals to share knowledge (Moon & Park, 2002). In this case, employees are rewarded with cash bonuses for their contributive efforts to the systems. Also, highly recognized knowledge contributors received a certificate award and an opportunity for overseas educational support.

Researchers suggested in knowledge sharing literature that incentives may be used to motivate individuals to share their knowledge with others. Bartol and Locke (2000) proposed that rewards contingent on knowledge sharing have a positive effect on the extent of knowledge that individuals contribute to knowledge management systems. They suggested that it is possible

to reward individuals by using merit pay plans as an assessment of knowledge sharing. Bartol and Srivastava (2002) expanded the role of organizational reward systems for encouraging knowledge sharing by categorizing knowledge sharing into four mechanisms based on how the knowledge is shared. The four mechanisms include knowledge sharing through an organizational database, knowledge sharing through formal interactions in work units, knowledge sharing through informal interactions within work units, and knowledge sharing through communities of practice. Their research suggested that sharing through organizational databases was mostly suited for rewards application in knowledge sharing because it is quantifiable for an individual's contribution to the knowledge database. Kamara and colleagues (2002) also suggested reward systems as one strategy to encourage knowledge sharing, but they did not offer any specific detail for an optimal system, either. Although they suggested providing rewards contingent on the behaviors of knowledge sharing, no further explanation was given on how this might be accomplished.

Empirical Results of Previous Research. Yao, Kam, and Chan (2007) found that a lack of incentives is a major barrier to knowledge sharing within organizations. Financial rewards, such as a bonus and higher salary, are positively related to the frequency of knowledge sharing made available to a knowledge management system (Kankanhelli et al., 2005). Similarly, employees who perceive a higher level of incentive to share and use knowledge are more likely to report the content of knowledge management systems as useful (Cabrera et al., 2006; Kulkarni et al., 2007). Additionally, the results of a study conducted by Maurer and Tarulli (1994) show consistent links between perceived extrinsic rewards and knowledge sharing.

Kamdar, Nosworthy, Chia, and Chay (2002) conducted a vignette-based experimental study and presented participants with different scenarios, including three conditions of incentives:

monetary incentives, recognition-based incentives, and no incentives. The results showed that people who anticipated incentives are more likely to be willing to share knowledge. The findings indicated that recognition-based incentives were as effective as monetary incentives. They extended a study including a sample of 295 employees working in a division of a Fortune 500 company (Chia, Kamdar, Nosworthy, & Chay, 2005). The results from the ANOVA analyses showed that a much higher degree of knowledge sharing was found in situations that included monetary inducements for sharing ($F = 215.76$, $p < .001$, $\eta^2 = .60$).

Yang (2010) examines the impact of knowledge management strategy on strategic performance with a sample of 500 R&D employees working in Chinese high technology firms. The results of the hierarchical moderated regression show a significant positive relationship between knowledge management strategy and performance ($\beta = .26$, $p < .01$), and a positive moderating effect of reward system on the relationship between knowledge management strategy and performance ($\beta = .43$, $p < .001$). He argues that intra-organizational knowledge sharing is necessary to prevent the loss of information, and he suggests that rewards play a significant role in the accumulation of knowledge.

Kim and Lee (2006) conducted research to examine the influence of organizational factors and information technology on employee knowledge sharing capabilities. The study was conducted based on a convenience sample of 322 employees in 5 public-sector and 5 private-sector organizations in Korea. The results from the ordinary least squares multiple regression analysis showed that reward systems for knowledge sharing were highly and positively related to employees' knowledge sharing in both sectors ($\beta_{public} = .24$, $\beta_{priavte} = .24$, $p < .01$). The findings suggest that reward systems for knowledge sharing promote involvement and communication among employees to share information about the performance of organizational processes.

Contrary to an assumed positive effect of rewards, not all research has found positive outcomes relative to extrinsic rewards. Bock and Kim (2002) found that expected rewards were negatively related to attitudes toward knowledge sharing (β = -.124, p < .001). Researchers replicated the study based on Ajzen and Fishbein's theory of reasoned action (Bock et al., 2005). Again, the results did not support the hypothesis that expected rewards would have a positive effect on attitudes toward knowledge sharing (λ = -.159, p < .01). A possible explanation for these results is that extrinsic rewards undermine employees' intrinsic motivation. Thus, tangible rewards are not the motivational solution for sharing knowledge in the long term (O'Dell & Grayson, 1998). Other researchers argued that outcome-based rewards and sufficient rewards for effort did not foster employees' knowledge sharing in a product development team setting (Yeh, Lai, & Ho, 2006).

Furthermore, research showed that particular types of incentives influence knowledge sharing differently (Quigley, Tesluk, Locke, & Bartol, 2007). The results of hierarchical regression and random coefficient modeling revealed that group-based incentives (M = 10.40, *s.d.* = 1.08) more significantly affect knowledge sharing than those with an individual incentive condition (M = 9.76, *s.d.* =.64, p < .001). Siemsen, Balasubramanian, and Roth (2007) explored the design of optimal incentive systems that induce knowledge sharing within workgroups. The findings indicated that the balance between individual-level and group-level incentives induced cooperation and coordination among employees. They argued that both individual and group incentives are necessary to facilitate knowledge sharing in workgroups ($\beta_{individual}$ = .52, β_{group} = .30, p < .01).

Perceived Benefits as Social Exchange

Another antecedent of knowledge sharing in this study is individuals' perceived benefits in a social exchange relationship between employees. Social exchange theory explains that an individual predicts a degree commensurate with the contributions that s/he perceives is being made by others (Blau, 1964). Thus, an individual's shared knowledge contributes to his/her colleagues and viewed as a reciprocal arrangement (Kane, Argote, & Levine, 2005; Wasko & Faraj, 2000). For example, individuals decide whether or not to share knowledge based on the perceived benefit-to-cost ratio in a given social relationship.

Perceived social exchange emphasizes the norm of reciprocity and a mutual give-and-take of knowledge (Bartol et al., 2009; Inkpen & Pien, 2006; Lin & Lee, 2004). From this perspective, Molm, Takahashi, and Peterson (2000) state, "individuals help others and share information without negotiation of terms and without knowledge of whether or when the other will reciprocate" (p. 1396). In the context of knowledge sharing, individuals may share with others even if they are uncertain about exactly what the outcome will be (Nahapiet & Ghoshal, 1998). Knowledge sharing reciprocity may influence an individual's attitudes toward knowledge sharing with the expectation that s/he might benefit from the value created by social exchange (Han & Yang, 2013; Kaser & Miles, 2002; Ipe, 2003).

Blau (1964) argued that an individual engaged in a social exchange relationship predicted a balance to be maintained in exchange with others. If one perceives that an exchange is unbalanced, the exchange partner will feel an obligation for more exchanges in order to create a balance in the exchange relationship. Gouldner (1960) termed this obligation as the norm of reciprocity, which refers to the social obligation created when an individual receives some benefit from another with an expectation of future return. Considering a social exchange

relationship in organizations, an employee willingly makes a contribution to other organizational members as a sign of good will based on trust that this contribution will be reciprocated in the future (Levine & Cross, 2004; Renzl, 2008; Reinholt, Pederson, & Foss, 2011).

In practice, many businesses implemented knowledge repositories as a form of generalized social exchange (Fulk, Flanagin, Kalman, Monge, & Ryan, 1996). Grover and Davenport and Grover (2001) offered examples of common knowledge repositories, including Lotus Notes, Web-based intranet forums and boards, and Microsoft Exchange, supplemented by search engines. Every employee who has access to these repositories may benefit from someone who shared his/her knowledge in the repositories. In addition to the economic benefits that individuals may receive directly from an organization, there may be other perceived benefits, such as respect, from others, as well as a positive reputation.

Unlike an economic exchange relationship, the potential benefits of a social exchange relationship are based on trust developed over time (Meyer, Stanley, Herscovitch, & Topolnytsky, 2002). In a social exchange relationship, people act in accordance with general expectations of some future return. Social exchange assumes the existence of relatively longer-term relationships of interest between individuals as opposed to short-term exchanges, such as monetary rewards (Molm, 1997). Again, an individual regulates his/her interactions with others on the basis of self-interested analyses of costs and benefits (Song et al., 2009). These benefits for individuals may include reciprocity in the future based on mutual trust (Szulanski, Cappetta, & Jensen, 2004; Szulanski & Jensen, 2006).

Fulk and his colleagues (1996) regarded knowledge exchange as a form of generalized social exchange. Employees are interdependent and indirect with a knowledge repository that is used as an intermediary between knowledge providers and recipients.

Accordingly, Davenport and Prusak (1998) argue that knowledge sharing forms cooperation, outlining some of the perceived expected benefits that regulate an individual's behavior. Empirical results from a meta-analysis of organizational behaviors suggest that cooperation leads to higher performance when employees are interdependent with each other and exchange resources (Hardy, Phillips, & Lawrence, 2003; Stanne, Johnson, & Johnson, 1999).

Resources exchanged during social interaction or knowledge transfer may be regarded as costs for knowledge providers. Intellectual resources received as a result of social exchange or shared knowledge may be regarded as benefits for knowledge recipients (Lathien, 2013). Social exchange theory explains that people behave in ways to maximize personal benefit and minimize cost (Molm, 1997; Singh, 2005). This theory implies, then, that people pursue benefits and reduced cost from knowledge sharing behaviors (Wasko & Faraj, 2000).

Gupta, Govindrajan, and Malhotra (1999) argued that social exchange provides channels for knowledge transfer among employees in organizations. Research on organizational communication highlights the importance of interpersonal interaction as a way to diffuse new ideas within organizations (e.g., Ghoshal et al. 1994, Leonard-Barton & Sinha 1993). Interpersonal social interactions remove barriers to knowledge sharing and shape common interests to support, build, and nurture new and cooperative relationships (Tsai & Ghoshal 1998). Indeed, social interaction is an important element that facilitates knowledge transfer among organizational members (Tsai, 2002; Yli-Renko, Autio, & Sapienza, 2001). Through social interaction, employees gain opportunities to share experiences and ideas and increase knowledge flow within the organization (Hardy et al., 2003).

Research demonstrated the relationship between social exchange and positive outcomes in organizations. In particular, Tiwana and Bush (2001) use social exchange theory in

their examination of factors that impede and facilitate knowledge sharing to understand the behavior of individuals in distributed web communities. Similarly, Bock and Kim (2002) develop a model of knowledge sharing behavior in an organizational context that includes constructs based on social exchange theory. It found that social factors are important predictors of knowledge sharing behaviors. Social exchange theory is a useful theoretical lens for understanding why individuals engage in cooperative behaviors, sharing their valuable knowledge with other organizational members although it is not formally required (Liao & Chuang, 2007).

Empirical Results of Previous Research. Substantial empirical research showed recently that social exchange relationships are influential for explaining the process of knowledge sharing (e.g., Cabrera & Cabrera, 2005; Cabrera et al., 2006; Chowdhury, 2005; Schepers & van den Berg, 2007; Phelps et al., 2012; Wang & Noe, 2010; Wu, Hsu, & Yeh, 2007). Davenport and Prusak (1998) also articulated knowledge sharing based on this theory, outlining some of the expected benefits perceived that may regulate behavior. These factors include future reciprocity, job security, and promotional prospects. In accordance with the norm of reciprocity, employees respond to the perception of social exchange and strengthened socio-emotional bonds with the organization manifested in elevated affective commitment, improved task performance, and heightened job involvement (Wu et al., 2007). Lin's study (2008) showed that employee's organizational citizenship behavior, a discretionary work behavior, is positively related to knowledge sharing in the context of a lack of direct incentive pay. Schulz (2001) explored inter-unit knowledge flows for 570 companies in the United States and Denmark. Empirical evidence indicated that receiving knowledge from others promotes a reciprocity of knowledge flow in the direction of the sender, both horizontally and vertically, in organizations.

Bartol and her colleagues (2009) conducted research on social exchange and knowledge sharing with a sample of 255 IT professionals in 12 Chinese companies. The results of the hierarchical, linear modeling indicated that employees' perceptions of support in organizations are positively associated with knowledge sharing ($\gamma = .28$, $p < .01$). This relationship held only for employees who perceived a high level of job security ($\gamma = .21$, $p < .01$). Additionally, these findings revealed that reciprocity and social exchange mechanisms might be difficult to develop sufficiently when job security is relatively low for an uncertain period of time.

Lin (2007) applied structure equation modeling to investigate the influence of individual, organizational, and technology factors on knowledge sharing processes. Based on a survey of 172 employees from 50 firms in Taiwan, the findings for the acceptance level of overall model fit (GFI = .88, NFI = .87, CFI = .92, RMSEA = .06) showed that a positive mood state of employees, regarding social exchange, positively influenced knowledge donating ($\lambda = .31$, $p < .01$) and knowledge collecting ($\lambda = .27$, $p < .01$). In Lin's study, the results also showed that individual self-efficacy ($\lambda = .45$, $p < .01$) and top management support ($\lambda = .23$, $p < .01$) are positively related to individual knowledge sharing in organizations.

Constant (1994) and his colleagues conducted three experimental research projects on attitudes toward knowledge sharing. Their experiment included 458 students at Boston University's School of Management. The findings showed that when cooperate outputs from knowledge exchange are required, the two students were influenced by their social contexts. The social exchange relationship is a major determinant of individual attitudes toward knowledge sharing.

Bock, Zmud, Kim, and Lee (2005) developed an integrative understanding of the factors supporting individuals' knowledge sharing intentions. In their study, 30 organizations, equipped with chief knowledge office programs, were asked to participate, and 259 responses were analyzed through a partial least squares method. The findings indicated that an individual's perceived reciprocal relationship is the strongest factor that influences his/her attitude toward knowledge sharing ($\lambda = .367$, $p < .01$). Relative to the theory of reasoned action, such relationships influenced individual attitudes toward knowledge sharing and positively influenced an individual's intention to share knowledge ($\lambda = .232$, $p < .01$).

Hew and Hara (2007) conducted a qualitative study of knowledge sharing for three online communities. Researchers gathered data through online observations and semi-structured interviews with 54 participants. Among the seven motivators found, the most common motivator was reciprocity. Among the eight barriers identified to inhibit knowledge sharing, a lack of time and unfamiliarity with the subject were the two most frequently cited reasons for not sharing knowledge.

Summary

This chapter reviewed the literature on knowledge sharing, proactive personality, extrinsic rewards, perceived social exchange, and the relationship of knowledge sharing to these concepts. The review suggested that both individual and organizational factors are related to knowledge sharing among individuals. Relevant literature based on the theoretical framework for this study was reviewed. Relationships, hypothesized between individual/organizational factors, and knowledge sharing were proposed. In particular, definitions, concepts, classification, and empirical results were addressed.

CHAPTER 3

METHODS

Introduction

This chapter opens with a description of the overall research design: an explanatory mixed method, which employs a combination of quantitative and qualitative approaches. It offers a list of research questions and research hypotheses followed by specifics for each method. For a quantitative study, the identification of participants and data collection procedures are described. This is followed by details about instrumentation, validity, and reliability of instruments. Data screening and preliminary tests, such as normality, linearity, outliers and missing data, were conducted. Finally, the data were analyzed via a multiple regression in order to test the hypotheses.

The chapter then moves to the specifics of the research procedures and shares research approaches for a qualitative study. During the qualitative research process, data were collected using various methods, including interview, observation, field notes, and documents. Ten knowledge contributors recommended by HR managers were recruited for the interviews and seven R&D engineers were interviewed. These interviews were audiotaped and recorded in a secured manner. Also, the observation was allowed to further understand the issues presented during data collection. Throughout the research process, the researcher maintained a reflective journal and field note to better understand the issues and challenges that arise in using mixed methods within a case study framework. Included in the subsection of a qualitative study is a brief description of the participant access, procedures for establishing the credibility and trustworthiness of the study, and finally the details of the methods and techniques used for the data analyses.

Research Design

The purpose of this study is to investigate the relationships between knowledge sharing and perceived individual factors by research and development engineers. A sequential explanatory strategy was used in this study to respond to research questions. Mixed methods research is the best choice for this study because it allows for an in-depth understanding of the research engineers' knowledge sharing within a single institution. It also utilizes rich and complex data sources. The overall design of this mixed methods study is shown in Figure 3.1, as recommended by Creswell (2009). The sequential explanatory strategy is characterized by the collection and analysis of quantitative data in the first phase of research followed by collection and analysis of qualitative data in the second phase. Although both phases were connected, each phase underwent separate analysis.

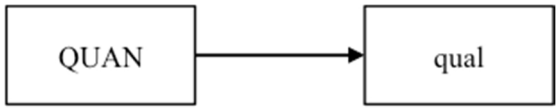

Figure 3-1. Overall design of mixed methods in this study (Creswell & Clark, 2007, p. 209).

This model indicates that quantitative data collection occurs first and is followed by qualitative data collection. Quantitative data is more significant for the purposes of this study; thus, primary quantitative research received greater emphasis. Insight was gained from the combination of quantitative and qualitative research and provides a comprehensive understanding of the research problems presented. For a quantitative study, a survey-based research design was employed to answer the aforementioned research questions and to examine research hypotheses about the relationship between knowledge sharing and its antecedents.

Rigorous instrument validity and reliability examinations were used to confirm the validity and reliability of the instrument. These were analyzed through multiple regression. For a qualitative study, a case study was employed. The researcher conducted face-to-face interviews with selected research engineers. These interviews involved unstructured and open-ended questions that were few in number and intended to elicit opinions and ideas from participants. During observations, the researcher took notes on the behaviors and activities of participants at the research and development center. A detailed description of the research process for this study is shown as follows:

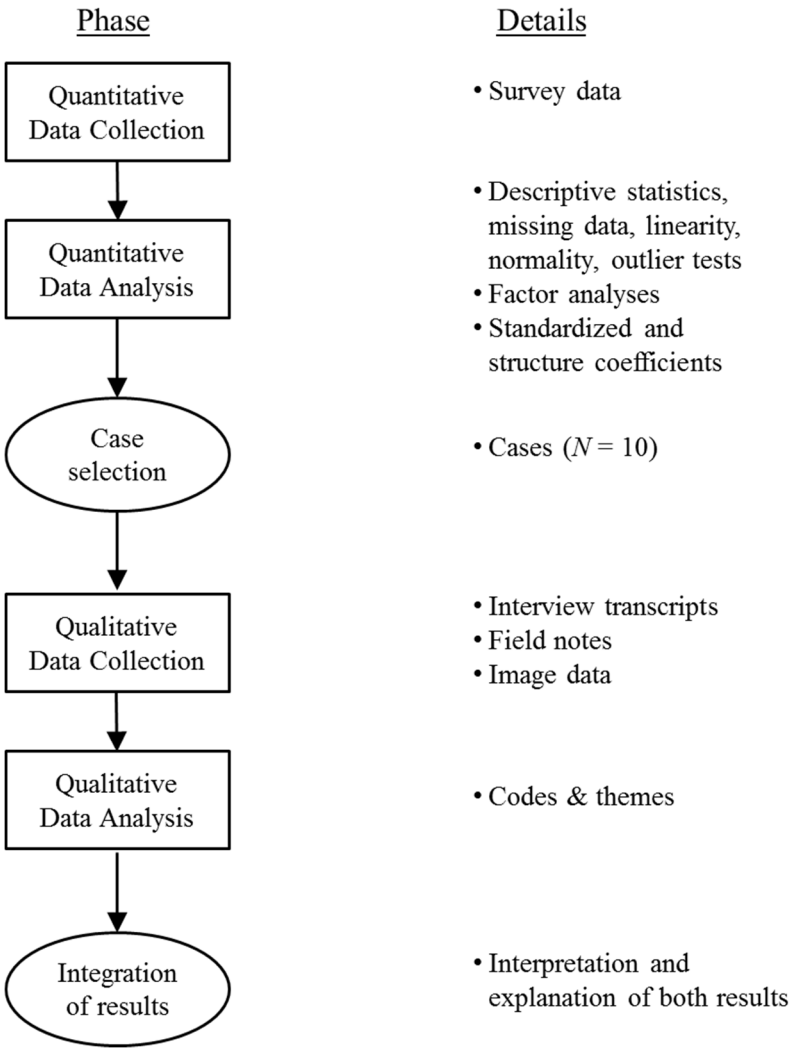

Figure 3-2. Detailed diagram of explanatory mixed methods design for this study.

In an effort to integrate the results, the following research reports how the qualitative findings help to elaborate and extend the quantitative results in Chapter 6. With regard to the quantitative results, the findings suggest that examining the relationships between variables is central to answering questions and hypotheses through the use of surveys. Additionally, qualitative results provide a unique tool for investigating the subtext of engineers' knowledge sharing. Detailed research approaches for quantitative and qualitative studies are described in the sections that follow.

Research Questions

This study examined the relationships of an individual's proactive personality, the perceptions of economic exchange and social exchange with respect to knowledge sharing. To achieve the research purposes of this study, the research questions accrued from the conceptual model, illustrated in Figure 1.1, were based on the review of existing research. These are listed as follows:

1. Does an individual's proactive personality relate to knowledge sharing with others?
2. Do individuals' economic rewards relate to knowledge sharing with others?
3. Does an individual's social exchange perception relate to knowledge sharing with others?
4. How do research engineers describe their knowledge sharing with others?
5. What facilitators and barriers influences research engineers to share their knowledge?

Research Hypotheses

Based on the research questions, the researcher proposes three hypotheses that were tested in a quantitative study.

Hypothesis 1. Proactive personality of research engineers will be positively associated with knowledge sharing with others.

Hypothesis 2. Research engineers' perception of economic rewards will be positively associated with knowledge sharing with others.

Hypothesis 3. Research engineers' perception of social exchange will be positively associated with knowledge sharing with others.

Quantitative Research

Target Population and Research Sample

After permission was granted from the Institutional Review Board (IRB) at the University of Illinois (Appendix A), the researcher contacted managers of the Department of Human Resources (HR) to acquire a list of full-time research engineers actively employed at the selected R&D center. The target population of this study was research engineers working in the R&D center at a leading IT company in South Korea. According to the industrial R&D investment scoreboard (European Commission, 2013), this company ranks second in R&D spending with 10.4 billion dollars in 2013. This company has a strong reputation for knowledge management and for creating a new corporate culture by providing a knowledge-sharing plaza where people participate and create new knowledge (Maeil Business, 2010). About 40,900 R&D employees, who comprise 45% of the total employees, are disbursed across six R&D company centers. These divisions include media, telecommunication networks, semiconductors, displays, and digital appliances. Slightly more than 70% of these employees hold bachelor degrees in science and engineering. Each year the company invests more than 6% of sales revenue in R&D

with a commitment to leading technology standardization and securing intellectual property rights. The targeted company holds 5,043 patents in the U.S as of 2014.

In this research, a non-random purposeful strategy was used so that participants were adequately representative of the population. Regarding the knowledge sharing process, the company has a more structured knowledge management system, which enables employees to share their knowledge with others. A targeted company has a successful knowledge management system (KMS) and boasts a stronger reputation than other companies in terms of learning organizations. For example, each employee shares his/her own best practices and expertise in a shared blog on the community of practices (see Appendix K). For an inter-exchange of knowledge between teams around the globe, employees share information through an intranet, Globalization for Excellence (GLEX). Also, the knowledge map promotes the building of new technology sensing systems (S-KMS) and helps information searching and mining solutions (SaltLux: outsourcing knowledge platform). Additionally, the company also offers its employees access to a fixed-mobile convergence (FMC) infrastructure for information exchange between teams. This enables research engineers to connect with each other in real time through a wireless Access Point (AP) and Voice over Internet Protocol (VoIP).

The criterion-based method was adopted for selecting participants in order to examine the research objectives. This research focuses primarily on individuals' knowledge sharing at the R&D center of an IT company. Therefore, it is important to include research engineers in this study who have actively participated in knowledge sharing through their systems. At the institution selected for this study, there are three sub-groups – future IT, materials and devices, and emerging technology – totaling 2,668 research engineers. Since the focal point of this study is related to knowledge, efforts will be made to ensure that participants in the sample group will

be comprised of knowledge workers. This inclusion will increase the validity of the research.

Moreover, a required criteria for this study is to include a particular group of employees. Research engineers are key personnel for maintaining and promoting effectiveness in an organization, and they constitute the core of the workforce responsible for creating innovation (National Academy of Engineering, 2005). Organizational performance is predominantly influenced by engineers' synergy of knowledge and innovation (Luecke & Katz, 2003). For engineers working at the R&D center, knowledge sharing would be more important than for other job types. To focus on the objectives of this research, employees who work as R&D engineers will be surveyed and only employees whose tasks primarily deal with information, or require the development of knowledge to solve problems as a requirement of their daily functions, were included in the study.

Another criterion for dynamic knowledge sharing was whether s/he belongs to a knowledge management system and how often s/he participates in knowledge sharing. The HR manager selected participants whose knowledge sharing is at an above average frequency for using a knowledge management system. Thus, the majority of the selected sample participants are more engaged in sharing their knowledge with colleagues. About 1,600 engineers were recruited as a potential group from the selected R&D center.

Data Collection

HR managers working at the target group were contacted to provide information about the current research, research procedures, and potential risks and benefits, as recommended by the Institutional Review Board at the University of Illinois. Then, HR managers communicated with potential participants via the intra-net or e-mail for the purposes and logistics of the survey, including an embedded website link. With regard to ethics in this

research, informed consent and respect for privacy and anonymity is important (see Appendix B). Participants were informed that their responses are to be collected and maintained in a secured storage space with a passcode that is codified by secured numbers.

This study used a self-administered internet-based online survey to obtain individual-level perceptions by using an online commercial service provider (http://www.kwiksurveys.com). The online survey method offered several advantages: (1) accessibility for participants regardless of time and space (Birnbaum, 2004); (2) design flexibility (Dillman, Smyth, & Christian, 2008); (3) decreased possibility of missing data within questionnaires (Gall, Gall, & Borg, 2007); (4) convenience of data coding and management. Notably, the online survey method could be negatively influenced by technological illiteracy and server access errors.

Before launching the online survey, a preliminary meeting was held with HR managers and a senior executive director to analyze the survey and ensure that participants understood and could answer the questions. This meeting made several valuable suggestions, with respect to survey instructions and wording of questions to match the vernacular of the company in Korean.

After the survey is in place, the HR managers sent a center-wide email, asking all R&D engineers in the selected R&D center to participate in the survey. Approximately 1,600 employees in total were included in participants, except management support, facilities, and prototype production employees. All the participants contacted were R&D engineers engaged in knowledge intensive project work, the nature of which required a significant reliance on others, for both explicit and tacit knowledge. The survey was active from February 25th, 2014 to March 14th, 2014. To increase the online survey response rate, follow-up emails were sent to

participants one week after the first email, and another final notice was sent through the HR managers another week after the second email (see Appendix B). The procedure required three weeks to complete data collection. The responses were sent directly to the researcher through an online survey provider. After data was collected through an online survey tool, participants' responses were transferred to a spreadsheet for analysis.

Instrumentation

The researcher used a survey questionnaire, employing measures drawn from existing literature. Participants received a 31-item survey instrument (see Appendix C), designed to examine employees' perceptions and opinions of knowledge sharing within organizational settings. Each consists of items that were measured on a five-point Likert scale, ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Since this study was conducted in South Korea, all measures were translated from English into Korean. Measurement equivalences are a critical issue of cross-cultural research (Presser, Rothgeb, Couper, Lesselr, Martin, & Singer, 2004). Brislin, Lonner, and Thorndike (1973) argued, "unless researchers present empirical evidence to support their claim that different language versions of the same instrument are equivalent, translation problems will always be plausible rival hypotheses for any obtained results" (p. 32). To address such issues, this study employs validated Korean-version instruments from previous research and the following rigorous translation procedures: (1) forward translation, (2) assessment of forward translation for clarity, (3) common language and cultural adequacy, and (4) assessment of back translation for conceptual equivalence. Details will be offered in the "instruments translations" subsection.

Knowledge sharing. Items that measure an intention to share knowledge were adapted from Fishbein and Ajzen (1975). The modified measures contained two constructs,

including a second-order constuct derived from a scale that measures an intention to share explicit knowledge and implicit knowledge (Bock et al., 2005). Intention to share implicit knowledge was measured by three items, including, "I intend to share my experience or know-how from work with other organizational members more frequently in the future." Intention to share explicit knowledge was measured by two items, including, "I will always provide my manuals, methodologies and models for members of my organization." Since Korean researchers originally developed this questionnaire, a validated Korean version of this measure will be used for this study. The empirical results of previous studies using this scale for knowledge sharing have shown a highly acceptable level of internal reliability (Cronbach's alpha = .92 and .93) for explicit knowledge sharing and implicit knowledge sharing, respectively.

Proactive personality. This study used a 10-item, shorter version of Bateman and Crant's (1993) original scale. The shortened 10-item scale was developed and validated by Seibert, Crant, and Kraimer (1999) and has been used in subsequent studies more often than the original, longer-itemed list (e.g., Brown, Cober, Kane, Levey, & Shalhoop, 2006; Major et al., 2006). Sample items include the following phrases: "I am constantly on the lookout for new ways to improve my life" and "I can spot a good opportunity long before others can." Previous research indicated a high level of internal consistency (alpha = .92) (e.g., Major et al., 2006). A recent Korean researcher revealed an acceptable level of reliability (alpha = .81) of this measure in a longitudinal study (Kim, Hon, & Crant, 2009).

Economic rewards. To measure the perceptions of economic rewards, the items used for this research were modeled after Siemsen, Balasubramanian, and Roth's (2007) measurement for economic rewards for sharing knowledge. The measures passed tests of convergent and discriminant validity through a confirmatory factor analysis. The reliability coefficient was .86

for Siemsen, Balasubramanian, and Roth's research. Items included: "My company provides added compensation if I share what I know with my coworkers" and "My company provides monetary incentives to share knowledge with my coworkers."

Perceptions of social exchange. This study used scales developed by Shore et al. (2006) to measure individual perceptions of social exchange. Song, Tsui, and Law (2009) noted that Shore's measurement is a highly acceptable instrumentation because of its reliability and validity. Eight items measured social exchange, including, "my relationship with others is based on mutual trust" and "The things I do on the job today will benefit my standing in the long run." The original scale shows an acceptable reliability (alpha = .87), and a recent empirical study consistently shows high reliability (alpha = .91) (Song et al., 2009). Shore and her colleagues also conducted research in South Korea, showing a high reliability of .86 (Shore et al, 2009).

Demographic variables. Five demographic variables (e.g., gender, age, years of experience, position, and education level) were used as control variables in the analyses because these factors may affect some of the major constructs of the study. For example, an employee who has a higher level of management experience is more likely to feel psychologically supported by an organization because s/he has more managerial power and internal information than those who work at a lower organizational level. Similar logic suggests that an individual with a higher level of education is more likely to have knowledge and feel competent with his/her or job tasks than those who work at a lower level. A summary of the research instrument follows.

Table 3-1

A Summary of Research Instrument Description

Construct	Authors	Items	Reliability
Knowledge sharing	Bock, Zmud, Kim, & Lee (2005)	5	.92
Proactive personality	Seibert, Crant, & Kraimer (1999)	10	.92
Economic rewards	Siemsen, Balasubramanian, & Roth (2007)	3	.85
Social exchange	Shore, Tetrick, Lynch, & Barksdale (2006)	8	.86
Demographic variables	Gender, Age, Seniority, Position, Education level	5	n/a

Translations of the Instruments

The final version of measures were translated, modified, and validated so they could be used for a Korean target sample. The entire survey was translated from English to Korean and then translated back to English by two independent bilingual scholars of linguistics. This double translation practice was intended to ensure equivalency of meaning (Brislin, Lonner, & Thorndike, 1973). The aim of the translation processes was to maximize equivalence while minimizing translation errors. According to a guideline for the translation of measures in cross-cultural research (Brislin, 1986), four translation procedures were used for translating the current instruments: (1) initial translation, (2) assessment of forward translation for clarity, common language and cultural adequacy, (3) back translation, and (4) assessment of back translation for conceptual equivalence.

Initial translation. The initial translation of the measures, proactive personality, knowledge sharing and the perceptions of economic/social exchange, from English to Korean, were performed by two bilingual doctoral students whose major focus is linguistics. Based on their degrees and their experience with translation, the researcher provided detailed information regarding the objectives of this research and the intent of the instruments. This step is considered as most critical to ensure the quality of the instruments because its outcome is highly dependent on and influenced by the translators (Weeks, Swerissen, & Belfrage, 2007).

Pre-test procedures. After the initial translation was completed, the instruments were tested in accordance with the recommendations made by Schuman (1966). Field-testing the instruments involved a panel of four additional Korean doctoral candidates' cross-checking the translations against the original English version to find evident translation discrepancies. They were asked to note each item and its problems. This procedure was undertaken with the aim that the translators could provide feedback on the accuracy, clarity, accessibility, and cultural appropriateness of the translated study instruments for the target groups involved with the main study. Questions pertaining to an item of the instruments were answered, for example, through discussions with other participants. Further, these discussions facilitated the identification of a clearer and more accurate way of expression or phrasing. The participants decided which manner was the best by offering their comments and suggestions.

Backward translation. In addition assessing the initial translation, back translations were conducted and involved hiring a separate translator accredited at the professional level who was not previously exposed to these instruments. According to Brislin's recommendation(1986), the process is one of blind translation, whereby the translator was provided with the translated study instrument and asked to translate the material back to English. Comparisons were made to

identify any differences between the English version and the Korean version. The discrepancies identified initiated extensive discussions among the original bilingual translators and the researcher. These discussions were held in an effort to understand the reasons why certain items were not translatable while others were translatable. For example, the verb, "equal to," as in the question related to the measure of economic exchange perception – "My efforts are equal to the amount of pay and benefits I receive" – was initially translated to Korean as "same to or alike in quantity." However, extensive discussions concluded that it was necessary to adopt the translated expression of meaning "worthy of" in the Korean version. According to the results of this review, an appropriate translated Korean version of measurements has been confirmed.

Data Screening and Diagnostics

Scrutinizing data and resolving issues prior to the main analyses may be particularly important for multiple regression analysis (Pedhazur, 1997). Many researchers stress the importance of regression diagnostics (Bollen, 1996; Hair, Black, Babin, Anderson, & Tatham, 2009; Johnson & Wichern, 2007). Based on their recommendations, the data gathered were checked for accuracy, missing data, normality, linearity, outliers, and multicolinearity.

Data entry and accuracy. The initial data entry was performed by kwiksurveys.com. The responses stored in online storage were transformed into a spreadsheet. No significant errors were detected during the data transformation. An Excel file was then imported into SPSS for analysis. Neither response value was corrected in the data file or unusual responses identified. Then, the accuracy of the data was checked. The original data may have been entered into the data file incorrectly, which would make correlations and regressions distorted. Hair et al. (2009) recommended proofreading the original data against the spreadsheet. Two independent

researchers double-checked the accuracy of the computerized data. The graphic representations of the descriptive statistics confirmed that the data transformed to a spreadsheet were accurate.

Normality. Both analysis of variance (ANOVA) and regression analysis depend upon an assumption of normality for all scales. The ratios of the skew and kurtosis values to their respective errors were used. The skewness test examines the extent to which the distribution curve has an asymmetrical shape. The kurtosis test is a measure of whether the data are peaked or flat relative to a normal distribution (Hair et al., 2009). Kline (2005) regards absolute values of the skew index greater than 3.0 to be extremely skewed. For kurtosis, Kline (2005) recommended a conservative index of 10.0 as possibly suggesting a problem, and the data have severe non-normality. Skew and kurtosis values were calculated for all scales, and all skewness coefficients ranged from -.816 to 1.607, and the kurtosis coefficients ranged between -1.399 and 0.585 (see Appendix G). These results indicate that none of the skew or kurtosis values were outside of the range recommended by Kline (2005).

Linearity. Two implicit assumptions of the main analyses of this study are linearity and equal variance dispersion. The impact of error in the predictors leads to an increase in type II errors by underestimating regression weights. That is, the scales in this study are not measured without error, suggesting caution in interpreting non-significant results (Pedhazur, 1998). The linearity of the relationship between a dependent variable and an independent variable represents the degree to which the change in the dependent variable is associated with the independent variable. Linearity was examined through residual plots. The Levene test was used to assess whether the variances of a single metric variable were equal across any number of groups. There were no serious violations in homoscedasticity.

Outliers. Outlier tests, which include univariate and multivariate detection, were conducted. The first step was to examine each of the variables individually. Z-values for identifying outliers were used to present the distribution of cases and to select, as outliers, those cases occurring at the outer ranges of the distribution. Only two scales – proactive personality (pp3) and social exchange (sx1) – had more than 3 values that were outside he ± 3.0 range. The remaining scales had 3 or less values outside of this range. Since there were 432 total responses, it is not unreasonable that 3 values, or 0.7%, would be in the extreme 1% of the distribution. Across all scales, there was only one value larger than 4 on the knowledge sharing scale (ks4). The individual in this case was a male associate research engineer. This individual did not have extreme scores on any other scales, suggesting that this score may reflect a true perspective for this individual or a data entry error. Examinations of his other responses did not indicate fraudulent answers or an attempt to skew the results. On the regression analysis, he did not have a large residual and was not identified as influential. This suggesting that his responses should remain in the data set. Standardized DFBETAs were calculated for all possible outliers. No standardized DFBETA values were found near the $\frac{2.0}{\sqrt{n}}$ cutoff, as suggested by Belsley, Kuh, and Welschn (1980).

The next step was to assess multivariate outliers using the Mahalanobis D-square measure, which yields the distance in multidimensional space of each case from the mean center of the cases. The statistical tests for significance, using the Mahalanobis D-square, were conducted conservatively ($p < .001$). Given this threshold, one case ($D^2 = 94.61$, $p < .001$) was identified as an outlier and eliminated (Hair et al., 2009). An influential case, which is "a special kind of outlier" (Bollen & Jackman, 1985, p. 512), was also detected using Cook's D, which is a

measure designed to identify a case whose influence is due to its status in the independent and dependent variables.

Missing data. This study applied a list-wise deletion method to account for missing values (Allison, 2001). In this method, cases are excluded from the analysis if any single value is missing. This is the most frequently used method for a few reasons. First, missing values are typically small. Second, missing values are typically non-random. In this study, even if there were a few missing values on individual items, composites of the items for the regression analysis could be made by averaging them to make one new variable – knowledge sharing – by averaging two implicit knowledge items (ks1 and ks2) and three explicit knowledge items (ks3 to ks5). This composite variable would not have missing values because it is an average of the existing data.

One possible explanation for missing values is that research engineers may not have understood some of the questions or may have felt that some of the questions did not apply directly to their job responsibilities and assignments. Since research engineers at the selected R&D center were running many collative projects, some were pressed for time to participate in the survey. Other engineers might find some of the questions problematic or feel that they could not adequately answer the question.

Multicollinearity. Multicollinearity refers to the extent to which a variable can be explained by other variables in the analysis. As multicollinearity increases, the possibility for variables to predict accurately decreases. This relates to the potential adverse effects of correlated independent variables, such as proactive personality, economic rewards, and social exchange on the estimation of regression statistics. To identify this issue, Variance Inflation Factor (VIF) was used to screen multicollinearity. The examination of the VIF indicated there was no severe

multicollinearity. All VIF indices were less than 10. These results indicated that all of the variables in the study were not collinearity problems. Thus, further transformation of the variables was not necessary.

Data Analysis

After preliminary analyses of data were complete, the main analyses were conducted. These included descriptive statistics, factor analysis, reliability estimations, correlation analysis, and multivariate regression analysis. Statistic software, SPSS 19.0, was used in data analyses.

Descriptive statistics. The survey includes five demographics, including gender, age, seniority, position, and education level. These statistics were used to report the demographics of the research participants. For the participants' characteristics, chi-square tests were conducted to examine the difference in participation rates.

Factor analysis. The primary purpose of factor analysis is to define a set of common underlying dimensions and to validate the structure by demonstrating an item's load on the same factor (Hair et al., 2009). Although previous studies established the validity of each instrument, factor analysis was conducted to cross-validate a set of instruments used in this study and to identify separate dimensions of the structure. Principle component analysis is the most frequent method used to extract factors and to reproduce the maximum variance in the sample data. For this reason, principle component analysis was be used to extract factors with values greater than 1.00 and with factor loading, which are greater than .60 (Cliff & Hamburger, 1967).

Reliability tests. Reliability tests were used to describe the overall consistency of measures and to determine if the instruments are stable and replicable. For this study, an indicator of reliability (Cronbach's alpha) was used for each of the original measures exceeded them minimal acceptable range of .65-.70 (Nunnally, 1978). As described in Table 3-2, previous

studies have shown satisfactory reliability, ranging from .85 to .92 of four instruments. According to the Kline (2005) guideline for internal consistency, more strict level of Chronbach's alpha greater than .80 was considered reliable and acceptable for this study.

Correlation analysis. Correlation analysis was used to examine the associations between variables. Based on the McMillan (2000) guideline, the relationship between variables was determined as follows: a weak relationship between .10 and .30 of a correlation coefficient, a moderate relationship between .40 and .60 of a correlation coefficient, and a strong relationship above .70 of a correlation coefficient. The 95% of significant level was used for the criterion statistic of the correlation coefficient.

Regression analysis. Regression analysis was used to examine the relationship among the dependent variable and three independent variables. The goal of a multiple regression is to predict the individual's knowledge sharing level by using, as antecedents, personality, economic rewards, and perceptions of social exchange. This study hypothesized that proactive personality, anticipated economic rewards, and perceptions of social exchange are predictors of an individual's knowledge sharing. For testing hypotheses, this study conducted regression analyses with list-wise exclusion in case of missing data. Multicollinearity was calculated for all regression analyses to avoid adverse effects of inter-correlated independent variables. First, the regression analyses were entered. The control variables included position, gender, education level, and age. These were followed by proactive personality, economic rewards, and social exchange perceptions. A p-value of 0.5 or less was used as the criterion to decide if the degree of prediction was significant.

Qualitative Research

Research Approach

In addition to quantitative study, qualitative aspects of this study were also used to explain and further understand the inferences of the quantitative study. The purpose of the qualitative portion is to "expand findings as analytical generalization…not to enumerate frequencies as statistical generalization" (Yin, 2009, p. 9). Gall, Gall, and Borg (2006) recommend case study as particularly useful when research is focused on understanding a process, and specifically for understanding knowledge sharing processes in a given place. in addition to a certain set of variables identified in a quantitative study, this research employed case study to investigate the meaning of a particular situation.

Yin (2009) defines a case study as "an empirical inquiry that (1) investigates a contemporary phenomenon in depth and within its real-life context, (2) when the boundaries between phenomenon and context are not clearly evident" (p. 18). This method is preferred for examining contemporary events that are bound by time and activity over a sustained period of time (Stake, 1995). A case study is also "a strategy of inquiry in which the researcher explores in depth an event, process, or one or more individuals" (Creswell, 2009, p. 13). Yin (2009) argues that case study is particularly useful for understanding the research questions that involve "how" and "why," and for dealing with operational links that need to be traced rather than frequencies. Therefore, conducting a case study is the best method for the qualitative portion of this study because it allows the researcher to examine individual research engineers' intentions for sharing knowledge and understanding behaviors. Case study enables the researcher to obtain diverse and unique perspectives on phenomena while working within a specific time and place (Stake, 2006). Once quantitative data collection is completed, the researcher visited a select division to gather

evidence.

Participants of Qualitative Study

Stake (2006) argues that "case study is not sampling research" (p. 4) because it is not intended to provide generalizability to the population as a whole. It should be considered which cases will likely lead to understanding and assertions. He recommends a purposeful selection of participants based on the assumption that one maximizes discovering, understanding, and gaining insights.

Patton (1990) recommends a sample size "based on expected reasonable coverage of the phenomenon given the purpose of the study" (p. 186). According to the Stake (2006) guideline for sample selection, including 4 to 10 individual cases, a case study started with ten cases through a purposeful criterion-based strategy. As Stake (1995) stressed, the case is a specific, complex, and functioning entity. To understand the complex functioning of a case, several criteria were used to select the cases. Participants for a case study were identified through the lists of "best knowledge contributor," which were recruited by HR managers. For each targeted participant, the researcher gathered information on demographics, such as position, gender, rank, and academic degree record. Participants regarded as a knowledge contributor of the company shared time, information, and documents relative to the knowledge sharing initiative.

Purposefully selected individuals for the case study facilitated an interpretation of the research question (Creswell, 2011). Miles and Huberman (2013) identified four aspects of case selection: (1) "the setting where the research will take place, (2) the actors who will be observed and interviewed, (3) the events where the actors will be observed or interviewed, and (4) the evolving nature of events undertaken by the actors within the setting" (p. 30). The selection of

cases from these criteria enabled this study to comprehend how a selected research engineer has been successful in sharing knowledge and why one shares information with other colleagues. Due to the nature of their work that primarily knowledge intensive, participants heavily relying on the co-workers' knowledge sharing provided an ideal information for studying knowledge sharing between engineers.

Data Saturation

In general, qualitative research consists of in-depth studies of a small number of informants (Creswell, 2011). The determination of a sample size in a qualitative study takes a different approach from that used for a quantitative study. The reason is because a qualitative study is more concerned with meaning and not with the purpose of generalizing hypothesis statements (Kvale & Brinkmann, 2009). According to Patton (2002), determining an adequate sample size in qualitative research is influenced by the following factors: (1) type of sampling techniques, (2) resource of the study, and (3) saturation of knowledge. Ultimately, subjective judgment is used when evaluating the quality of information collected against the particular research method, employed sampling strategy, and the research inquiry intended (Sandelowski, 1995).

In this study, the researcher stopped interviewing when the saturation of information occurred (Guest, Bunce, & Johnson, 2006). In other words, the decision to stop interviewing was made when the following events occurred: (1) a strong sense that there was an adequate number of interviews conducted, (2) investigator's experience and fatigue, and (3) homogeneity of data achieved.

The researcher recruited ten participants from a targeted institution (Guest et al., 2006), and established that a sufficient number of participants were interviewed based on the

sufficiency and saturation of information. The researcher interviewed seven participants from these different positions: assistant research engineer, associate research engineer, research engineer, and principal research engineer. A saturation of information was achieved when the researcher began to collect similar information from informants and new information was no longer obtained.

Data Collection

After the quantitative data were collected, the site was visited to conduct focused interviews with R&D engineers, to gather qualitative data, and to further understand and interpret the unique significant relationships found during analysis. In several cases, meaningful facilitators and barriers to share knowledge between engineers were found, which these interviews help understand their knowledge sharing.

First, the researcher has no personal relationship with any of the interviewees, and this is crucial for the study to maintain objectivity. During data analysis, considerable effort was made relative to understanding the context in which each participant operated. Second, multiple methods of data collection were utilized. These included the interview, document review, observation, and artifacts. Additionally, the researcher took detailed notes during the interview, transcribed the interviews and maintained detailed files on each participant by using a case study database.

Conducting a case study offers a way to gain information about the perceptions and experiences of those involved in knowledge sharing processes. For this purpose, Yin (2009) proposed six different sources of evidence: documentation, archival records, interviews, direct observation, participant observation, and physical artifacts. Also, Stake (2006) listed the primary methods used for case study as “observation, interview, and documents review” (p. 34). Thus,

interviews, observation, document review, and physical artifact examination were used as the framework for data collection in this study. Qualitative data, collected from observation, interview, and electronic documentations, took place in March of 2014 at a selected institution. The researcher conducted one-hour audio taped individual interviews, with seven participants total, and observed knowledge sharing activities during certain periods of time in the field.

Interview. The interview is the most important and essential source of case information because it contains descriptions of an interviewee's point of view with respect to interpreting one's own meaning of the described phenomenon (Yin, 2009). A focused interview with open-ended questions was used for this study because it is the most efficient way to interview a selected person given a short period of time—for example, an hour. The interviews were conducted in a conversational manner; however, they were led by a certain set of questions derived from protocol. During the interview, a protocol was used as the interview guide, but clarifying questions were asked to insure understanding of the inquiry. Participants provided historical information from their personal experience. Interviews were audiotaped using a recording device, and the researcher transcribed the interviews.

Observation. Since a case study should take place in the setting of the case, creating the opportunity for direct observations is important to this study. Primary focus is on gathering field notes on the behavior and activities of individuals at the research site. This approach has several advantages, including that (1) the researcher gains first-hand experience with participants; (2) the researcher can store information as it occurs at the site; (3) unexpected aspects can be noticed during observation; (4) a participant may reveal uncomfortable topics during an interview. At the time of the personal visitation to each organization, the researcher made detailed field notes to include observations in a field journal and through pictures.

Observation included team meetings, seminars, and project works.

Documentation and archives. Since employees share their knowledge through intra-net in many cases, various forms of documentation offered strong evidence for a case study. In particular, this is an unobtrusive source of information that the researcher can obtain (Creswell, 2009). Although Yin (2009) argues that documents will not answer in-depth research questions, the considerable use of documents increased the sources of evidence. This evidence includes blog postings, internal memos, proposal notes, and other forms of written communication. Thus, the researcher could review all related documents, including personal postings in knowledge management systems because they might provide personal insight to knowledge sharing that is not revealed otherwise in public postings. However, documents and archives were not made available for this research due to security policies.

Research Process

The process of data analysis includes a series of interpretations to make sense of text and image data gathered from selected participants. Unlike statistical analysis with fixed formulas, a case study analysis depends greatly on one's "own style of rigorous empirical thinking along with the sufficient presentation of evidences and careful consideration of alternative interpretations" (Yin, 2009, p. 127). Creswell (2009) recommends that to more comprehensively understand evidence, the researcher should prepare data for analysis and conduct different forms of analysis. This is an ongoing process involving continual reflection about the data. The process of data analysis is described as follows:

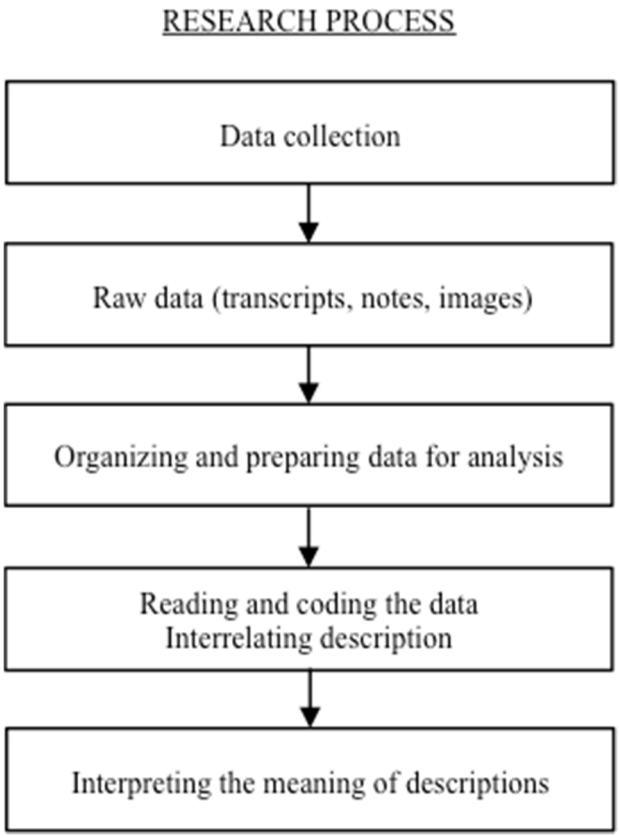

Figure 3-3. A process of data analysis and tests in a case study (Creswell, 2009, p. 185).

Construct validity. Yin (2009) defined construct validity as "identifying correct operational measures for the concepts being studied" (p. 40). In other words, this test aims at establishing correct operational measures for the objective of the study to be accurately measured. Three useful tactics were recommended, including: multiple sources of evidence, establishing a chain of evidence, and a review of the case document by key informants. To insure construct validity, this study used multiple sources of evidence – involving interview, observation, and document reviews – in a manner that encourages convergent lines of inquiry during data collection. Also, the chain of evidence was accurately and carefully protected through detailed memos and notes.

Reliability. Reliability refers to the extent that research findings can be repeated with the same results. This test is concerned with the consistency of findings and conclusions. To increase reliability, the researcher hired an analysis assistant to code a transcript. The generated codes were compared for inter-coder agreement (Yin, 2009). This included a cross check: whether two coders agree on codes used for the study. According to Yin's (2009) recommendation, this study developed a case study database, including many operational steps that led to consistent results.

Data Analysis

Stake (1995) defines analysis as "taking the collected data apart" (p. 71). This involves the preparation of data for analysis, different analyses, and understanding and gaining knowledge of the data in order to answer the posed research questions. Therefore, data analysis in this study "involves making sense out of text and image data" (Creswell, 2009, p. 183). Creswell (2009) suggests a linear and hierarchical approach in the following steps.

Data preparation. As described in Figure 3-4, data analysis began with data preparation. This included interviews transcription, importing photos and optically captured image data, and typing field notes from observation. The audiotaped interviews were transcribed during this phase, placed in easily accessible file folders, and printed. Other documents were sorted according to date and location. The researcher's journals and field notes were also filed according to date and location.

Reading through all data. To garner a general sense of the information acquired, the researcher read the data and reflected on its overall meaning. During this step, the margin notes, along with the interview transcripts and other notations, were reviewed in detail. The researcher created layers to summarize the data. The main interests of the researcher were to gain a general

idea of what the participants were trying to say, the tone of their ideas, and an impression of its overall depth.

Coding. After reading the data in-depth, the researcher began to make statements via a coding process. Rossman and Rallis (1998) define coding as "the process of organizing the material into segments of text before brining meaning to information" (p. 171). Detailed analysis, in the ordinary way of making sense, began with recording data, segmenting it as categories, and labeling it, according to theme. For example, each transcribed interview was coded separately using the software, and then these codes were collapsed across similar categories to arrive at themes. The computer software, MAXQDA, was used for data analysis. This program enables the researcher to organize text, pictures, audio, and video clips, along with coding, memos, and findings, into a project. Codes in this step were developed on the basis of data collected from participants.

Description and representation. Description refers to "a detailed rendering of information about people, places, or events in a setting" (Creswell, 2009, p. 189). During this step, the researcher used coding to generate themes, which appeared as the major findings of this study. A narrative approach was used to assess the findings of this study. For example, themes were represented in the narrative and provided information about each participant. These descriptions will include tables and figures to substantially represent the results of data analysis.

Interpretation. This final step was to deduce the meaning of the data: "what were the lessons learned." This interpretation listed both consistencies and contradictions acquired from the data. Consistent data results were used to build a coherent justification of the themes. Contradictory results provided an opportunity for the researcher to construct a multidimensional view of the phenomena under investigation. Also, meaning derived from the data offered a

comparison for the information from the quantitative study.

Summary

In Chapter 3, methodological issues were discussed, including participant sampling, instrumentation, data collection process, and data analysis. An online survey tool was used for data collection in the quantitative study. The survey included knowledge sharing, antecedents' variables, and demographic variables. Collected data were analyzed through SPSS 19. The results of the analyses were interpreted with qualitative research. In a qualitative study, data were collected, primarily through interviews. The collected data were transcribed and coded into themes to build a general understanding of how and why employees share their knowledge. In an interpretation of the results, emphasis is typically placed on quantitative data. A mixing of two forms of data occurs when they have consistencies or contradictions. Therefore, the quantitative results are explained and interpreted through a follow-up of the results from the qualitative analysis.

CHAPTER 4

RESULTS AND FINDINGS: QUANTITATIVE STUDY

Introduction

This chapter presents the results of the quantitative study. The main purpose of this study was to explore various determinants of knowledge sharing at the individual level, including, as antecedents, proactive personality, economic exchange, and social exchange perceptions. To understand the personal dynamics of knowledge sharing, this study investigates the extent to which those dimensions lead to increased knowledge sharing at a R&D center, which is part of a high performance IT company in Korea. The following research questions and hypotheses were proposed to achieve this research objective:

Research questions

1. Does an individual's proactive personality positively relate to social exchange and knowledge sharing?
2. Does an individual's social exchange perception relate to knowledge sharing with others?
3. Do individuals' economic rewards relate to knowledge sharing with others?

Research hypotheses

Hypothesis 1: Proactive personality will be positively associated with the intention to share knowledge.

Hypothesis 2: Economic rewards will be positively associated with the intention to share knowledge.

Hypothesis 3: Social exchange will be positively associated with the intention to share knowledge.

Results from the quantitative data analysis are described first. An overall response rate of 26% was achieved. Preliminary analyses, including data screening and missing data procedures, were performed. No significant differences were found between participants with missing data and participants with complete data. Next, reliability analysis and confirmatory factor analysis were used for research constructs. Scales were normalized to account for homogeneity of variance and for aiding the interpretation of results. Scales were transformed, as needed, to ensure normality. There were no influential outliers identified.

Descriptive statistics are reported for all measures, including the mean and standard deviation. Demographic characteristics are reported for age, gender, education, position, and years of employment. A multiple analysis of variance was performed to identify differences by demographic characteristics. Analysis of variance was also performed by age and gender. One significant difference was found by gender, age, and position, respectively. Two significant differences were found by education after applying the Bonferroni correction. Post-hoc follow-up tests were performed. Multiple regression analysis was performed to identify scales that predict R&D engineers' knowledge sharing within an organization. The chapter then moves the results of the qualitative study. The connection between the two phases of research is also explained. Cross-case themes are developed and presented. The chapter closes with an examination of the experience of using mixed methods and presents a pragmatic conceptualization of the use of mixed methods within traditional research frameworks.

Response Rate

There were about 1,600 employees at the R&D center were contacted for participation in the survey. Employees working at the test and manufacturing lines were removed from the data list before HR managers sent the emails. To avoid being routed in a spam filter,

kwiksurveys.com was registered into the mailing system temporarily during the survey period.

The overall response rate was 26%. Response rates varied from the lowest of 9% for female senior research engineers to the highest of 58% for male assistant research engineers as shown in Table 4-1. The null hypothesis (H_0) of this chi-square test is that there is no difference in the response rate, regardless of gender. The test rejected this null hypothesis and showed that there was a significant difference in response rates between male and female employees (χ^2 = 9.211, $d.f.$ = 1, $p < .001$). These results imply that response rates differed significantly for male and female genders.

Table 4-1

Response rate by gender and position

		Count	**Percent**	**Chi-square**
Male				
	Assistant Research Engineer	158	58%	
	Associate Research Engineer	105	53%	
	Research Engineer	49	48%	
	Senior Research Engineer	34	47%	
	Principle Research Engineer	1	33%	
Female				
	Assistant Research Engineer	58	48%	
	Associate Research Engineer	11	26%	
	Research Engineer	7	39%	
	Senior Research Engineer	1	9%	
	Principle Research Engineer	0	n/a	
Unknown		3		
Total		432		9.211 ($d.f.$ = 1)

Note. The chi-square value indicates statistical significance at the .01 level.

Eight responders did not indicate their education level, gender, or both. Education tended to be left blank more often than gender status, with 2% of the education responses falling in the missing category, and only 1% of the gender responses (3 cases) falling in the blank.

Demographic Information

Table 4-2 reports participants' demographics, including frequency and percentage. 432 participants provided their demographic information, such as gender, age, education level, job position, and years of employment. Jagacinski (1987) described the engineering field as a male-dominated field. Accordingly, men outnumbered women at the selected company. Male employees (81.2%) completed 351 of the surveys, and female employees completed 81 (18.8%) of the surveys. Nearly half of the participants (41.7%) were in their thirties, and about 37% of them hold masters or doctoral degrees. 220 (50.9%) participants were entry-level research engineers, 116 (26.9%) were associate research engineers, and 56 (13.0%) were research engineers. 35 (9.0%) were in leadership positions, meaning that they are in charge of a project. One participant was a principle research engineer (0.2%). More than half of the participants (60.0%) were employed by their current workplace for a period of less than 10 years.

Table 4-2

Participant demographics

Variables	Values	Frequency	Percentage
Gender	Male	351	81.2%
	Female	81	18.8%
Age	20s	49	11.3%
	30s	180	41.7%
	40s	115	26.6%
	50s	88	20.4%
Education	Bachelor	274	63.4%
	Master	110	25.5%
	Doctoral	48	11.1%
Position	Assistant research engineer	220	50.9%
	Associate research engineer	116	26.9%
	Research engineer	56	13.0%
	Senior research engineer	39	9.0%
	Principle research engineer	1	0.2%
Years of working	Less than 5 years	169	39.1%
	5 to 10 years	86	19.9%
	10 to 15 years	74	17.1%
	15 to 20 years	102	23.6%
	20 years or more	1	0.2%
Total		432	100.0%

The gender distribution differed by job position, age, education, and years of employment. It showed a slightly higher ratio of women (28.18%) compared to the overall gender distribution (18.8%) at the entry level. Senior and principle research engineers in a leadership position were male-dominated (97.44% and 100.0%, respectively). Chi-square tests

highlighted statistically significant differences in the demographic variables ($\chi^2 = 27.76$, $p < .001$). There was a statistically significant difference in the distribution of participants between males and females based on job position (see Appendix F).

Next, age distribution by gender showed that 31.5% of participants were male and around 30 years old (see Appendix G). Significantly, gender difference by age classification showed that the older in age classification, the greater difference between male and female responses. The greatest difference ratio between genders was found to be in the 50s (91% vs. 9%). The lowest ratio of gender difference was found in the 20s (73% vs. 27%). There was also a statistically significant difference in the distribution of participants between the age classifications based on the gender ($\chi^2 = 12.93$, $p < .01$).

A comparison of results between genders, based on education level, reveals that two-thirds of the participants hold bachelor's degrees (63.4%). Half of the male participants hold bachelor's degrees (50%). Males are about five times more likely than females to hold a master's level or higher degree (see Appendix H). However, there was no difference in the gender composition of education level at the significance level of .05 ($\chi^2 = 3.08$, $p = .215$).

The tenure distribution by gender shows that 129 participants were males employed for less than 5 years (35.3%). Only one participant worked more than 20 years. This individual holds a doctoral degree. The longer period of time that employees work for the company, the more disparity exists between male and female employees (see Appendix I). The ratio of difference between genders in less than 5 years was 76:24; meanwhile, the ratio in 15 to 20 years of tenure was 91:9. Also, there was a statistically significant difference in the distribution of participants between genders based on years working ($\chi^2 = 15.10$, $p < .05$).

Reliability and Validity Analyses

After completing the data screening procedures, all scales from the dataset underwent a reliability analysis and factor analyses to verify reliability and validity.

Reliability. Reliability refers to the overall consistency of the item-level errors within a single factor. A scale has a high degree of reliability when it produces similar results under consistent conditions. Cronbach's alpha scores were used to check for internal consistency, according to Nunnally's (1978) recommendation. He suggests .7 as a satisfactory level for social science research. Given that this instrument is used to explore factors related to research engineers' perceptions toward knowledge sharing, and not, for example, to diagnose a disease in practice medicine, all scores beyond 0.8 seem to be a reasonable expectation for reliability.

All of Cronbach's alpha scores are higher than a satisfactory level and show reliability relative to internal consistency. However, they are at a slightly lower than published reliability level, except with regard to economic rewards. Table 4-3 shows the number of items and reliability for each scale.

Table 4-3

Internal Consistency Reliabilities, Means, and Standard Deviations

Scales	**Number of items**	**Cronbach's α**	**Published Reliability**
Proactive personality	10	.84	.92[a]
Social exchange	8	.80	.86[b]
Economic rewards	3	.87	.85[c]
Knowledge Sharing	5	.90	.92[d]

Note: Seibert et al. (1999)[a]; Shore et al. (2006)[b]; Siemsen et al. (2007)[c]; Bock et al. (2005)[d]

Factor analysis. Due to the large number of items and scales, exploratory factor analysis (EFA) was conducted to detect misfit variables. EFA determines the correlation among the variables in a dataset and provides a factor structure (Hair et al., 2009). Principal component analysis was used with Varimax rotation to allow for correlations between factors. The factors were statistically formed based on item-factor loading, and eigenvalues greater than 1 were used to retain the number of a factor extracted from factor analysis (Table 4-4). The first factor has an eigenvalue of 6.85 and explained 26.34% of the total variance, followed by the second factor with an eigenvalue of 3.49 and 13.43% of the total variance. The extracted five factors explained 60.54% of the total variance. Table 4-5 shows the factor loadings for the items from each scale. All factor loadings larger than 0.5 are shown.

The first factor held ten items of proactive personality (PP1, PP2, PP3, PP4, PP5, PP6, PP7, PP8, PP9, PP10). Their factor loadings ranged from .54 to .69. The ten items on the first factor were interrelated and reflected one's proactive personality. These findings implied the reasonable construct validity of the proactive personality scale, as other researchers reported in previous study (Major et al., 2006; Seibert et al., 1999). The second factor had five items of knowledge sharing (KS1, KS2, KS3, KS4, KS5). Their coefficients ranged from .75 to .87. These five items reflected participants' inclination for knowledge sharing. The five items were closely associated with one another as Bock et al. (2005) reported relative to constructive validity. The third factor includes all items of social exchange (SX1, SX2, SX3, SX5, SX6, SX7, SX8), except SX4. The factor loadings of these items ranged from .61 to .76. These findings indicated a reasonable construct validity of the social exchange scale, as previous study reported (Shore et al., 2006). The fourth factor possessed three items of economic rewards (ER1, ER2, ER3), with pattern coefficients ranging from .72 to .89. The items strongly loaded on the factor.

Table 4-4

Total variance explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	6.847	26.335	26.335	6.847	26.335	26.335	4.122	15.855	15.855
2	3.492	13.433	39.767	3.492	13.433	39.767	3.855	14.826	30.682
3	2.452	9.432	49.199	2.452	9.432	49.199	3.662	14.086	44.768
4	1.840	7.075	56.274	1.840	7.075	56.274	2.845	10.942	55.710
5	1.109	4.265	60.539	1.109	4.265	60.539	1.256	4.829	60.539

Table 4-5

Deduction dimensions of organizational climate

Items	Factor1	Factor2	Factor3	Factor4	Factor5	Initial Communality	Extraction
PP8	0.693					1.00	.632
PP10	0.680					1.00	.520
PP1	0.668					1.00	.548
PP9	0.627					1.00	.620
PP2	0.621					1.00	.526
PP6	0.591					1.00	.593
PP7	0.587					1.00	.517
PP3	0.568					1.00	.543
PP4	0.566					1.00	.515
PP5	0.540					1.00	.579
KS2		0.870				1.00	.784
KS3		0.857				1.00	.771
KS1		0.846				1.00	.745
KS5		0.790				1.00	.658
KS4		0.752				1.00	.662
SX5			0.758			1.00	.613
SX2			0.731			1.00	.653
SX7			0.719			1.00	.643
SX3			0.699			1.00	.621
SX6			0.633			1.00	.577
SX1			0.628			1.00	.626
SX8			0.612			1.00	.565
ER2				0.887		1.00	.808
ER3				0.884		1.00	.808
ER1				0.720		1.00	.581
SX4					0.763	1.00	.641

Note: Extracted by Principle Components Analysis with VARIMAX Rotation

Communality is the extent to which an item correlates with all other items. No particular variable below 0.4 was found (Falk & Miller, 1992). This indicates that all variables struggle to load significantly on the factors. The items from each scale consistently load on the factors, as initially constructed. For factor retention criteria, the eigenvalue greater than 1 (Kaiser, 1960), and the scree plot (see Figure 4-1), were used. Although SX4 was independently loaded on the fifth factor, it was removed to avoid over-reliance on a single indicator. All four factors – knowledge sharing, proactive personality, economic rewards, and social exchange – were created as planned.

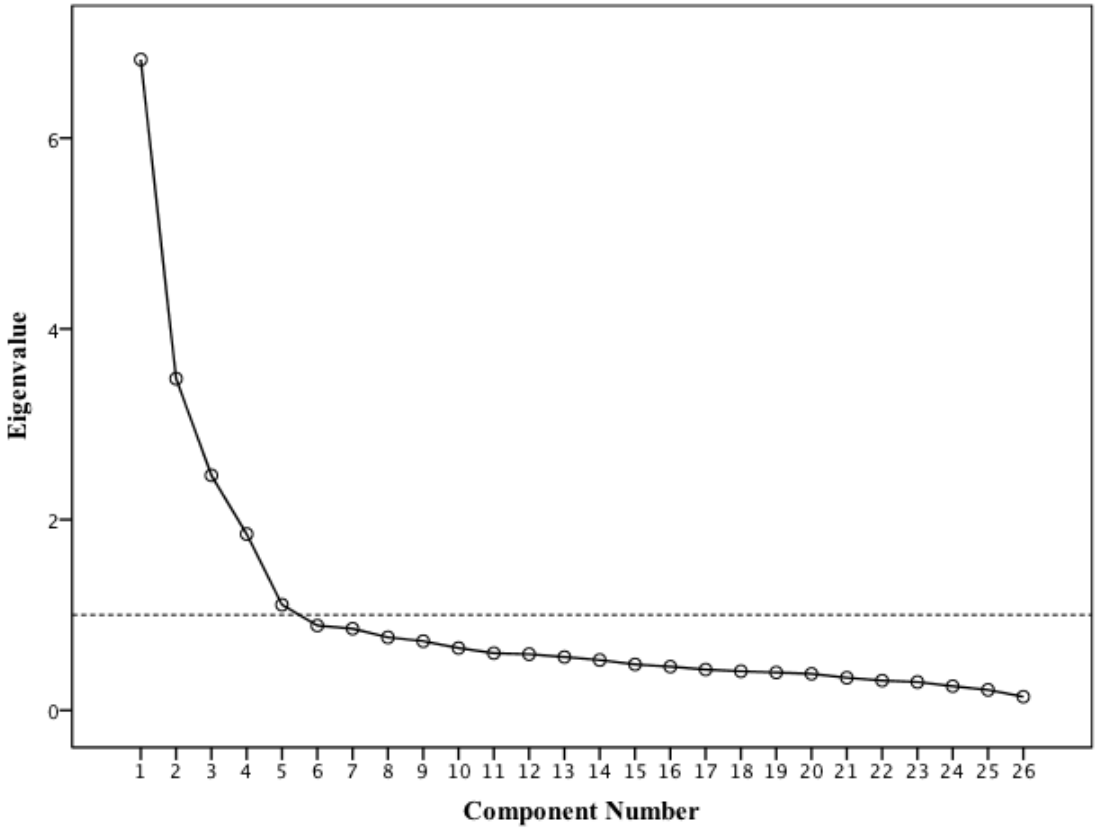

Figure 4-1. Scree plot

Table 4-6 presents the comparison between the published factor structures and the factor loadings of this study. The results of factor analysis show relatively strong loading on each factor (> .50) and almost uniformly to the published factor structures except the social exchange scale. Reliability for the social exchange was improved after SX4 was removed, showing a higher Cronbach's alpha (α = .85) than its coefficient in the original scales (α = .80). Since this means how much a set of items are closely associated to one another as a group (Fabrigar, Wegener, MacCallum, & Strahan, 1999), the seven items social exchange scale without SX4 will be used for the regression analysis.

Table 4-6

Comparison of factor loadings with published factor structure and Cronbach's alpha

Constructs	**Indicators**	**Chronbach's α**	**Factor loadings**	**Published Factor loadings**
Proactive personality [a]	PP1	0.86	0.67	0.53
	PP2		0.62	0.58
	PP3		0.57	0.68
	PP4		0.56	0.64
	PP5		0.54	0.65
	PP6		0.59	0.61
	PP7		0.58	0.58
	PP8		0.69	0.63
	PP9		0.63	0.65
	PP10		0.68	0.58
Economic rewards [b]	ER1	0.87	0.72	0.77
	ER2		0.89	0.84
	ER3		0.88	0.84
Social exchange [c]	SX1	0.85	0.63	0.49
	SX2		0.73	0.60
	SX3		0.70	0.52
	SX4		-	0.58
	SX5		0.76	0.77
	SX6		0.63	0.70
	SX7		0.72	0.69
	SX8		0.61	0.67
Knowledge sharing [d]	KS1	0.90	0.84	0.73
	KS2		0.87	0.80
	KS3		0.86	0.79
	KS4		0.75	0.78
	KS5		0.79	0.80

Note: Seibert et al. (1999)[a]; Siemsen et al. (2007)[b]; Shore et al. (2006)[c]; Bock et al. (2005)[d]

Convergent and discriminant validity. Based on exploratory factor analysis, this study measured the composite reliability of the construct that assesses internal consistency within and across constructs (Bollen, 1989). Composite reliability in the measurement model was above .80 and showed a variance in that indicator which was not accounted for by measurement error (see Table 4-7). The average variances extracted (AVE) were all above the .50 level recommended by Fornell and Larcker (1981), which means that the variance observed in the items was accounted for by their hypothesized factors. In addition, the standardized λ and T value of latent variables reached the significant level of .01, indicating that every construct has convergent validity. As for discriminant validity, this study further utilized the matrix Φ (phi) to understand the extent to which a construct is truly distinct from other constructs. Jöreskog and Sörbom (1981) propose that two conceptually similar constructs are distinct if Φ ± 1.96 standardized errors excluded 1. Phi in Table 4-8 showed that the discriminant validity existed among the constructs.

Table 4-7

Composite reliability, AVE, Phi and T-value

Constructs	**CR**	**AVE**	**1.**	**2.**	**3.**	**4.**
1. Proactive personality	0.93	0.78	0.77 (11.01)			
2. Economic rewards	0.81	0.72	0.26 (6.60)	0.69 (10.10)		
3. Social exchange	0.94	0.57	0.42 (9.30)	0.32 (7.15)	0.63 (9.08)	
4. Knowledge Sharing	0.88	0.59	0.33 (7.91)	0.33 (7.35)	0.41 (8.42)	0.62 (9.72)

Notes: CR (composite reliability), AVE (average variance extracted), Phi (t-value).

Table 4-8

Standardized λ and T value

Constructs	**Indicators**	***Standardized λ***	***T value***
Proactive personality	PP1	.88	N/A
	PP2	.95	29.12
	PP3	.81	21.37
	PP4	.89	25.51
	PP5	.88	24.46
	PP6	.77	17.32
	PP7	.79	19.28
	PP8	.75	16.13
	PP9	.81	21.37
	PP10	.89	25.51
Economic rewards	ER1	.78	N/A
	ER2	.80	17.23
	ER3	.90	20.34
Social exchange	SX1	.74	N/A
	SX2	.82	14.51
	SX3	.67	12.09
	SX5	.71	13.31
	SX6	.74	13.57
	SX7	.82	14.51
	SX8	.67	12.02
Knowledge sharing	KS1	.75	N/A
	KS2	.81	15.52
	KS3	.81	15.52
	KS4	.68	12.98
	KS5	.76	14.59

Common method variance. Since this study employed a cross-sectional research design, the survey data were self-reported and collected through the same questionnaire during the same period of time. Attributed to "the measurement method rather than to the constructs the measures are assumed to represent (Podsakoff, MacKenzie, Lee & Podsakoff, 2003, p. 879)," common method variance may cause systematic measurement error and further bias the estimates of the true relationship. This spurious variance can either inflate or deflate observed relationships between constructs (Podsakoff et al., 2003).

To attenuate the errors associated with common method bias, Harman's one-factor test and confirmatory factor analysis were conducted to test the effect of common method variance. All of the 26 variables were entered into a factor analysis, using unrotated principal component factor analysis to determine how many factors are necessary to account for the variance in the variables. If a substantial amount of common method variance is present, either (a) a single factor will emerge from the factor analysis, or (b) one general factor will account for the majority of the covariance among the variables (Podsakoff et al., 2003; Podsakoff & Organ, 1986; Podsakoff, Todor, Grover,& Huber, 1984). Only 21.23% of variance was explained by a single-factor, and it does not account for the majority of the covariance among variables. However, the four factors together account for 55.71% of the total variance; thus, no general factor is apparent. Next, all of the 26 variables were loaded on one factor to examine the fit of the model. If common method variance is largely responsible for the relationship among the variables, the confirmatory factor analysis should fit the model well. The analytical results for fitness included: $\chi^2 = 872.33$; degree of freedom = 292; CFI = 0.78; GFI = 0.59; NFI = 0.75; RMSEA = 0.18, suggesting that the fitness of the one-factor model was poor. All items were measured according to the research model; the analytical results for fitness were: $\chi^2 = 117.67$;

degree of freedom = 287; CFI = 0.98; GFI = 0.94; NFI = 0.96; RMSEA = 0.05, indicating that the fitness of the four-factor model was sufficient. These results suggest that common-method variance is solved and is thus unlikely to confound the interpretations of results.

Descriptive Statistics and Correlation

Descriptive statistics are reported for the ten proactive personalities, three economic rewards, seven social exchange perceptions, and five knowledge-0sharing intentions. Each of the dimensions was scored on a Likert scale ranging from 0 (*strongly disagree*) to 5 (*strongly agree*). Table 4-9 presents means, standard deviations, and correlations for employees' proactive personality traits, economic rewards, perceptions of social exchange, and knowledge-sharing intentions. The final analysis consisted of 81.2% males and 18.8% female engineers.

Female associate research engineers showed the highest mean values for knowledge sharing (Mean = 4.07). Male principle research engineers scored the lowest mean for knowledge sharing (Mean = 2.60). Principle research engineers scored the highest of proactive personality (Mean = 3.80), and female research engineers scored the lowest mean value of proactive personality (Mean = 3.17), as well as perceived economic rewards on knowledge sharing (Mean = 2.00).

The simple correlations between the variables suggested that an engineer's knowledge sharing was significantly correlated with proactive personality (r = .38), economic rewards (r = -.08), and social exchange (r = .47).

Table 4-9

Descriptive Statistics by gender and position

		Knowledge Sharing		Proactive Personality		Economic Rewards		Social Exchange	
Groups	***N***	***Mean***	***S.D.***	***Mean***	***S.D.***	***Mean***	***S.D.***	***Mean***	***S.D.***
Males									
Assistant Research Engineer	158	3.97	0.99	3.37	0.53	2.33	0.97	3.35	0.57
Associate Research Engineer	105	3.52	1.02	3.34	0.57	2.52	0.94	3.30	0.60
Research Engineer	49	3.93	0.84	3.46	0.44	2.71	0.85	3.53	0.59
Senior Research Engineer	38	3.82	1.02	3.47	0.65	2.62	1.05	3.41	0.69
Principle Research Engineer	1	2.60	n/a	3.80	n/a	2.67	n/a	3.50	n/a
Females									
Assistant Research Engineer	62	3.99	0.66	3.36	0.53	2.47	0.96	3.37	0.59
Associate Research Engineer	11	4.07	0.79	3.57	0.44	2.73	0.86	3.48	0.33
Research Engineer	7	3.40	0.76	3.17	0.79	2.00	0.61	3.34	0.41
Senior Research Engineer	1	3.60	n/a	3.30	n/a	3.33	n/a	3.63	n/a
Total	432	3.84	0.95	3.38	0.54	2.47	0.94	3.40	0.59

Table 4-10

Inter-correlation matrix

	Mean	**S.D.**	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**
1. Gender	1.19[a]	0.39	1.00								
2. Age	2.56	0.94	-0.17**	1.00							
3. Education	1.48	0.69	-0.07	0.24**	1.00						
4. Position	1.81	0.99	-0.22**	0.37**	0.24**	1.00					
5. Tenure	3.10	2.29	-0.13**	0.80**	0.15**	0.38**	1.00				
6. Proactive personality	3.82	0.85	-0.01	0.09	0.01	0.06	0.07	1.00			
7. Economic rewards	3.38	0.55	0.00	0.13**	-0.03	0.11*	0.10*	0.12**	1.00		
8. Social exchange	2.47	0.95	0.09	0.02	0.02	0.02	-0.02	0.46**	0.27**	1.00	
9. Knowledge sharing	3.40	0.59	0.07	0.06	0.01	-0.08	0.08	0.38**	-0.08**	0.47**	1.00

Note. N= 432, [a] Dummy coded; for gender, male = 1 and female =2. *$p < .05$, **$p < .01$

Significant Tests of Demographic Variables

To test the overall effects of the variables, including the four demographic variables – gender, age, education, and job position – a series of one-way analyses of variance (ANOVA) was conducted. In each instance, Levene's test for equality of variance was performed. When Leven's test rejected equality of variance, the Brown-Forsythe test was used in place of the F-test. Omega squared effect sizes were calculated for all significant F-statistics.

As shown in Table 4-11, there was only one significant scale difference by gender.

Table 4-11

Summary of Results of ANOVA by gender.

Scale	***DFb***	***DFw***	***F***	***p*-value**	**Levene statistic**	**Brown-Forsythe**	ω^2
Knowledge sharing	1	430	1.40	0.24	4.38*	2.17	
Proactive personality	1	429	0.03	0.86	0.21		
Economic rewards	1	430	0.00	0.99	2.53		
Social exchange	1	430	3.74*	0.05	1.36	4.23*	0.006

Note: ** $p < .01$, * $p < .05$, *DFb* = degree of freedom between groups, *DFw* = within groups.

Social exchange F (1, 430) = 3.74, p = .054, ω^2 = .006, was statistically significant after applying the Bonferroni correction. However, the Levene's test to assess the equality of variances for two groups was not significant ($p < .05$) and concludes no homogeneity of variances. According to Cohen (1988), an omega squared value of 0.0099 is considered "small," of .0588 is considered "medium," and .1379 is considered "large" (p. 285). Although females

were found to have reported significantly higher perceptions on social exchange with a mean difference of .14, the omega squared was less than 0.05, indicating a minimal gender effect.

Table 4-12

Summary of Results of ANOVA by age.

Scale	***DFb***	***DFw***	***F***	***p*-value**	**Levene statistic**	**Brown-Forsythe**	ω^2
Knowledge sharing	3	428	3.27	0.02	0.03		
Proactive personality	3	428	1.80	0.14	0.63		
Economic rewards	3	428	4.46**	0.00	2.93*	4.33**	0.023
Social exchange	3	428	1.00	0.39	3.02*	1.00	

Note: ** $p < .01$, * $p < .05$, *DFb* = degree of freedom between groups, *DFw* = within groups.

As shown in Table 4-12, there were significant scale differences by age on economic rewards $F(3, 428) = 4.46$, $p = .006$, $\omega^2 = .023$. Follow-up tests conducted for economic rewards showed significant differences between age groups. The results of Tukey HSD tests revealed that there is only one statistically significant mean difference between 30s and 40s ($\mu_2 - \mu_3 = -.377$, $p < .01$). That is, 40s were found to have reported significantly higher economic rewards, and the effect size ($\omega^2 = .023$) shows minimal effect.

Table 4-13

Summary of Results of ANOVA by education.

Scale	***DFb***	***DFw***	***F***	***p*-value**	**Levene statistic**	**Brown-Forsythe**	ω^2
Knowledge sharing	2	429	1.81	0.16	0.51		
Proactive personality	2	429	1.69	0.18	0.90		
Economic rewards	2	429	7.46**	0.00	0.99	7.76**	0.030
Social exchange	2	429	1.07	0.34	0.84		

Note: ** $p < .01$, * $p < .05$, *DFb* = degree of freedom between groups, *DFw* = within groups.

As shown in Table 4-13, there were significant scale differences by education on economic rewards F (2, 429) = 7.46, p = .001, ω^2= .03. Follow-up tests were conducted on economic rewards found significant differences between age groups. Results of Tukey HSD tests showed that two cases have significant mean differences on economic rewards. A mean difference between a bachelor's degree group and a master's degree group is .353 ($p < .01$). Using the values on Hedge's G of .20 as small, .50 as medium, and .80 as large (Cohen, 1988, p. 25), the effect size (Hedge's G = .373) shows a small effect. That is, a bachelor's degree group reported higher economic rewards than a master's degree group, but it has only a small effect. A mean difference between a master's degree group and a doctor's degree group is - .524 ($p < .01$), and the effect size (Hedge's G = .575) shows a medium effect.

Table 4-14

Summary of Results of ANOVA by position.

Scale	***DFb***	***DFw***	***F***	***p*-value**	**Levene statistic**	**Brown-Forsythe**	ω^2
Knowledge sharing	4	427	3.95**	0.00	2.92*	3.63*	0.027
Proactive personality	4	427	0.53	0.71	0.46		
Economic rewards	4	427	1.43	0.22	0.64		
Social exchange	4	427	0.94	0.43	0.26		

Note: ** $p < .01$, * $p < .05$, *DFb* = degree of freedom between groups, *DFw* = within groups

There was a significant scale difference by position on knowledge sharing intention F (4, 427) = 3.95, p = .004, ω^2= .027 (see Table 4-14). Follow-up tests conducted for economic rewards found significant differences among position groups. The results of Tukey HSD tests showed that there is only one significant mean difference on knowledge sharing. A mean difference between an assistant research engineer group and an associate research engineer group is .404 ($p < .01$). The effect size (Hedge's G = .432) shows a medium effect. That is, the assistant research engineer group reported higher intention to knowledge sharing than the associate research engineer group.

This section presented the results of demographics, chi-squares, data screening, reliability, and factor analysis. Based on the initial analyses, the next section will present statistical analyses performed to address the relationships among engineers' knowledge sharing and determinant factors, such as proactive personality, economic rewards, and social exchange in the context of the R&D center.

Tests of Hypotheses

The overarching research question is as follows: "What is the relationship between determinants – proactive personality traits, economic rewards, and perceived social exchange – and knowledge sharing?" A hierarchical regression analysis was conducted to investigate the determinants as predictors of the dependent variable: knowledge sharing, In other words, demographic variables that were significantly correlated with knowledge sharing were entered into the regression first as control variables, followed by each determinant, to estimate the additional contribution of the antecedents to the dependent variable.

There are several assumptions to be considered in the regression analysis: measurement error, linearity, normality, and homoscedasticity. The impact of error in the predictors leads to an increase in type II errors by underestimating regression weights. The scales in this study were not measured without error, suggesting caution when interpreting non-significant results. The regression analysis assumed a linear relationship between the predictors and the dependent variable. Scatterplots were examined for evidence of non-linear relationships. Normality was ensured through transformation of the dependent scales. Homoscedasticity was met if errors were random and independent. This assumption was met through the examination of outliers, residual plots, and calculation of VIF for multicollinearity.

Proactive personality and knowledge sharing

> Hypothesis 1: *Proactive personality will positively impact the engineer's intention of knowledge sharing*.

Individuals who have a higher level of proactive personality were predicted to have higher levels of knowledge sharing intention. For example, the contribution of proactive personality to knowledge sharing (proactive personality) was entered into the regression model

after the five control variables (gender, age, education, position, and tenure of participants). There was a 4.2% increment in the total variance explained when a proactive personality variable was added to the regression model. The total variance explained, including 2.3% by the five control variables, was 16.5% ($F = 14.03$, $p < .001$). Position ($\beta = -.13$) and proactive personality ($\beta = .38$) variables were significant, relative to an engineer's intention to share knowledge. Therefore, Hypothesis 1 is supported.

In order to check the collinearity issues among the predictors, the VIF (variance inflation factor) was used to assess the problem of significant multicollinearity (Pedhazur, 1997). The multicollinearity diagnostics indicated that the VIFs of the six independent variables, antecedents of knowledge sharing, fell in the range of 1.01 to 2.95, smaller than 10. Thus, there was no collinearity problem.

Table 4-15

Hierarchical regression of knowledge sharing on proactive personality.

	Model 1	**Model 2**	**VIF**
Control variables			
Age	.06	.06	1.06
Gender	.01	-.02	2.95
Education	.02	.03	1.10
Position	-.12*	-.13*	1.27
Tenure	.12	.12	2.90
Predictor			
Proactive personality		.38**	1.01
F	2.03	14.03	
R^2	.02	.17	
ΔR^2		.15	

Note: * $p < .05$, ** $p < .01$

These findings support Seibert and his colleagues' research (2001), which found that proactive personality (γ = .28,) had a stronger relationship to knowledge sharing. In addition, this result supports the finding from a path analysis in a sample of 190 matched employee-manager pairs, which indicated that proactive personality had a significant and positive relationship with knowledge sharing (γ = .31).

Economic rewards and knowledge sharing

> Hypothesis 2: *Economic rewards will positively impact the engineer's intention of knowledge sharing*.

Hypothesis 2 predicted that economic rewards have a positive effect on an engineer's intention to share knowledge. Similar to testing the effect of proactive personality, hierarchical regression analysis was conducted, adding economic rewards to the control variables. The results are presented in Table 4-16. There was a 0.7% increment in the total variance explained when an economic rewards variable was added to the regression model. The total variance explained, including 2.3% by the five control variables, was 3.0% (F = 2.18, p < .05). Position (β = -.11) and economic rewards (β = -.08) variables were significant to the engineer's intention to share knowledge. Therefore, Hypothesis 2 is not supported.

The VIFs of the six independent variables as antecedents of knowledge sharing ranged from 1.03 to 2.90, less than 10. Thus, there was no collinearity problem.

Table 4-16

Hierarchical regression of knowledge sharing on economic rewards.

	Model 1	**Model 2**	**VIF**
Control variables			
Age	.06	.07	1.07
Gender	.01	.02	2.97
Education	.02	.01	1.11
Position	-.12*	-.11*	1.28
Tenure	.12	.12	2.90
Predictor			
Economic rewards		-.08*	1.03
F	2.03	2.18	
R^2	.02	.03	
ΔR^2		.01	

Note: * $p < .05$, ** $p < .01$

These findings support Bock and Kim's (2002) study, which found that rewards were negatively related to one's attitude toward knowledge sharing ($\beta = -.124$). In addition, this finding lends support to other researchers (Chia et al., 2005; Kamdar et al., 2002; Kankanhelli et al., 2005). The findings contradict Yang (2010), who found a positive effect of the reward system on employee's knowledge sharing behavior ($\beta = .43$).

Social exchange and knowledge sharing

Hypothesis 3: *Social exchange will positively impact the engineer's intention of knowledge sharing*.

Hypothesis 3 examined the effects of an engineer's social exchange perception

toward knowledge sharing. It was hypothesized that social exchange would have a positive effect on one's intention to share knowledge. Social exchange was entered into the regression model after entering the five control variables. There was a 23.8% increment in the total variance explained when the social exchange variable was added to the regression model. The total variance explained, including 2.3% by the five control variables, was 26.1% ($F = 24.98$, $p < .001$). Position ($\beta = -.13$), tenure ($\beta = .17$), and social exchange ($\beta = .49$) variables were significant to the engineer's intention to share knowledge. Therefore, Hypothesis 3 is supported.

In order to check the collinearity issues among the predictors, the VIF (variance inflation factor) was used to assess the problem of significant multicollinearity (Pedhazur, 1997). Multicollinearity diagnostics indicated that the VIFs of the six independent variables, antecedents of knowledge sharing, fell in the range of 1.02 to 2.96, less than 10. Thus, there was no collinearity problem.

Table 4-17

Hierarchical regression of knowledge sharing on social exchange.

	Model 1	**Model 2**	**VIF**
Control variables			
Age	.06	.01	1.08
Gender	.01	-.04	2.96
Education	.02	.01	1.10
Position	-.12*	-.13*	1.27
Tenure	.12	.17*	2.91
Predictor			
Proactive personality		.49**	1.02
F	2.03	24.98	
R^2	.02	.26	
ΔR^2		.24	

Note: * $p < .05$, ** $p < .01$

These findings support Bartol and her colleagues (2009), who found that employees' perceptions of social exchange are positively associated with knowledge sharing ($\gamma = .28$). In addition, this research supports other who showed that social exchange relationships are influential for explaining the process of knowledge sharing (Cabrera & Cabrera, 2005; Cabrera et al., 2006; Chowdhury, 2005; Schepers & van den Berg, 2007; Phelps et al., 2012; Wang & Noe, 2010; Wu et al., 2007).

Multiple Regression Analysis

Three independent variables were entered into the regression model after the demographic variables were entered. The model was found to be significant, $F(8, 423) = 24.903$, $p < .001$, $R = 0.566$, $R^2 = 0.320$, adjusted $R^2 = 0.307$. This is considered a large effect by Cohen (1988) who established the value of $R^2 = 0.26$ as large (p. 414). Thus, about 32% of the total variance was explained by proactive personality, economic rewards, and social exchange based on the regression model ($F = 24.90$, $p < .001$). Their influence on knowledge sharing accounted for 32% of the variance beyond the demographic variables.

As expected, the betas of the demographic variables were not statistically significant. Social exchange ($\beta_{sx} = .44$) was the most significant factor, and it showed the strongest beta of any of the subscales in the analysis. The more that employees perceived the benefit of social exchange, the greater their intention to share knowledge with colleagues. Therefore, employees shared more knowledge when they perceived mutual benefit from knowledge sharing. Social exchange also showed a large effect size (Cohen's $f^2 = .25$). Thus, social exchange was not only statistically significant, but it also had a substantial impact on explaining the dependent variable, knowledge sharing. The largest beta in the regression model was social exchange, followed by

economic rewards (β_{er} = - .22), and proactive personality (β_{pp} = .20). An employee's job position was also found to be a significant predictor.

For multiple regression analysis, it was important to check for collinearity issues among the predictors. The VIF (variance inflation factor) was used to assess the problem of significant multi-collinearity (Pedhazur, 1997). Multi-collinearity diagnostics indicated that the VIFs of the nine independent variables, antecedents of knowledge sharing, fell in the range of 1.06 to 2.94, less than 10. Thus, there was no collinearity problem.

Table 4-18

Regression Estimates Predicting Knowledge Sharing.

Independent variables	**Model 1**			**Model 2**			**VIF**	**Cohen's f^2**
	B	**SE**	**Beta**	***B***	**SE**	**Beta**		
Control Variables								
Gender	.14	.21	.06	.04	.09	.02	1.06	
Age	.01	.11	.01	-.02	.06	-.02	2.94	
Education	.03	.07	.02	-.01	.05	.00	1.10	
Position	- .09	.05	- .17*	-.10	.04	-.12*	1.28	
Tenure	.02	.01	.12	.02	.01	.16	2.90	
Predicting Variables								
Proactive personality				.31	.07	.20**	1.28	.13
Economic rewards				- .20	.04	-.22**	1.11	.06
Social exchange				.64	.07	.44**	1.38	.25
R^2	.02			.32**				
F	2.03			24.90**				
ΔR^2				.30**				

Note: ** p < .01, * p < .05, N = 432

Table 4-19 presents an overview of the hypotheses and results from the regression model. In sum, three hypothesized factors – proactive personality, economic rewards, and social exchange perception – are statistically significant for explaining employee intention relative to knowledge sharing. The perception of social exchange was found to be the most influential impetuous for sharing intention. However, economic rewards were not positively associated with knowledge sharing. The results will be discussed in detail in the next chapter.

Table 4-19

Summary of support of hypotheses.

Number	Hypothesis	Support
1	Proactive personality of research engineers will be positively associated with knowledge sharing intention.	Yes
2	Research engineers' perception of economic rewards will be positively associated with knowledge sharing intention.	No
3	Research engineers' perception of social exchange will be positively associated with knowledge sharing intention.	Yes

Summary

The survey was given to research engineers of a targeted division at the R&D center, and a response rate of about 26% was obtained. The measurement process and procedures for establishing evidence of reliability and validity were described. Descriptive statistics were reported for each scale and item by gender, age, education, and position.

Analysis of variance was performed to identify significant differences in the scales by

gender, age, education, and position status. Females were found to have significantly higher perceptions of social exchange than males. Research engineers in their 40s were found to have reported significantly higher perceptions on economic rewards than other age groups. In education, research engineers who hold a doctoral degree reported higher perceptions of economic rewards than those with a master's degree. Assistant research engineers were found to have significantly higher intentions for knowledge sharing than associate research engineers.

Multiple regression analysis revealed four significant predictors of knowledge sharing. Although a result of a regression analysis was opposite to one hypothesis, the models were statistically significant, with 52% of the coefficient of determination. The results of the linear regression analysis indicated support for hypothesis 1, hypothesis 2, and hypothesis 3 of this study. First, proactive personality was related to an employee's intention of knowledge sharing in the R&D center of a high performance IT company in South Korea. Proactive personality had a significantly positive relationship to knowledge sharing (β = .20). Second, this study did not find that economic rewards related to knowledge sharing. The result of multiple regression analysis showed that economic rewards had a negative relationship to knowledge sharing (β = - .22). Third, the results of regression analysis showed that engineers' perceptions of social exchange revealed a statistically positive and stronger relationship to knowledge sharing than other variables (β = .44). The next chapter will discuss the results of the qualitative study.

CHAPTER 5

RESULTS AND FINDINGS: QUALITATIVE STUDY

Introduction

This section presents the findings of the qualitative inquiry study of R&D engineers' knowledge sharing at the selected R&D center. The section begins with information about the study and the researcher's questions. It provides a discussion of the sample, research methodology applied to the data analysis, presentation of data and results of the analysis, and an analysis summary. A qualitative method was chosen for its detailed understanding of a process and the experience of R&D engineers' knowledge sharing. Thus, the purpose of the qualitative study is to describe how R&D engineers share and use knowledge among colleagues.

Research Questions

The qualitative study was framed to answer research questions (Creswell, 2007). The research questions included in this study included:

4. How do research engineers in the R&D center describe their knowledge sharing with their colleagues?
5. What influences research engineers to share their knowledge?

The overall purpose of the above questions is to use a qualitative strand to explain initial quantitative results. That is, qualitative data analysis is implemented for the purposes of explaining the initial results in more depth. Although the quantitative study examined the hypotheses, drawing from various constructs built from the literature review, there was insufficient information available specifically on how to share knowledge among R&D engineers. In addition, while in discussion with R&D engineers, the result was that

understandings of knowledge sharing were challenging activities, which could benefit from additional research. The researcher was interested in better understanding the process of knowledge sharing – how and when do R&D engineers share knowledge in work their practices – and what facilitators and barriers to knowledge sharing do R&D engineers have. Why do they share knowledge?

Description of the Site

The targeted company is a global leading information technology company that manufactures and distributes home appliances and mobile telecommunications products. This company also provides key electronic components, such as dynamic random-access memory and non-memory semiconductors. The company operates through more than 220 subsidiaries around the world, including three business divisions: IT and mobile communications, consumer electronics, and device solutions of semiconductor and display panel businesses.

Despite recent challenges in the global economy, the company recorded historically high sales and profits, securing its leadership position in the global electronics industry. As of 2013, this company employed over 280,000 people around the globe. According to its 2013 financial statements and annual reports, the company recorded revenue of $205 billion during the financial year (ended December of 2013), an increase of 13.7% over 2012. The operating profit of the company was $33 billion in FY2013, an increase of 26.6% over 2012. Its net profit was $26.8 billion in FY2013, with increases of 14%, 27% and 28%, respectively, over the previous year.

The company pursued growth and innovation through research and development centers, identifying new opportunities and possibilities for transformative technologies and innovation. The company ranks second in R&D expenditure with $10.4 billion for 2013,

according to the EU Industrial R&D investment scoreboard (European Commission, 2014). The ratio of R&D investment to sales is about 6 percent, and 22% of its total employees are engineers. The sustainability management report published by the company states, "we continued to reinforce our core competencies in R&D and design by recruiting outstanding talent and by developing them. By establishing an open innovation system, we strengthened partnerships with outside research institutes and launched new professional organizations. We are adding to our extensive global R&D network by building a new R&D Center to develop future technologies including materials" (p. 17). Overall, this company has 5,043 patents in the US and continued award-winning performance, earning International Design Excellence Awards and Consumer Electronics Show Innovations Awards.

The G campus is a specialty R&D center, serving the targeted company. The division of device solutions at G campus has more than 1,600 engineers who research, develop, and design products for commercial use prior to mass production. Its core competency is the ability to create and manufacture innovative product solutions to sustain growth within a projected period. The differences between this company and others relate to its focus on organic and flexible knowledge sharing, which transfers as effective ways to improve and sustain the company's competitive advantage. In 1998, the company recognized a need for a knowledge management system (KMS) that would facilitate growth in the value of knowledge that existed within the company. The best minds for a particular topic were not necessarily on the same team but spread across other divisions in the company. Hence, KMS was required to facilitate communication between divisions so that the collective knowledge and understanding of the entire organization could be brought to any problem. The resulting acceleration of knowledge led to a strategic advantage based on the leverage of internal intellectual capital. Its goal was to

accelerate the accumulation and dissemination of knowledge by all R&D engineers, to provide easy and rapid access to lab knowledge bases, and to eliminate time and space constraints on communication.

The primary tools to enable engineers to share knowledge is TEMS, and it is an inter-connected system of knowledge bases that are used by engineers to share knowledge electronically and to collaborate closely with each other, unfettered by time and distance. The principle component of TEMS is a tech forum, a secured bulletin board that only employees are allowed to access. An employee who needs information about a mobile network process can post a question to the bulletin board, and in the next post find answers from a researcher from a different R&D center. This method of knowledge sharing recognizes that no single person knows everything about a topic; knowledge is generally decentralized among many people. Employees are encouraged to solve their own problems and to provide solutions to other's questions on the tech forum.

For employee education, G campus consolidates training information, support resources, learning updates and materials, competitive intelligence, and an array of other content on the intranet server. In 2012, the company intranet was morphed into a Microsoft-based platform. This platform provides real-time communications ubiquitously and offers the richest and most actively-used media of learning architecture on the personal cloud. Users can stream or download through the device at their convenience. With web conferencing and online training, it is no longer necessary to retain a great deal of knowledge in one's head. Instead, the knowledge that you need is of the location where you can find information. In this way, the enterprise portal acts as a just-in-time knowledge performance support system, enabling engineers to rapidly access critical information for the needs of a particular project. Moreover, engineers may train in

self-directed way at their mobile devices or laptops without the need for a weeklong training course.

Description of the Participants

Qualitative inquiry facilitated in-depth interviews to understand the personal experiences of R&D engineers and their interpretations of these experiences. For interview participants, a modified interview process was used, which consisted of an initial contact email, a detailed interview, and a follow-up contact (Creswell & Clark, 2011). Potential participants recommended by HR managers were identified and initially contacted by email, explaining the research and interview process. Interested potential participants were sent a pre-interview questionnaire before the interview occurred. Detailed interviews and observations were conducted over a period of two weeks and lasted from 60 minutes to 90 minutes each.

In preparation for qualitative study, several meetings with HR managers occurred to identify appropriate samples for the study. To select participants based on their expected ability to provide experience and insight, a purposive sampling strategy, based on knowledge and expertise, was used. Only participants that were KMS users and the best knowledge sharers, as recognized by colleagues, were considered for this study. Ten participants were selected based on different level positions, ranging from an assistant engineer to a principle engineer. From the ten participants, HR managers confirmed seven engineers for the interview.

Informant 1 studied electronic engineering at S University and earned his bachelor's degree in 2008. During his senior year of the college, he started to do an internship at the current company. After graduation, he was reassigned into the G campus for the R&D position. He then moved to the display division to test the prototype through a computer simulation. By using a hardware module, his team focuses on developing a high-speed serial interface circuit and

system design. The developed serial interface minimizes the signal lines between the controller and the column drivers in a display panel. An extra-large sized and full high-definition panel with process technology was developed by his team and this product successfully came to the market. He now is an assistant R&D engineer. He believes knowledge in the R&D center is a "fruit of employee learning process," such as frontier seminar, training, and meetings. He was regarded as the best knowledge sharer in the forum.

Informant 2 holds a bachelor's degree of material engineering and currently is an assistant research researcher with five years' seniority. He struggled with the nature of research practices as a young engineer, often finding the research lab to be a very pressured and stifling environment. However, he was always interested in and "energized" by intellectual activity and "found himself as someone who would work well in a research environment." He joined the display research team immediately after graduation from the university, believing that he was "going to be an engineer." He started working at the team, serving on one-on-one research settings. He realized that he "really liked working closely with researcher and...I did best [when] working with my peers on the project." Realizing a new direction in his career, he attended the research seminars in the center and found his "intellectual home" in the research field "which was more pleasing than academic research would've been." The practical implementations of research were so impressive to him. His greatest involvement in project work occurred relatively early in his career when he worked to revise a module design. His participation has mostly been through direct assignment and he was awarded the best knowledge sharer in 2011.

Upon entering a master's degree program in chemistry, informant 3 had an opportunity to participate in the industry-university cooperation program and got hired right after graduation. She began her career working for the semiconductor team as an R&D engineer. She

was then promoted to managing a fab operation. She acquired practical R&D skills through hands-on experience from fab operation and got relocated to the R&D division, which had always been of interest to her. She received an associate research engineer position on the display research team. At the same time, she became involved in developing novel materials. She found that she really enjoyed the tasks and committed to the assigned job, "banging my head against the wall" to accomplish the goals. She was awarded the best knowledge sharer in the KMS.

Informant 4 began studying chemical engineering during his undergraduate work. He continued to practice and take lessons and eventually decided to pursue the study of chemical engineering in college after being heavily involved in chemical engineering practice. After earning his bachelor's degree in chemical engineering, he spent four years working in chemical industry. He then returned to graduate school and earned a doctorate degree. He is now leading a variety type of development project as a research engineer. He is interested in the process from development to manufacturing and focuses more of his efforts in that direction instead of the bridge between research and development. He was regarded as the best knowledge provider in the forum.

As a research engineer, informant 5 has worked for seven years at this company. His dream since a child was always to be a scientist. He selected to pursue chemistry as a lifelong career because he believes that there is "something beyond what we see." Once he began studying he quickly realized that this was something that he wanted to do as a career. Upon graduation, he transferred to the graduate program at the same university. He focused on the interactions and transformations of atoms and molecules. This research interest connected him to the current R&D center. After receiving a doctoral degree, he got a job offer. He likes to work closely with a diverse group of researchers from many different disciplines: "to have people from

different disciplines working together to achieve a common goal." As describing himself that "I got involved in doing research about the properties of the chemical bonds formed between atoms," he was regarded as the best knowledge sharer in the team.

Informant 6 joined a company right after his master's degree in physics. With fifteen years' seniority, he currently is a senior research engineer at the R&D center. He led the research team of photovoltaic cladding panels for years. He identified "experience, know-how, and gut responses from trial-and-error" as important concepts of knowledge that should be understood in research and development centers. He uses the tech forum to create and update knowledge: "a principle [that] research engineers had failed in [the] research and development process more times than an assistant researcher had even tried." He was treated as the best knowledge provider in the forum.

Informant 7 received a Ph.D. in material engineering from K University in South Korea. Then he moved to the U.S. for a post-doctoral program. The National Research Foundation of Korea (NRF) funded his research while he worked in the states for two years. While doing research at the advanced materials laboratory, his work attracted the attention of a principle research engineer at the current R&D center. After completing several invited seminars and interviews with executives, he accepted their job offer with remunerative salary and benefits in 2010. Upon completing his first research project, he discovered, "I delight to do work here." As a result of his experiences at the R&D center, he decided to dedicate his passion to research, and that research was something that he would enjoy. He now holds the senior research engineer position of display research. He has worked on a number of projects, relating to his specialty area: grapheme quantum dots. In addition to research work, his duties include facility safety management. He chooses to be involved with this safety committee because "research safety and

health is important as much as we do research" and to ensure that he has a "seat at the table" to encourage the inclusion of his discipline in conversations related to the redesign of the research facility. He is recognized as the best knowledge sharer among peers. The composite participant information is presented below.

Table 5-1

Participants of Qualitative Study

Participants	**Gender**	**Age**	**Education**	**Position**
Informant 1	Male	20s	Bachelor	Assistant research engineer
Informant 2	Male	30s	Bachelor	Assistant research engineer
Informant 3	Female	30s	Master	Associate research engineer
Informant 4	Male	30s	Doctor	Research engineer
Informant 5	Male	30s	Doctor	Research engineer
Informant 6	Male	40s	Master	Senior research engineer
Informant 7	Male	40s	Doctor	Senior research engineer

Data Preparation for Analysis

Before the presentation of data analysis, a process of reducing data through coding and displaying data for discussion was conducted. Data preparation was done inductively, which allowed for themes to emerge. This section discusses theme development and provides a concept map for data analysis.

Data preparation includes transcribing text from interviews and observations, and organizing the document and visual data for review. During the transcription process, the

transcription was checked for accuracy and reviewed by the participants. Based on their review, participants agreed with the transcript, provided corrections, or requested changes. Then, the document files of transcription, memos, and filed notes were entered into a qualitative data analysis program, MAXQDA.

Theme Development

A constant comparison and contrast strategy was used throughout the data collection process (Creswell & Clark, 2011). This meant that (a) two independent researchers read the transcripts and compared them to establish underlying uniformity, and (b) they identified emerging concepts and generated initial themes for a composite synthesis of the data.

The researcher read the data twice to develop a general understanding of the database. In the initial review of the data, all forms of data were reviewed, and the initial codebook was created to form broader categories of information. This tasked helped to organize the data and facilitate an agreement transcript contents. Raw data were separated by research questions and coded into initial themes. Again, the initial themes were analyzed by reading the transcripts, and the data was recoded t if necessary.

The first question: "what is knowledge, and how do you define knowledge at your work," was asked to obtain data for the first section on perceptions of knowledge. This section provided an awareness of the participants' perspective on knowledge used. The second question: "how do you share knowledge with colleagues and when do you share your knowledge," and the third question about the best knowledge sharing were combined to form a unit of coding for analysis in the section on practices for sharing knowledge. The fourth question: "what makes engineers share their knowledge with others among projects" was used to produce data for the perceptions of the facilitators and barriers to sharing knowledge. Responses for the third section

were used to gain the idea, which provided a common platform to discuss their facilitators and barriers for knowledge sharing. To organize the findings, the data were separated into three sections: (a) perceptions of knowledge, (b) practices for knowledge sharing, and (c) perceptions of facilitators and barriers to knowledge sharing (see Figure 5-1). Thematic analysis was conducted to assess the data for the occurrence of themes across multiple participants and multiple responses (Creswell, 2009).

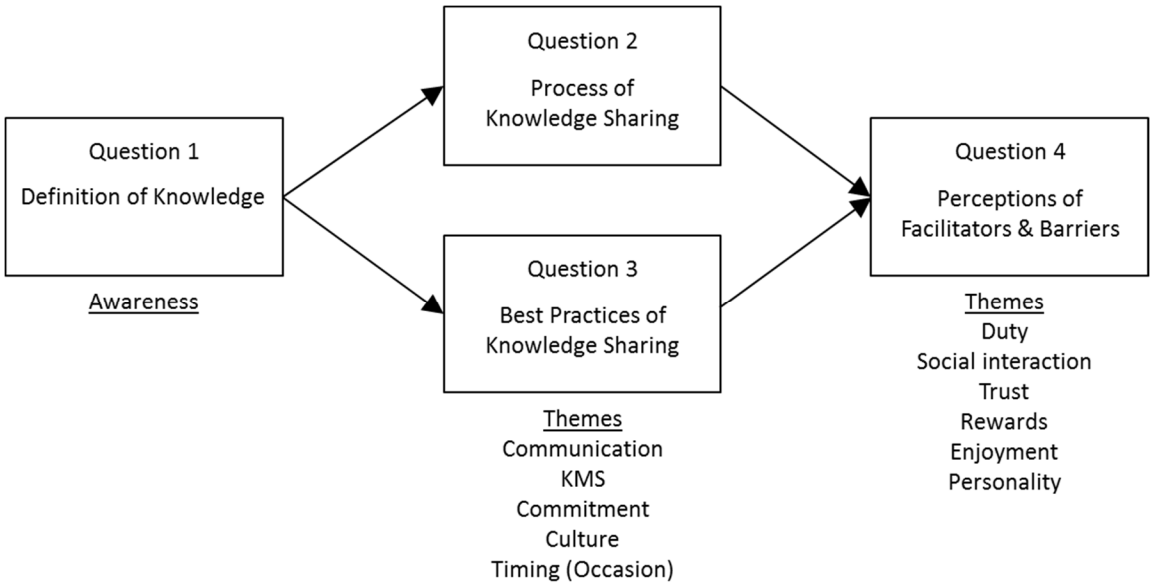

Figure 5-1. A concept map for data analysis

A concept map, as shown in Figure 5-1, visualizes how this study separated the four interview questions for data analysis and how the results were organized by awareness and themes. Responses from the first interview question: "how do you define knowledge at your

work and knowledge sharing with your colleagues" were analyzed for more information to determine the characteristics of knowledge sharing being investigated. Responses from the second interview question: "how do you describe process of knowledge sharing," and the third question: "the best practices of knowledge sharing the participant experienced" were analyzed for describing practices of knowledge sharing. Themes included communication, KMS, commitment, culture, timing, and occasion. Responses from the fourth interview question: "why do you share your knowledge in the project" was analyzed for a detailed understanding of the facilitators and barriers of knowledge sharing with others within the R&D center. Themes included duty, social interaction, trust, rewards, personality, and enjoyment.

Results of Analysis

This section provides a discussion of how the data were analyzed. To organize the findings, the researcher separated the data into four sections: (a) perceptions of knowledge, (b) understanding of knowledge sharing process, (c) experience from best practice of knowledge sharing, and (d) perceptions of facilitators and barriers to knowledge sharing. The participants provided composite responses with rich descriptions for perceptions and experiences of knowledge sharing at the R&D center.

Perceptions of Knowledge

The first interview question: "what is your definition of knowledge at your work" was not included in the thematic analysis. The purpose of this question was to obtain an awareness of the participants' understanding of knowledge as it relates to the knowledge sharing process. To answer this question, participants were asked to identify the interview purpose: (a) explain the concept of knowledge, (b) define own concept, and (c) is there a relationship with knowledge sharing. The benefits of this question involved identifying what participants know and how they

use what they know.

All of the participants were reluctant to define knowledge because of its intangible and ambiguous nature. Five participants responded to the researcher's request to "identify and define knowledge" with a request of their own. They wanted the researcher to more clearly describe the criteria of "knowledge." Only one participant directly answered the question as it was asked. He identified "experience, know-how, and gut responses from trial-and-error" as important concepts of knowledge that should be understood in research and development centers. He also explained how engineers create and update knowledge: "a principle [that] research engineers had failed in [the] research and development process more times than an assistant researcher had even tried."

One research engineer stated,

> *I think knowledge is completely different from what we get from textbooks. When I began to work here, I realized that there is nothing valuable in reality and the matter is how we can materialize in reality. This is why we exist as an R&D engineer…I'd consider, well, my own experience? When faced with limited resources at the initial level of a project, I make the project efficient from the experiences, there should be someone's research records in somewhere, it is matter of efficiency, because it makes a beginning point different with previous experiences, [laughter], with never enough experiences, you know, then it is matter of time and how many people get involved in trial-and-errors to find out sustainable results.*

Another engineer stated,

> *For me, knowledge in the R&D center is a fruit of employee learning process. Learning process, for example, includes employee training, seminar, and meetings. I can define knowledge as relatively observable and this asset leads to capabilities that enhance the availability for growth and survival of our company. I think, depending on an individual R&D engineer, the company identifies information and knowhow along with combinative capabilities of personal expertise and organization knowledge.*

One participant believes knowledge in a research process "is not a property solely reserved for my own research, but for organization property that should be shared with others." He does not consider knowledge as individual intellectual property. Instead, in his view, "it is company property once the company hired an individual." While answering the question, he stated,

> *I am troubled by more traditional notions of the knowledge of engineers, and frustrated by things like skills and typical meaning of knowledge, you mentioned, which sort of reifies knowledge, give it an additional reality. The lexical meaning of knowledge rankles me because, from a dictionary definition, what knowledge is means, well, I think information and understanding about a specific subject which a person has, or which all people have? However, I think knowledge means more than that. I think it includes my experience, gut, of course, know-how.*

All of the participants agreed that knowledge includes personal and team experiences from countless trial-and-errors and know-hows acquired over time. However, participants had various opinions on how knowledge forms.

In defining knowledge, participants emphasized the presumption that knowledge should be regarded as socially constructed and rests with an individual researcher. In this sense, they did not agree with the notion that knowledge is "not simple information" that can be transmitted without loss of integrity. Rather, many people frequently used the term "know-how" interchangeably with "knowledge." As one participant elaborated,

> *My team consists of various education background and level. I don't think the higher degree of education does represent the value of knowledge…quantity and quality of knowledge, I mean. Know-how is the accumulated expertise that makes the research process smoothly.*

Another engineer described,

> *It is output of the process...Surely, it's not always about the quantity. It is more about what [the engineers] develop and produce and what they contribute after*

they've developed.

Despite the difficulties of defining knowledge, it is generally agreed upon that knowledge is an organized combination of ideas, experiences, procedures, and information. The term "organized" means that information finds its value and becomes knowledge only through the organization. Thus, at best, it is not the organization but R&D engineers in the organization that share, capture, and generate knowledge. Knowledge sharing is a process of facilitating knowledge-related activities, including learning, collaboration, and experimentation for the purpose of integrating diverse sets of tasks and implementing appropriate information.

Practices for Knowledge Sharing

Responses from the second interview question: "how do R&D engineers share knowledge among others in a project" was analyzed to form a unit of coding, which was used to present participants' practices and experiences with knowledge sharing. To answer the second question, participants were asked to: (a) describe the processes—how and when do R&D engineers share knowledge with others, (b) describe the tools and techniques used to share knowledge, and (c) explain knowledge sharing experience. The results from the interview were combined for thematic analysis.

Frequency scoring was used to identify the themes. Frequency and scaling were then used with each of the four themes to determine meaningful themes. Table 5-2 provides the description, frequency, and percentage for each of the four themes: communication, KMS, commitment, and culture.

Table 5-2

Themes for knowledge sharing practices of R&D engineers

Theme	Description	Frequency (%)
Communication	It represents the activities of conveying information and knowledge through exchange of ideas, feelings, intentions, and attitudes, as by speech, non-verbal gestures, writings, and behavior while performing their project.	7 (100%)
Knowledge Management System	This incorporates the processes and tools used to store and access data and information used for knowledge sharing.	7 (100%)
Commitment	R&D engineers are committed to knowledge sharing because they feel psychological attachment to the organization. Engineers find ways to improve their jobs by knowledge sharing.	6 (86%)
Culture	This represents the environment and atmosphere surrounding R&D engineers for knowledge sharing.	6 (86%)

Note: N = 7

Communication. Communication was the first theme that emerged from the knowledge sharing component of the participant interview data. Communication represents the activities of conveying information and knowledge through the exchange of ideas, feelings, intentions, attitudes, expectations, perceptions or commands, as by speech, non-verbal gestures, writings, and behavior. The participants all talked about systematic approaches as an integral part of the knowledge sharing experience. Participants emphasized communication, and conversations primarily, as a valuable medium as KMS' role in knowledge sharing. An associate research engineer stated, "I'm less worried about assessment via KMS and more worried that

they really share valuable information and knowledge in interdependency and mutual trust."

All of the R&D engineers mentioned that communication plays a significant role in process improvement for organizations that support more efficient results. They believe that continuous communication provides opportunities for improvement. A principle research engineer mentioned that communication could help with process improvement if the lessons learned are integrated when moving forward into the next project. One senior research engineer provided an example of how communication can be used for process improvement.

> *From M+2 project—the next and next generation project, a month after the preceding R&D team developed a product, there are probably about six months left in the process development team, we had the lessons learned workshop, gathered all of the lessons learned and transferred them to the R&D engineers in a manufacturing team so that they could incorporate ones that they thought they could take action on…. We continued discussion and communication for six months…It's improving the processes because we are bringing everyone together, gathering the information from everybody in all of the different groups, and compiling that because one lessons learned for one group can impact another group, so the groups are seeing how they proceeded. They can make improvements and the different groups are having their own meetings to make those improvements. I just want to say; however, there is no governance. I cannot institute changes in other teams [manufacturing R&D or process R&D]; I can just make recommendations. As long as it's not affecting business then it's really up to each group to make those improvements themselves. A lot of the different departments have changed their processes and improved them based on what we discovered during the lessons learned. Because one department may not be aware of something, that another department is. So it has really helped our communication.*

Three of the participants heavily depended on conversation as a medium for knowledge sharing. These participants found human networking to be crucial for working with one another. Through observation, an important skill in their work processes, and the act of engaging in knowledge sharing in conversation, informs know-how and provides the opportunity for developing abilities. According to one associate research engineer, communication comes from various mediums, such as discussions, emails, sharing documents, and creating an

"environment, which can exchange know-hows and skills." Therefore, it is important for research engineers to have a solid relationship with engineer gurus, having "value knowledge" and "core information." This means that "knowledge sharing happens elsewhere in the company, even at the outside of the center...Truly I have experienced that several core research experience have shared in the company dining." In her view, knowledge sharing has a "mutual social relationship" and "tacit contract among researchers."

One assistant research engineer indicated that in the first phase of the project, they found many gaps and discrepancies. Conversations from team meetings greatly improved the second phase of the R&D process. Another engineer stated "I believe communication can greatly improve the R&D results. When a process is identified as less than successful it can be analyzed as to why and either "tweaked" or eliminated completely as being ineffective."

One associate research engineer mentioned that the use of communication will help reduce the risk of failure and increases the probability that a positive result will occur. He stated,

> *What we do is the lessons that we learn in a project is an ex post facto discussion. We plow that back or work that back into the subsequent phases so we do not have to make the same mistakes twice. So that mitigates some of the risks of moving forward through the project.*

One senior research engineer used workshop discussions as a way to gain knowledge and ideas about specific content that he regarded as important and as a way to gather feedback on his own knowledge. He stated:

> *I like company seminars and workshops used to coordinate intelligence-gathering efforts that pull information from many research gurus. It enables a discussion of R&D processes and ongoing dialoguing and sharing among engineers. This organizes a joint project, and successful cases are stored in the corporate library. It received a boost when it was featured at a knowledge fair that showcased existing knowledge activities to people from throughout the organization. I think this chain of communication is good example of knowledge sharing,*

Another senior research engineer mentioned that communication could be used to minimize the risk of a project. He said, "Communication with colleagues can greatly enhance the identification of risk so as to avoid it in the future. It may help projects run smoother but it will not eliminate issues or challenges, but it will make you more proactive instead of reactive to issues. Thus knowledge sharing will allow you to communicate better and be more prepared with risk." One research engineer discussed communication by institutionalizing knowledge and said,

> *I think a lessons learned should be institutionalized at the project process, or even post project closure with a wider group of people. We could probably benefit by having more communication with all engineers about lessons learned. Because the same lessons although they may immediately impact the project team, the lessons are probably valid to share with an entire organization*.

As a senior research engineer stated,

> *Establishing the trust through the meetings, through communications, through talking with people, and having them know what they need to do, establishing trust is definitely an enabler for getting the information and for them to provide the information. Getting their buy-in was a big thing so that the core team members know it's important for the organization to meet our strategic goals. I think having communication and responsibilities, and having people accountable has really helped in gathering our lessons learned.*

Also, the engineers used a network communication with authorized colleagues because they believed it would help with the exchange of certain knowledge in secured way; thus, this process allowed colleagues to share more information.

> *A good example is communication from the Trial and Error Management System (TEMS), which can be described as a closed loop learning application. Not only from communication over the system, but also conversations from practices are very important. We experience something in the work, either through analysis, discovery, or dialogue. The key is in extracting what was learned, and providing a connection between what was learned and what is practiced. Lessons from trial and error need to be documented and disseminated to the masses in a form that is easily accessible to all. Feedback is then collected and incorporated into the documentation process. The challenge*

is to continuously exchange experiences through conversations by sharing the information about what is happening on the project.

As much as R&D engineers emphasized the importance of communication, they also mentioned knowledge management systems by using examples as tools. All engineers do not possess all necessary skills and knowledge. So, the goal for knowledge sharing when using a knowledge management system is to encourage employees to continually refresh their knowledge base by interacting with those who possess work-specific skills and expertise.

Knowledge Management System. The second theme for knowledge sharing among R&D engineers is the knowledge management system (KMS). KMS incorporates the processes and tools used to store and access data, as well as the documents used for sharing data and information. All seven participants provided input to this theme.

Of the participants, five engineers spoke on the importance of having an electronic means to store and share data and information. One research engineer said,

I think the basis of success in knowledge sharing is on how we are effectively and efficiently sharing knowledge and skills we have. Once your project is complete, you have captured a lot of knowledge from your project…. You have to have the processes in place for capturing experiences and you have to have the right structure to store that information. You may have a database but the database should have the fields that will allow you and your colleagues later on to extract the information…. Plus you can look at how people learn, how they use knowledge.

Another engineer expressed the importance of KMS and said,

In our organization, we have a lot of different places that we keep information. We have Knowledge Map Intranet site, we have a program TEMS (Trial-and-Error Management System) site, and all of the information out there is readily available for anybody on our project team…. While the Knowledge Map Intranet site has hundreds of topics; the TEMS site would have those lessons that are applicable to the business and project that we are going to capture today…. We use TEMS sites for each of our projects and within those TEMS

sites for each of those projects. We do list the lessons learned so that they are available to everyone on the team.

A third engineer stated,

We have a very intuitive system for knowledge sharing, in a virtual community of practice for on-line works. If valuable experiences or lessons learned are acquired and should be shared ultimately, they absolutely must be transcribed into an electronic means to be easily shared, so everyone in the community can learn quickly.

A fourth engineer provided an explanation on how to use KMS for mutual learning process,

All R&D engineers at the G campus used the knowledge map through personal computers, tablets, and smartphones. It is considered to be a successful knowledge application. To demonstrate the knowledge map, a colleague typed the word "light emitting diode" and the top name on the retrieved list was a systems architect who was in the room, but had never been identified as someone knowledgeable in display technology. There are lots of conversations in email that they are not aware of, and there are lots of hidden experts.

Another engineer indicated that all of her work is stored on a secured network drive. She said, "because project teams are located across the physical locations, you need a place where all project members can share information, not just know-hows but project information and documents as they are created." As stated,

Your work process became part of your overall database of information for the project. So to speak, you have a project and your team captures all experiences and trial-and-errors. They should go into the overall project documentation because when you capture that it's part of your history. Another project and look at that information and gain some historical information from it. So that helps with the next project, it helps with the next project.

All of the interviewees emphasized the importance of KMS as a helpful storage place for knowledge resource. One person said,

A knowledge management system, I found to be always helpful, not only do I know what to do with my useful information, but there are things that I found that have been what I thought was unique so at least I know where to put them or how to share them or definitely what to do with them. That makes it easier

because if I have found someone that has experienced something similar then instead of reinventing the wheel, I can bounce ideas off this person and see if it's something worthwhile to continue pursuing. I definitely enjoy going back and reviewing the lessons learned and preventing what I could and salvaging what can and making it into a best practice.

Two engineers discussed the use of a web 2.0 blog as a means to share knowledge and data set skills. One engineer stated,

I frequently use my blog in the company intranet. The Web 2.0 blog was originally developed for individuals, but it is now available to a team belonging to taskforces worldwide. One of my favorite functions in the blog is database technology in order to track and profile individual usage of the system. This leads to create own customized learning opportunity and notify employees when appropriate resources become available. A coordinate collaboration is integrated into this web environment, allowing its users to add many video feeds onto a single screen for a high-tech meeting or panel discussion. Another add-on technology is a conceptual indexer that allows users to search and retrieve content with keywords much in the same way that they now search text.

The second engineer stated,

KMS includes a custom-built Web 2.0 blog that allows engineers to build a personal profile and post it as a webpage on the intranet. It is not required that the content of the profile be entirely work-related. Pictures and hobby lists coexist alongside user's summaries of their careers and job expertise. The blog content and the company's e-mail systems are linked through a knowledge map (K-map) from the tacit knowledge system, which monitors an employee's e-mail, moving phrases that seem to reflect a person's expertise on a particular subject into a private profile accessible only to that employee. The person then chooses which phrases to publish in a public directory to help others distinguish him or her as a potential expert in a specific area. Someone searching for an expert in chemical treatments, for example, would find a list of people associated with that phrase. Clicking on a name in that list would prompt a profile of the person in the knowledge map and provide a link to the person's profile.

In addition, Technology Roadmap (TRM) for intelligent building technologies, in which teams compete on a project, teaches engineers the importance of idea sharing. "It allows employees to have a good sense of the functions other engineers play in the team," says the vice president of the organization. Once employees realize that their willingness to share knowledge

affects the bottom line of a project, they are more open to making changes with regard to their method for accomplishment in the real market. A TRM helps engineers match short-term and long-term goals, and it supports employees' continuing education. Data are logged in a system and may be accessed by managers who seek the best candidates for the job. This becomes part of the overall knowledge base for moving the organization forward.

Commitment to knowledge sharing. Commitment is the third theme for knowledge sharing learned. Although the five participants used different methods and ideas of commitment to knowledge sharing in different settings – TRM, KMS, large-sized lectures, emails, instant messages, and an intensive workshop for post-research feedback – all of the participants demonstrated a commitment to a project's success through knowledge sharing. The participants demonstrated this commitment in many different ways during my observations. In a team meeting, a senior research engineer constantly checked other subordinate engineers to see whether they fully understood the current project. He often asked, "Do you understand?" Consequently, team members paid attention to discussions and to the project process. He said, "This [understanding of the project] is a key of project success."

Another assistant research engineer said, "Because I see colleagues and I know that they're really devoted engineers, and I know how they use time to engage in their work." He recognized that "knowledge sharing is required to be a source of innovative activity as much if not more than [our] own work." He searches for ways to "get his time spent on work [that is] recognized and valued and counted."

One senior engineer emphasized knowledge sharing: "the new source of power is here not money or visible property in the hands of a few but knowledge in the hands of many engineers." He explained the work process and described it as an "obscure boundary between

research and development part." There is an intermediate process between research and development, but there is nothing without knowledge sharing between two parts. Many meetings are formed to move this process along smoothly. His team also used message systems for knowledge sharing. Meetings and message systems facilitate collaboration, knowledge sharing, and the discovery of an area to be addressed. The research engineers identify the best cases and provide training for research projects. Further, knowledge management systems support a website that provides worldwide access to documented best practices, creative ideas, key readings, links to related websites, and bibliographical information. He described over 10,000 theme-based sections in place. The team learned that to be successful, each community needed a facilitator who is somewhat familiar with the subject matter and has strong communication skills. He noted that commitment is the "core of knowledge sharing." In general, he spent 3 to 4 hours conducting meetings. "A series of meetings make cooperation and better idea," he said. Face-to-face meetings that he mentioned built "trust between colleagues" and provided ways for "mediating tension between teams."

Another senior research engineer facilitated sessions to share knowledge of the R&D process. Seniors led discussion during facilitated sessions, He commented that facilitated sessions are a way to encourage team members to commit to knowledge sharing. Also, the facilitator must possess the right skills. The facilitator needs to be able to acquire information from people in a civilized manner; therefore, commitment is important, "you should be able to get along with people in a very humble way." In addition to commitment, the team leader also needs to understand the culture, especially when working with other teams.

One research engineer facilitated the lessons-learned session and said, "I will get people together in a conference room and I will have a white board and markers. Sometimes I

will get someone else to do the writing for me so I can facilitate a little bit better." Facilitation skills are important for engineers' commitment. One project manager said,

> *If you do not know anything about facilitation then a class can be really helpful, but if you already know how to do it and you want to improve upon it then talking to other people is more useful and more down to earth or practical. A class is going to teach you theory and maybe let you practice a little; whereas, talking to other people who do this will give you real practical application advice. I actually took a facilitation class because I have to facilitate lots of meetings and that was good, it gave me some basics, but actually being in front of real people and dealing with real problems [is different]…. You have to deal with people and sometimes it's great, but sometimes it's hard. It's good to be able to apply the theory to a real person.*

Most teams at the R&D center used a technical roadmap (TRM) for regular task management. They also had an organic plan to match short-term and long-term goals by integrating specific solutions to help meet long-term goals, and they were highly interested in performance-based results. For example, one senior engineer currently has six working projects in the form of matrix taskforces, having daily, weekly and monthly meetings. For efficiently managing knowledge, an engineer's commitment to knowledge sharing is very important. To increase commitment, senior engineers provide "ongoing verbal feedback to colleagues and subordinates during the research projects and used group peer review of projects and written feedback."

In a meeting with a principle research engineer, he said:

> *Commitment is a key. Since an individual engineer only views a part of the whole working process, I assigned daily/weekly work and made a detailed report. Engineers should be highly committed to research projects; knowledge sharing between research engineers and across teams is the best part of work at the R&D center.*

Another research engineer also stated,

> *Typically as many of the project team members that we could get together, as*

well as a project leader if available because it is important for them to hear some of the input. Sometimes depending of the organizational structure, the manager because they need, in a matrix organization, to hear, some of things that would help them to improve the project team members, engineers, that they are supplying to projects.

An associate research engineer shared his perspective on commitment,

Successfully implementing knowledge sharing in projects, in general, is just requires commitment to taking knowledge sharing process seriously, and really practicing those individual pieces of the project that make projects successful; such as in capturing lessons learned. Commitment can be recognized as just a small piece of the project but it is so very important because it impacts everything else in the project.

The main goal of knowledge sharing should be to motivate and nurture the expertise of R&D engineers as experts in the field. This should not only challenge expert engineers for higher levels of expectation but also encourage them to share knowledge. The strategy for knowledge sharing is to make individual engineers commit to knowledge sharing and motivate them to handle responsibilities. Often, self-confident engineers run their own agenda and do not pay attention to the projects. R&D engineers need to have a commitment to their projects and determine the ways to balance the exploitation of valuable knowledge and the desires of expertise by knowledge sharing.

Culture. The fourth and last theme for knowledge sharing is culture. Culture represents the organizational environment and belief system for knowledge sharing between engineers. There are benefits beyond creating rich systems where engineers can share. Simply put, there are invisible factors involved in the success of projects. Culture includes mutual trust, motivation, and the meaning attached to knowledge sharing. In a meeting with a principle research engineer, he said:

The learning culture of G campus is unique. It views engineers' knowledge sharing as a combination of people, processes, and technologies. It is through

learning that the project team is able to improve their methods. Knowledge sharing, when used appropriately, facilitates learning that is effective. Various management approaches *were used in combination to build a learning organization, which can also provide improved outputs, including competence management and performance management. Organizational values were reflected in the day-to-day operations of an organization, which impacted its knowledge strategy. The knowledge map promotes a culture of learning that is premised on four priority values: intellectual satisfaction, respect for the individual, achievement, and continuous learning. The knowledge map works through a series of mechanisms, mainly interactions between engineers, placing power in the hands of the individual to develop in the organization.*

One senior research engineer also said,

Well…Let me start out by saying the invisible thing; it's not a technology issue, it's a people issue and environment surround them. In some cases, especially when we talk about lessons learned; it's hey I made this mistake and this is how I corrected it. In some organizations, quite frankly, the fear is so high that nobody is ever going to write down that they made a mistake. I think there can be some behavioral things that are bigger hurdles in capturing than the technology…. to be capturing new knowledge by sharing, it has to be a learning culture. It also has to be a culture that really supports people in admitting that mistakes were made and things had to be fixed.

One assistant research engineer shared his experience from an orientation for new employees. The orientation strongly emphasized the company's values and culture. The culture that is particular to G campus may be understood through the philosophical words of its chairman. He described it as such:

The orientation booklet contains more than one hundred stories which employees read in order to better understand the company's values. One program includes a storytelling method of knowledge sharing providing examples of what engineers do and how they apply values. For example, the chairman emphasized the saying, "Get one step ahead: there is but a step from the failure and the success." Later on, I realized how chairman's words lead the R&D center prepare for the next generation of business and technology. The leadership and engineers are building ahead of time, they are thinking ahead, the CEO said.

One research engineer introduced the company's annual report, which is called the "sustainability management report." It gives progress reports on how the company culture is moving toward a knowledge sharing culture with no limits on learning, participating, and building a better future. He said:

> *We were able to change our culture for knowledge sharing by designing flat, networked, and matrix organizations. Speed, flexibility, opportunity, and openness to discussion are its key features we have. Management evaluates how well employees do with respect to supporting knowledge sharing in terms of creating, transferring, and reusing knowledge.*

Another research engineer described learning culture as,

> *If often happens that what goes wrong on one project and what goes right on one project is likely to go wrong or right on subsequent projects. In a process of improving an individual's and improving in terms of organizational capability it's useful to understand what measures can be taken to do the next project better than the last to exploit the things that were well done to repeat those things and to avoid pitfalls and problems encountered on the previous project on the subsequent project. It's about institutional learning and learning implies the identification of something to be first remembered and then recalled. Once remembered it needs to be recalled at the right time…This is something that human beings as individuals do rather naturally because we have a memory, and we are very good at learning something and then applying it, which makes us uniquely human. Organizations do not do as well. The process of remembering organizationally is one of capturing through documentation, the process of recalling what has been remembered, again has to happen institutionally, it has to happen organizationally and it's not a process that often works very well, unfortunately…So I have drawn an analogy between learning as individuals and learning as an organization. The process to learn in an organization is essentially observing something that should be remembered, remembering it institutionally, capturing it in writing, and then recalling it institutionally at the right time for the right project.*

"Learning culture is a matter of staying competitive in the workplace," a senior engineer said. In my observations, all participants were busy and tried "to use every minute" in the most efficient manner. R&D engineers believe that a learning culture supports the efficiency and effectiveness of their jobs. One associate research engineer said, "Knowledge sharing is

important in order to try to stay on top of necessary knowledge. Because it's just a matter of keeping moving forward and trying to stay ahead of the expectations of competitors."

Best Practice of Knowledge Sharing

As part of the fourth interview question, participants were asked what the best practice of knowledge sharing they experienced was. The responses resulted in two themes: (a) have a protocol in place, and (b) communicate value and awareness. Since responses from this question are closely related to knowledge sharing practices, this section focuses on what particular characteristics made the best practice of knowledge sharing.

Table 5-3

Themes for the best practice of knowledge sharing

Theme	Description	Frequency (%)
Have a protocol in place	A documented methodology for knowledge sharing and tools to support the methodology	4 (58%)
Communicate value and awareness	Provide an understanding of the importance of knowledge sharing	4 (58%)

Note: N = 7

Have a protocol and tools in place. The first theme that emerged for what was the best practice of knowledge sharing is to have a protocol and tools in place. Having a protocol in place would include a documented methodology for capturing and sharing knowledge, and tools to support the methodology. Five participants provided data for this theme from interview and documents.

The primary tool to enable engineers to share knowledge is the internet-based knowledge management system (KMS). It is an inter-connected system of knowledge bases that are used by engineers to share knowledge electronically and to collaborate closely with each other, unfettered by time and distance. The principle component of KMS is a tech forum, a secured bulletin board that only R&D engineers are granted access. For example, an engineer who needs information about a mobile network process can post a question to the bulletin board, and in the next post find answers from a researcher from a different R&D center location. This method of knowledge sharing recognizes that no single person knows everything about a topic; knowledge is generally decentralized among many engineers. Engineers are encouraged to solve their own problems and to provide solutions to other's questions on the tech forum.

Regarding a protocol in practice, four engineers said that they have a process in place for sharing knowledge with others. One engineer said, "Lessons learned should have a knowledge management process documented so people searched for a same topic can follow how to do it, what facilities and tools to use, when to use them, etc. etc." Another said, "We have a system…we have a web-based system that as people are learning the lesson they could just enter them and we could collect them, real time and review them."

> *I integrate it into a knowledge management process. I found that the knowledge sharing [is] valuable because if I was stumped on how to do something or how to get that next deliverable done, or what the next deliverable should look like. I was able to go into the knowledge base, pull up key examples, and use that information. I would say tying lessons learned into knowledge management process is really something that should work…This is the first step we have to do prior to the project.*

In developing a new project, a senior research engineer showed how to use KMS for knowledge sharing.

> *We standardize templates, standardize processes, we have a standard set of*

> *questions, so that we have consistency in the way that we do this. Every project, everywhere, no matter how small, no matter how large, no matter what culture, no matter what timeframe, deadlines or whatever is going on in the project, lessons learned would either be a dedicated session, like a facilitated session; or it would be a dedicated portion of an overall end of phase, end of iteration meeting. During these sessions or meetings you would, say let us answer three questions: what did we do right? what did we do wrong? and how can we improve upon what we did? That should be part of every single project on a regularly scheduled basis with every project participant participating in that session to drive the success of the project.*

Communicate a value and awareness. Four engineers discussed their best practice of knowledge sharing, noting that they communicate the value or awareness of knowledge sharing. Two engineers tried to help others to see the value of lessons learned by building relationships to foster discussions. Another senior engineer provided examples of training and awareness for engineers, lessons learned facilitators, or whomever is playing that role in the organization. This awareness is aimed to ensure that everyone knows how to share knowledge and to make sharing a requirement for many different projects. One senior engineer said, "I want lessons learned to be so important to all my team members that at the end of the week we get together and have a retrospective on how things went without having to have it happen as a formal conscience part of the project."

According to one research engineer, the best knowledge sharing can be achieved by communicating a value of knowledge in work practices. This communication takes various forms, such as discussions, emails, sharing documents, and creating the "environment, which can exchange know-hows and skills."

> *It is important for R&D engineers to have a good communication with engineer gurus [experts], having "value knowledge" and "core information." I mean, knowledge sharing happens elsewhere in the company, even at the outside of the center...Truly I have experienced that several core research experience have shared in the company dining.*

R&D engineers believe that the best knowledge sharing practice "is when all knowledge is developed and shared by successful researchers as professionals." Overall, the engineers are passionate about the company's long-term mission to provide "a kind of intellectual leadership within the research team." They link their effort on the project to this mission, connecting "the product across the research and trying to make it feasible in the market." While they emphasize and support the long-term plan, they also recognize that there are many different goals. One R&D engineer said, "I can be supportive of those who are on a different team because we all share the value."

Perceptions of Facilitators and Barriers to Knowledge Sharing

As part of the third interview question, participants were asked to explain the facilitators that encouraged them to share knowledge and identify the barriers that prevented them from knowledge sharing with others. Their responses resulted in six themes: facilitator-enjoyment, duty, social interaction, and trust, barrier-rewards and personality that do not support knowledge sharing. For thematic analysis, frequency scoring was used to identify the themes. Table 4-24 provides the description, frequency, and percentage for each of the five themes. The facilitators are discussed first and then the barriers, with rich descriptions.

Table 5-4

Themes for Perceptions of Facilitators and Barriers to Knowledge Sharing.

Theme	Description	Frequency (%)
Duty	This refers to the responsibilities engineers have toward their group and R&D job. Knowledge sharing is a task R&D engineers must do for their R&D job.	6 (85%)
Social interaction	Social interaction is present in the organization and allows R&D engineers to share their knowledge based on a social structure with collective consciousness.	6 (85%)
Trust	This is naturally attributable to relationships between R&D engineers and refers to a situation characterized when one party is willing to rely on the actions of another party.	6 (85%)
Economic Rewards	Economic rewards are represented as a measure of knowledge sharing, indicating the engineer's ability to share knowledge.	5 (71%)
Enjoyment	Personal enjoyment represents the R&D engineers' feeling of happiness when they share knowledge with colleagues. It is their intrinsic motivation.	4 (57%)
Individual characteristics	Individual differences among R&D engineers with regard to behavior patterns, cognition, and emotion, influences knowledge sharing with others.	4 (57%)

Note: N = 7

Duty. The first theme that emerged for perceptions of facilitators and barriers to knowledge sharing is a feeling of duty. "Duty," for engineers, refers to the responsibilities and obligations they have toward their group and R&D job. Knowledge sharing is a task that R&D engineers must do for an R&D job. All of the participants indicated that duty is a strong facilitator for knowledge sharing.

Knowledge sharing is a shared group expectation related to an employee's behavior. One senior research engineer explains it as "invisible rules that govern an employee's work behavior." Six of the seven participants considered knowledge sharing to be part of their work, and they agreed with the idea of work duty. When the participants were asked about why they share knowledge, participants often answered, "that is what we should do at work practices." Participants recognized that knowledge sharing is "part of their task as workers."

Another senior research engineer said that work duty is emphasized from the start, at orientations for new employees. Shared knowledge is a "byproduct of performance-based project[s]." A sense of duty and obligation to the organization is the core feature of organizational culture.

> *I believe knowledge in a research process is not solely reserved for my own work, but for organization property that should be shared with others. I don't think of knowledge as my individual intellectual property. Instead, it is company property because the company hired me. I am a dedicated employee and my team, too. Knowledge sharing is duty and responsibility that employer pays for.*

A principle research engineer explained,

> *Technically, Korean patent laws hold that in-house inventions belong to employers. No cases really show that employees took legal rights of R&D results. In practice, all our employees are loyal to their job and we, executive levels, try to get them compensated as much as they want. Actually, we provide an annual pay about 180% than rival companies. All works including knowledge sharing among R&D practices are duty for employees.*

One research engineer stated,

> *…It comes from the top down…The higher authority [chairman and executive level] wants to give us [engineers] the time to get everyone together, to go through [knowledge sharing] in detail to see what was learned, to share the information, and then at the beginning of the project to give the leads time to review the previous lessons learned so they can incorporate them into their initial risk log…I think this [knowledge sharing] is one of my job duty…*

Social interaction. The second theme that emerged for perceptions of facilitators to knowledge sharing is social interaction between R&D engineers. Social interaction is present in the organization and allows R&D engineers to share their knowledge based on a social structure of collective consciousness. It offers intrinsic motivation. Although only six participants provided data for this theme, it remained important because the responses represented those of six of the eight program managers. They all agreed on the importance of knowledge sharing as part of social interaction, such as cooperating and respecting the property of others. However, the project managers also recognized the importance of the human component of organizations. While interacting with colleagues, an engineer learns communication, cognitive, and behavioral skills. One assistant research engineer said,

> *I think that the organizational predisposition to valuing social interaction is a primary source for knowledge sharing. If the R&D team was uncomfortable with social interaction, or with collecting and documenting things that went wrong, that would have been a major reason not to share knowledge. But because that organizational predisposition was there that was a major facilitator.*

Another associate research engineer said,

> *Many successful projects show that the interaction based on knowledge sharing maximizes their outcomes. Engineers are often rational and determine the best possible means to compete for rewarding situations. I believe that social interaction can have a big impact on an engineer's knowledge sharing.*

Another research engineer described knowledge sharing as a series of interactions based on an estimation of rewards and trust. Beyond monetary rewards from the company, "all human relationships are formed by a subjective cost-benefit analysis." All of the participants agreed that knowledge sharing is a social transaction, maintaining a belief that shared knowledge brings return with visible and/or invisible benefits.

A senior research engineer regards social recognition as having a complex relationship with knowledge sharing. He said,

> *On the one hand, social recognition gives you public acknowledgement to push knowledge sharing in social exchange. However, on the other hand, once you seek excessive recognition you can yourself [exhibit] traits of a narcissistic disorder…As a cornered stone meets the mason's chisel, [our] organizational culture does not like a such person.*

Also, the theme of social interaction is closely related to the next theme – trust. Participants recognize the potential of long-term relationships based on trust. One research engineer said,

> *No, money is not a purpose. I want to learn from others and hope I am of help to others, and just put my head down and forge ahead and do the best I can and hope that it will all sort out…my team was built on a long-term relationship with trust…*

In addition, he said,

> *Research engineers at G campus generally trust each other in terms of inter-organizational networks, but some may distrust in terms related to their own interests. But it is only few. I observed how engineers may be vigilant of others' interests and fearful of the loss of valued knowledge, leak of secret, or harming reputation in organization.*

Trust. The third theme that emerged for perceptions of facilitators to knowledge sharing is trust. All of the participants emphasized trust when they mentioned social interaction. Social interaction focuses on the relationship between engineers. Trust is a belief that one's colleague is reliable. It is a situation characterized by the fact that the person expects future benefits from a long-term relationship. In other words, it refers to the belief that your colleagues will behave in a way that benefits you, although you have no control over their behavior. One senior research engineer stressed the importance of trust in a team project,

Although the organization culture provides a strong environment for using KMS tools, I think the most important factor in knowledge sharing is trust. Engineers must trust one another before they share knowledge and skills. A distinctive feature at G campus is trust on the basis of direct communication, such as conversation, debate, and discussion between individual engineers. Its aim is to minimize distortion and misunderstanding of the knowledge content. For some of the engineers, however, there is still a concern that sharing knowledge means giving information away that would reduce one's competitiveness, and, in turn, incur a loss of monetary rewards. Thus, building trust was the key to knowledge sharing among R&D engineers.

Another research engineer said,

In my project, trust is essential for increasing interaction and the likelihood of knowledge sharing between team members. It is based a mutual belief that our team member will not act opportunistically and increase willingness to share information. We prove that by seeking and offering help, and increasing the number of sharing.

Trust appeared to influence how motivation was translated into group processes and performance. A team with a high level of trust motivation was transformed into collaborative or conjoint efforts that resulted in improved team performance.

I don't think my behavior of knowledge sharing is just simply one of my job tasks. It is an interpersonal process that is often highly interrelated in the workplace. Thus it needs interdependency….based on trust, it is better to lead not by a hierarchical direction but through cooperation, providing people with the necessary assistance to enable them to do better what they are already doing.

One principal research engineer explained 1990's experience that his company invested astronomical money in building a system. "Computer networks and technology were not the answer." The company found difficulties in encouraging engineers to use a system to share their ideas. "Non-technology issues that jeopardize the potential benefits of knowledge management system."

At that time, many praised the first generation knowledge management system. In spite of a simple function in the board, IT professional said that they laid the

> *cornerstone of the growth. I think we have insufficient understanding of benefits of knowledge sharing through a system. Also, we competed each other and had no trust. For the last years, we have learned the importance of trust within the organization for the breakthrough…now I am a knowledge provider to the next generation by sharing my experience and know-hows.*

Economic rewards. The fourth theme that emerged for perceptions of facilitators and barriers to knowledge sharing is a barrier; it is economic rewards. Economic rewards are represented as a measure of knowledge sharing, indicating the engineers' ability to share knowledge. Many controversies exist about the impact of economic rewards on knowledge sharing behaviors. Five participants provided data for this theme.

Four engineers indicated that economic rewards are not a purpose of knowledge sharing. One engineer stated, "Frequent knowledge sharing brings about financial benefits as well as social recognition from others." He continued, "nobody shares knowledge without considering money. This is a same reason why I am working. I want to be paid as much as I work and I provide my knowledge and labor." An average performance-based bonus for engineers ranged from 50 percent to 70 percent of their annual pay in 2013. Thus, monetary rewards can be a substantial part of extrinsic motivation to share knowledge.

Two other engineers explained the reasons why some people are not willing to share information. One said,

> *Unfortunately, in our organization that pay salary and bonus a lot, we do not very seriously consider economic rewards on knowledge sharing. In fact, this is little bit tricky because….who knows the quality of knowledge sharing. Counting the quantity of knowledge sharing is funny, it is meaningless. Because a real value of knowledge sharing comes from the co-work and communication…for example, some people do not want to share their experiences and they want to keep it to themselves so they can move on, but you should not be like that. You need to share these things [experience, knowledge, knowhow]…. The difference between the business environment and the research*

environment is sharing. In the research world we share everything, we share knowledge.

Another research engineer said,

There is an old saying, let me say, knowledge is not a selling product…. Part of the reason we do not think of knowledge sharing as financial rewards because it contributes to their intellectual power and position in the organization. The concept of 'we' is important. I think there is some aspect of if you know what I know then it is our value, again, if you know what I know and I know what you know then we both gain value. If someone gets paid more by something we have to commonly hold, I will be upset.

The participants did not conclude that engineers share knowledge with the primary purpose of a monetary reward. Rather, they recognized the greatest potential for knowledge sharing links to its value as an asset for competitiveness.

Enjoyment and interest. The fifth theme that emerged for perceptions of facilitators and barriers to knowledge sharing is enjoyment and interest. Although organizational structure influences employees' behavior, individuals are not equally likely to attain selected behavioral outcomes, such as knowledge sharing, on account of genetic composition. Four of the participants said they share knowledge because it was something they enjoyed and found interesting. One assistant research engineer regarded knowledge sharing as something that "came along with the bonus package" of the work process. He said,

While working here, I have experienced a kind of surprising and pleasant transition when I realized a whole different process of managing the laboratory apparatus then what I had thought the work of being a researcher was going to be.

Another associate research engineers admitted,

I found this new kind of research process to be kind of fun through knowledge sharing. Although this participant did not initially pursue a career as a research engineer for that reason, I got to recognize that I enjoyed the research process before I was obligated to cooperate with a knowledge management system.

The other research engineer said,

> *Because of technology applications and organizational rewards, the relative importance of enjoyment and personal interests has been underestimated. However, knowledge sharing is full of joy for research engineers and the interpretive process in forming feelings about one's job.*

In the context of enjoyment, related to knowledge sharing, another participant mentioned, "emotions are an inseparable part of work life." She realized that emotions influence knowledge sharing, and she accepts enjoyment as a legitimate emotion for knowledge sharing. Based on her description, her knowledge sharing relies on enjoyment and the belief that "everything I shared returns beyond the shadow of doubt."

Individual characteristics. The last theme that emerged for perceptions of facilitators and barriers to knowledge sharing is individual personality. When participants were asked about why they share knowledge, few people answered that it was because of individual traits. One research engineer indicated that his personality is positively related to knowledge sharing. He said,

> *I am struggling with the nature of research practices as a young engineer, often finding the research lab to be a very pressured and stifling environment. However, I am always interested in and energized by intellectual activity and find myself as someone who would work well in a research environment…Yes I am very optimistic… I realized that I really liked working closely with researcher and...I did best [when] working with my peers on the project by sharing what we know. Realizing a direction in my career, I found knowledge sharing is my intellectual home in the research field that was more pleasing than academic research would've been.*

One interviewee considers activeness to be the facilitator for meeting expectations regarding knowledge sharing. They are motivated to be successful and he stated,

Nobody wants to make the same mistake twice. So first time I make a mistake that is to be expected. You expect people to make mistakes. I find that acceptable that people will make mistakes. What I do not find acceptable is people making the same mistakes twice. To minimize this risk is simple. The solution is knowledge sharing. And now it depends on my personality to humbly share my mistakes.

Another engineer stated,

Personal success is at stake, those are the factors. To be more successful at executing your projects, that would look good. To be prepared for the project by sharing the previous or current success…A repeat of bad habits will hinder the success...I am very sensitive at knowledge sharing. I trust only information that is in the feasible, tangible, and concrete. Well, I only share knowledge, which can be applied for my project. So I prefer to look for details and facts… That is my personal motivation.

On the other hand, one assistant research engineer mentioned that an introverted personality was a barrier to knowledge sharing. He said, "Barrier number one is certainly my introverted traits."

Corporate Familism

Although specific determinants of knowledge sharing varied across informants, it is evident that each participant interviewed had in place a set of trust, social interaction, and a sense of duty determining their knowledge sharing intentions as R&D engineers. These findings were not found in quantitative research. Qualitative analysis, however, indicated that trust, social interaction, and a sense of duty are closely interrelated in codes. This means that R&D engineers share their knowledge based on a system of reciprocal trust and social interaction. Also, since South Korea is a highly collectivistic country, a long-term commitment and loyalty to the group is regarded as an important virtue (Hofstede, 2001, Bae & Lawler, 2000).

As described in Chapter 1, Confucian culture is deeply rooted in South Korea. Such culture values strong family-oriented characteristics. This socio-cultural infrastructure

prescribes the characteristics of individual behaviors and relationships in organizations (Choi, 2004). Results from the qualitative study indicate that so-called "Corporate Familism" encouraged R&D engineers to share their knowledge within a community. Informants repeatedly mentioned interdependency. This result is not necessarily indicative of their entire relationship; however, it increases our understanding of their relationship as a family-based notion derived from a sense of solidarity. Therefore, knowledge sharing between R&D engineers occurs when they form a firm consciousness to build trust and bilateral understanding between peers. It is important to note that social relationships play significant roles in promoting knowledge sharing between R&D engineers. Further, management should emphasize their efforts to nurture relevant social exchange relationships and interpersonal interactions.

Summary

The researcher conducted a qualitative study to answer the research questions: (1) how do research engineers in the R&D center describe their knowledge sharing, and (2) what influences research engineers to share their knowledge?

To obtain the results, the researcher used interviews to understand the participants' personal ideas and experiences. The unit of analysis was R&D engineers working at the R&D center of a high performance IT company in South Korea. Seven R&D engineers were participated: two assistant research engineers, one associate research engineer, two research engineers, and two senior research engineers. The raw data obtained from the interviews and observations were organized into four sections: (a) perceptions of knowledge, (b) practices for knowledge sharing, (c) the best practice of knowledge sharing participants experienced, and (d) perceptions of facilitators and barriers to knowledge sharing. The first interview question: "how do you define knowledge at your work and knowledge sharing between with your colleagues"

was asked to obtain data for the first section: perceptions of knowledge. This section provided an awareness of the participants' perspective on knowledge and knowledge sharing.

The raw data from the second interview question: "how do you describe the process of knowledge sharing," and the third question: "the best practices of knowledge sharing the participant experienced," were combined for analysis in the second section: practices for knowledge sharing. The data analysis resulted in six themes: communication, KMS, culture, commitment, protocol, and value. For thematic analysis, scaling with each of the six themes was used to show frequency and ratio. The fourth interview question: "why do you share your knowledge," was asked. A detailed understanding of the facilitators and barriers for the benefit of knowledge sharing among projects was gathered to produce data for the fourth section. Raw data provided for the fourth section – perceptions of facilitators and barriers to knowledge sharing – generated five themes. The themes were duty, social interaction, trust, rewards, personality, and enjoyment.

CHAPTER 6

CONCLUSIONS

This chapter begins with a brief summary of the study and discusses the research hypotheses and related findings. Next, the implications for HRD research and practice are addressed. Lastly, the limitations of this study are provided and recommendations and directions for future research are offered.

Overview of Findings

Because knowledge-related activities, such as creating, transferring, and sharing knowledge are the primary source of today's organizational competiveness (Boisot, 1998; Spender & Grant, 1996), the nature of competition and the sources of competitive advantage are heavily dependent on how well knowledge is shared between individuals, teams, and organizations (Alavi & Leidner, 2001; Argote, McEvily, & Reagans, 2003). How to share knowledge becomes one of the most important issues, especially for knowledge-intensive organizations, such as technology companies that engage in R&D work. Organizations might promote knowledge sharing successfully by directly incorporating knowledge in business strategy and by changing employee attitudes and behaviors in an effort to promote willful and consistent knowledge sharing (Connelly & Kelloway, 2003).

A substantial amount of research on management and organization study focused on the relationship between knowledge sharing and organizational outcomes, such as innovation performance and productivity (e.g., Calantone et al., 2002). However, researchers and practitioners gave less attention to an integrative approach that explores the various determinants – such as economic rewards, perceived social exchange, and proactive personality. Minimal empirical research examined the relationships among them. To fill this gap, this study develops a

research framework that links knowledge sharing enablers and intention to knowledge sharing. In particular, the study examines the determinants of knowledge sharing between R&D engineers in South Korea. This study adds to the knowledge sharing literature in several ways. First, various determinants from different perspectives were embedded in the research design to understand R&D engineers' knowledge sharing practices. Second, while much of the previous research relied on quantitative data that uses self-reported knowledge sharing intention as its focus, this study obtained qualitative data from R&D engineers and analyzed not only survey data but also interview data from eight R&D engineers. Finally, this study was conducted at a high performance IT company in South Korea, adding to previous studies limited to western cultures.

The results of this study are compared and discussed in the following sections. Additional explanations are provided for results that are different from the hypotheses of this study and not consistent to with previous studies.

Proactive Personality and Knowledge Sharing

Based on the personality traits theory and previous research on the relationship between personality and knowledge sharing, predictions were made as to how proactive personality variables affect one's intention to knowledge sharing. Results from a quantitative study showed that proactive personality had a positive effect on one's intention to share knowledge with others, indicating that the more proactive one was, the more likely s/he reported a higher intention to share knowledge. As stated in hypothesis 1, proactive personality will be positively associated with R&D engineer's knowledge sharing. Hypothesis 1 was supported by the empirical data from the sample. Proactive personality had a statistically significant and positive relationship with knowledge sharing intention; the strength of the association between

the two was moderate. Proactive personality was also found to be a significant predictor of knowledge sharing intention. This result indicated that proactive personality directly impacted an R&D engineer's intention to knowledge sharing, with 17% of the variance in knowledge sharing explained by the variance in proactive personality.

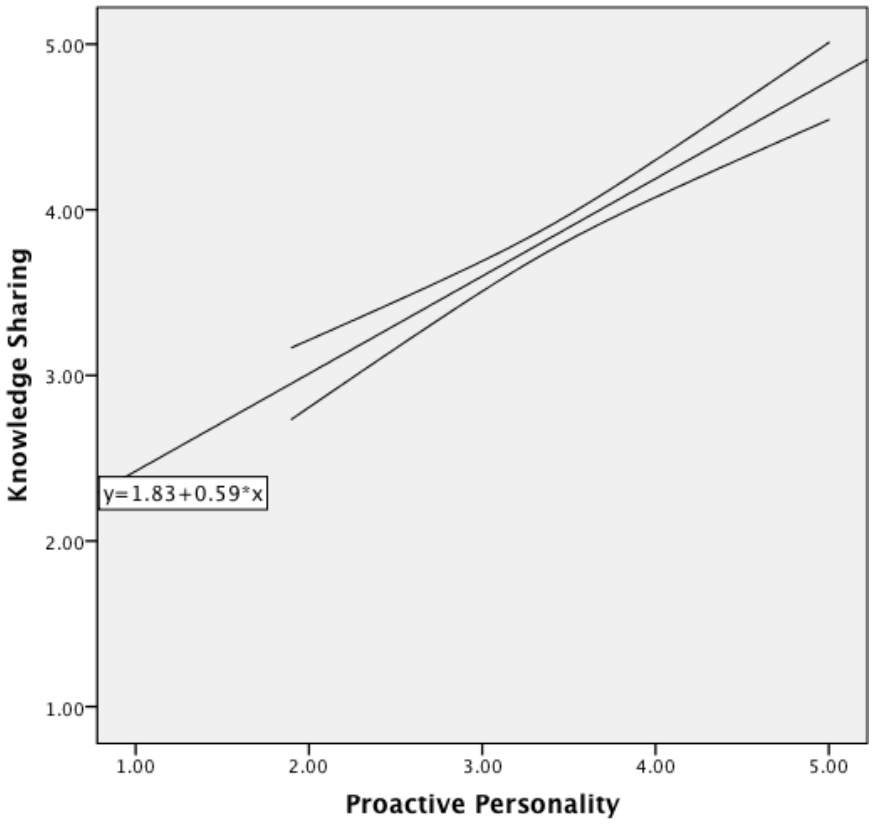

Figure 6-1. The effect of proactive personality on knowledge sharing.

This finding is aligned with results from a qualitative analysis of the study. When participants were asked about why to share knowledge, four participants answered that it is because of individual traits, which are regarded by them as the most influential factors in individual knowledge sharing (Bryant, 2005). Extant research and theories argue that an individual's decision to share knowledge is influenced by individual characteristics, such as

personality, that indicate general tendencies and predispositions (e.g., Colquitt, LePine, & Noe, 2000). Crant (1995) stated that proactive employees interact with others to exchange knowledge in order to identify opportunities. Through knowledge sharing with others, proactive employees accumulate informational resources, improve knowledge bases, develop know-how, and refine ideas (Grant & Ashford, 2008). It was reported that proactive personality is positively related to knowledge sharing (Gong et al., 2012). Thus, the current study supports the argument that proactive personality is directly and significantly related to knowledge sharing.

Economic Rewards and Knowledge Sharing

From an economic exchange perspective, the underlying assumption as to why people share knowledge is that they view knowledge as a private good owned by individuals. In this case, individuals share their knowledge based on market mechanisms to receive monetary benefits. People are motivated solely by self-interest and are more likely to share knowledge when provided with tangible returns. As stated in hypothesis 2 of this study, economic rewards will be positively associated with knowledge sharing. Hypothesis 2 was not supported by the sample of this study, however. Contrary to the study's hypothesis, a negative relationship between economic rewards and knowledge sharing was found; the strength of the association was trivial. It was revealed to be a negative predictor of knowledge sharing. The study's results indicated that economic rewards perceived by R&D engineers negatively impacted their intention to knowledge sharing. Only 3% of the variance in knowledge sharing was explained by the variance in economic rewards.

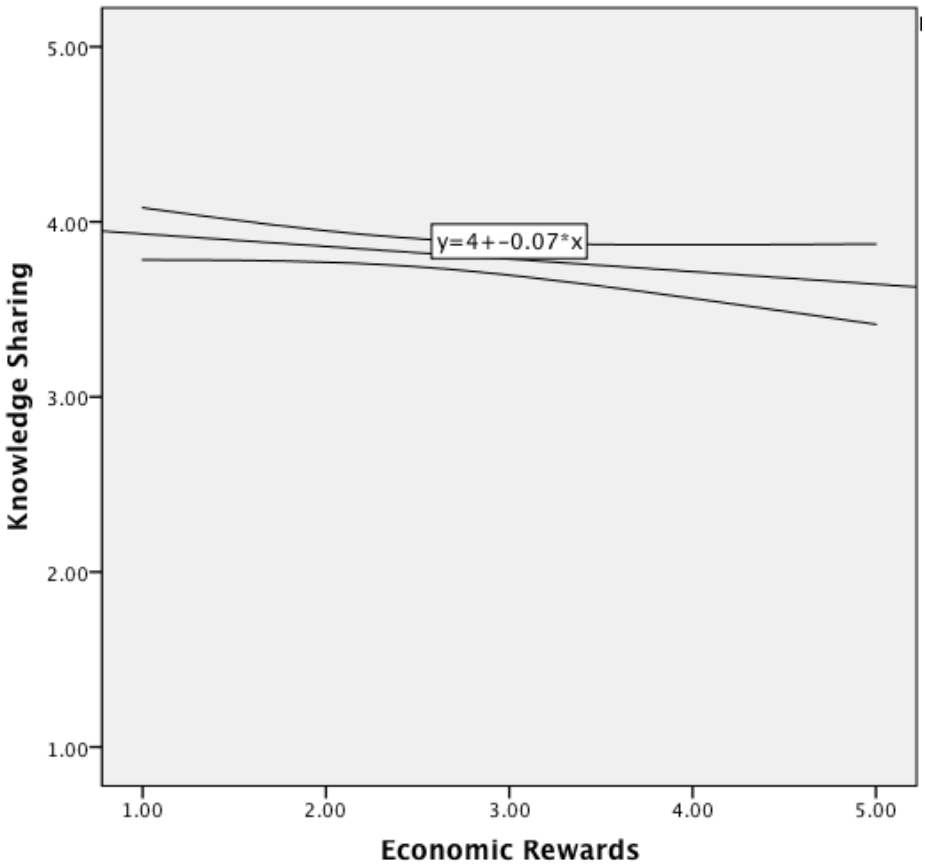

Figure 6-2. The effect of economic rewards on knowledge sharing.

Notably, the more that R&D engineers think that knowledge sharing is financially rewarded, the less likely they are to share knowledge with other engineers. In spite of an anticipated positive influence of economic rewards on knowledge sharing, the empirical results of previous studies have been mixed. Based on economic exchange theory and expectancy theory, economic rewards, such as a monetary bonus and other financial incentives are considered as positively related to knowledge sharing. For example, employees who perceive a higher level of incentives will be more likely to share and use knowledge. Cabrera and his colleagues (2006) reported that extrinsic rewards offered by organizations are positively associated with knowledge sharing. The majority of empirical research reported that there was a

significant positive relationship between economic rewards and knowledge sharing (Kankanhalli et al., 2005; Kim & Lee 2006; Siemsen et al., 2007).

Contrary to the expected positive relationship, the results of Bock and Kim's (2002) field study in South Korea indicated that economic rewards have a negative effect on knowledge sharing. Their study affirmed a negative influence of economic rewards on knowledge sharing (Bock et al., 2005). Considering the fact that that extrinsic rewards may negatively affect one's intrinsic motivation (Eisenberger & Cameron, 1996), it is possible that R&D engineers are less likely to share knowledge for the sake of receiving extrinsic rewards than refraining from sharing behavior completely. Moreover, they contribute knowledge of a relatively lower quality in a KMS that may not be as helpful for others' future reference.

The results of a qualitative study supplemented the results of a quantitative study. The participants of the interview did not conclude that engineers share knowledge with the primary purpose of monetary reward. Rather, they all recognized the potential for knowledge sharing as the most important vehicle for organizational competitiveness. These findings present results that are contradictory to the majority of previous literature insofar as economic rewards are not a positive predictor to knowledge sharing in this study. It is noteworthy that providing monetary rewards in return for knowledge sharing promotes self-interested behavior. It reduces intrinsic motivation and prevents engineers' knowledge sharing (Deci, 1972). Extrinsic rewards provide temporary satisfaction; however, these rewards rupture relationships between engineers, inhibit organizational learning, and undermine interest for the R&D work itself.

It is important to note that the internal validity of the research on the relationship between economic rewards and knowledge sharing can be suspect because a majority of studies measured variables based on the same survey attributable to common method variance. The

inconsistent findings also suggest the possibility of moderators of reward types, such as individual or group-based incentives (Bartol & Srivastava, 2002). Thus, moderating effects might alter the relationship between economic rewards and knowledge sharing.

Also, the contradictory results of previous research may be due to the study's context. In the organizational context, the reality is that there is keen competition that if one is not performing better than other employees, they may be endangered by layoff. There also exist limited opportunities for promotion and other opportunities. Perhaps engineers in knowledge intensive industries are aware that their job security highly counts on what they know, especially the knowledge that they have but that others do not have.

Social Exchange Perception and Knowledge Sharing

Based on social exchange theory and previous research, predictions were made as to how the perception of social exchange affects one's intention to knowledge sharing. As stated in hypothesis 3, social exchange perception will be positively associated with knowledge sharing. Hypothesis 3 was supported by the sample of this study. The perception of social exchange had a significant and positive relationship with knowledge sharing intention; the strength of the association between the two was moderate. Social exchange was also found to be a significant predictor of knowledge sharing. The study results indicated that the perceived social exchange impacted R&D engineers' intention to knowledge sharing. 26% of the variance in knowledge sharing was explained by the variance in perceived social exchange. Moreover, holding conditions constant, the more benefits from social exchange that the participants perceived in their R&D work, the greater their intention to share and the more likely they shared their own knowledge with other engineers.

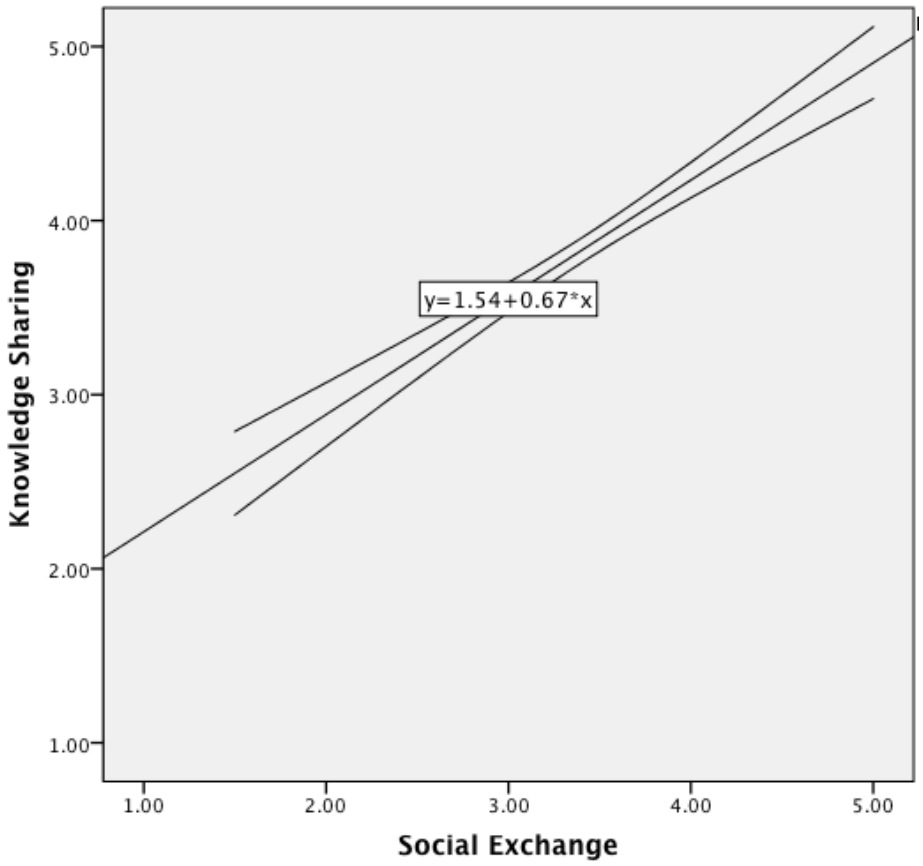

Figure 6-3. The effect of social exchange on knowledge sharing.

In social exchange theory, the perception of social exchange has been regarded as one of the most influential conceptual paradigms in organizational behavior (Cropanzano & Mitchell, 2005). Individuals estimate the perceived ratio of benefits to costs and base their knowledge sharing behaviors on the expectation that it will lead to return, such as respect and reputation (Blau, 1964). This finding provoked the expectation that R&D engineers, who perceived social exchange, are more likely to share their knowledge with others. Consistent with this theory, research shows that perceived social exchange is positively associated with knowledge sharing (Siemsen et al., 2007; Wasko & Faraj, 2000). Bartol et al. (2009) argued that perceived social exchange is a strong predictor of knowledge sharing. In other studies, it was reported that social

exchange had a significant and positive relationship with knowledge sharing (e.g., Majchrzak, Cooper, & Neece, 2004; Wilson, Goodman,& Cronin, 2007). Thus, these study findings add evidence to the claim that social exchange is a critical determinant of knowledge sharing.

Although cultural dimensions were not included in this study, the cultural influence might account for this result. Because Korean culture is considered highly collectivistic and pragmatic (Hofstede, 2001), it is more likely that if the Korean employees perceive themselves as benefiting from knowledge sharing, they would be more likely to contribute in return. In addition, what makes the results interesting is that in this study, the social exchange perception had a positive effect on sharing intention; while economic rewards had a negative effect on knowledge sharing, simultaneously. It is possible that individuals who thought knowledge sharing would be beneficial to R&D work toward a common goal and felt compelled to share knowledge.

Overall, the effects of social exchange perception are relatively larger than other determinants. The variance that was explained by social exchange in overall knowledge sharing was relatively larger than proactive personality and economic rewards. The result of a relatively large effect of social exchange in this study is consistent with those found in previous literature. For example, Lin's (2007) study indicated that perceived benefits for individuals engaging in social exchange positively affected employee attitudes toward knowledge sharing. Further, Wasko and Faraj (2000) found that knowledge sharing in three online communities of practice was primarily facilitated by a strong sense of social exchange.

Sense of Duty and Knowledge Sharing

In addition to the results from the quantitative study, the first theme that emerged from the qualitative study was a sense of duty. "Duty," for engineers, refers to the

responsibilities and obligations they have toward a R&D job. Knowledge sharing is a task that R&D engineers must do as part of a R&D job. All of the participants indicated a sense of duty as a strong facilitator of knowledge sharing. As Blau (1964) argued, social exchange theory entails unspecified obligations that are not stipulated in advance but obvious in organizational behaviors. The R&D engineers admitted a willingness to share knowledge at their own expense because they recognized themselves as part of the entire organization. Thus, knowledge sharing pertains to issues of duty and delegation, such as who should do what and how much responsibility different individuals should assume.

From this result, it is important to note that national culture results in certain differences in individual knowledge sharing in Korean organizations. South Korea is a vertical collectivist culture. According to Triandis (2002), vertical collectivism includes "a sense of duty serving the in-group and sacrificing for the benefit of the in-group, and behaving as expected of a good member of the in-group" (p. 26). Korean engineers tend to subordinate their goals and prioritize the needs of the in-group and the collective. In this collectivism culture, individuals have a moral obligation towards their in-group and share common interests and welfare. From this perspective, knowledge is a public good owned by the collective and is socially generated. When R&D engineers consider knowledge as a public good, they are motivated to share it with others due to a sense of obligation. Individual engineers have reciprocal obligations. They are expected to collaborate with each other by sharing knowledge as if they are fulfilling obligations to their colleagues (Michailova & Hutchings, 2006).

Social Interaction and Knowledge Sharing

The second theme that emerged from the qualitative study is the social interaction among R&D engineers. Social interaction is present in the organization and allows R&D

engineers to share their knowledge based on a social structure of collective consciousness. This is also characterized by pragmatism, emphasizing long-term relationships (Hofstede, 2001). Thus, knowledge sharing in Korean culture involves interactions with others as part of a whole relationship. It has often been argued that social interaction and communication promotes knowledge sharing between employees. Gupta and Govindarajan (2000) found that social interaction within multinational corporations influences the inflows and outflows of knowledge sharing between subsidiaries. Particularly, direct face-to-face interaction, including non-verbal and visual cues between organizational members, is desirable to facilitate knowledge sharing within organizations (Tsai, 2001).

Various forms of communication within the R&D center were described from a qualitative study, emphasizing how knowledge is constructed through collaborative efforts in social interaction (Plaskoff, 2003). Based on social learning theory, some researchers demonstrate that social interaction affects the willingness and motivation for mutual learning and the effort to share knowledge with others (Reagans & McEvily, 2003). Empirical evidence from precious studies revealed a considerable main effect of social interaction on knowledge sharing, confirming the expectations based on the social learning model. For example, the results of regression analyses in Noorderhaven and Harzing's (2009) study showed that social interaction is positively related to knowledge sharing between subsidiaries of a multinational enterprise. Chen and Huang (2006) also supported this claim, noting that the degree of social interaction is positively related to knowledge sharing. Therefore, this study aligns with previous research findings, arguing that the diverse and valuable knowledge of individuals can be shared through interpersonal social interaction.

Trust and Knowledge Sharing

The third theme that emerged for perceptions of facilitators to knowledge sharing is trust. All participants emphasized trust when they mentioned knowledge sharing. Trust refers to the belief that your colleagues will behave in a way that benefits you, although you have no control over their behavior. In previous research, trust is known as a strong predictor of behavior. Nelson and Cooprider (1996) found that knowledge sharing can be achieved through the mechanisms of mutual trust. Chowdhury (2005) demonstrated that the effect of affect-based trust is positively related to the knowledge sharing process. Affect-based trust results in emotional ties linking individuals and promoting shared values. Shared values, in turn, are an important determinant of knowledge sharing. Empirical evidence from previous research indicated a causal relationship between trust and knowledge sharing behavior. Tsai and Ghoshal (1998) provided empirical evidence from a multinational electronics company, showing that trust and trustworthiness influenced resource exchange. In a comparative study, Dyer and Chu (2003), reported a positive influence of a supplier's trust on their information sharing in a sample of South Korea. Thus, trust is important in the R&D center, as participants' answers revealed, because it could promote interaction with others and an interdependent atmosphere by sharing knowledge.

Enjoyment and Knowledge Sharing

Another theme that emerged for perceptions of facilitators to knowledge sharing is enjoyment in knowledge sharing. Intrinsic motivation refers to engaging in an activity for its own interest and the pleasure derived from the experience (Deci, 1975). Four participants answered that they can be satisfied through knowledge sharing that helps others. In the motivation study, research on altruism argued that intrinsic motivators, such as enjoyment to

help others, plays a critical role in explaining knowledge sharing in human behaviors (Osterloh & Frey, 2000). This study supported previous research on enjoyment in helping others, as employees' intrinsic and salient beliefs, which explains knowledge sharing behaviors. Lin's (2007) study, based on theory-reasoned action, showed that enjoyment in helping others positively affects employee's intention and attitudes toward knowledge sharing. Similarly, Hsu & Lin (2008) reported that perceived enjoyment is the most important factor for explaining knowledge sharing behaviors. The results of a qualitative study showed that intrinsic motivational factors, such as enjoyment in helping others, was significantly associated with engineer's knowledge sharing practices in the R&D center.

The Illusion of Economic Rewards

One of the most interesting findings in this study is that the expected economic rewards are negatively related to the R&D engineer's intention to knowledge sharing. Researchers and practitioners in management argued that economic rewards, such as bonuses and financial incentives, are important to promote knowledge sharing. Moreover, from the viewpoint of economic exchange theory, a person behaves in expectation of the payment received. Certainly, a vast number of companies use a total compensation strategy intended to motivate employees. Contrary to the belief that people will share their knowledge if they have been promised economic rewards, this research shows that the R&D engineer's intention to knowledge sharing is negatively related to such financial rewards. In other words, promised economic rewards discouraged engineers' knowledge sharing in the workplace. The question becomes, why might an economic-reward plan for knowledge sharing not work?

One reasonable explanation for this negative relationship can be found in the pay-for-performance research. Although the practices associated with pay-for-performance is still

pervasive, a growing number of evidence supports the notion that there is no relationship between rewards and employee's performance (e.g., Durham & Bartol, 2000; Kohn, 1993; Milkovich & Newman, 2013). A meta-analysis of 98 studies also indicates that there is no significant relationship between financial incentives and productivity (Guzzo, 1985). Yoo, Han, and Huang (2012) showed that there is no relationship between extrinsic motivators and an employee's behavioral intentions. Moreover, knowledge sharing between individuals in a knowledge intensive industry, such as IT, occurs mainly in their interactions as a form of informal and incidental learning (Marsick & Watkins, 2001). Thus, it is difficult to make economic rewards contingent on their knowledge sharing.

In addition, knowledge sharing is related to motivation theory. Kohn (1993) argues that economic rewards have punitive effects on employees' behaviors because it is manipulative. Hertzberg (1968) explains that rewards and punishments are two sides of the same coin. For example, when incentives and monetary rewards are highly desired, by making it contingent on certain behaviors, it is manipulation by managers for the purpose of controlling their subordinates. This experience is likely to assume outright punishment. Likewise, not receiving economic rewards that one has expected to receive demoralizes employee's intention to knowledge sharing.

In terms of intrinsic motivation, economic rewards do not create a lasting commitment, but merely change employee's behavior as a form of temporary compliance. According to Deci and Ryan (1985), economic rewards may actually undermine intrinsic motivation. The more employees experience being controlled by economic rewards, the more they are likely to lose interest in knowledge sharing. Economic rewards may lead to making people less enthusiastic about their knowledge sharing, and therefore, less likely to approach it

with a commitment to excellence in R&D. Frey and Jegen (2001) describe this hidden cost of rewards as a crowding-out effect. For intrinsically-motivated employees, knowledge sharing is more important than sharing with the motive of monetary compensation (Osterloh & Frey, 2000).

Lastly, the negative effect of economic rewards on knowledge sharing yields plausible explanations for the engineers' relationships and interactions. That is, economic rewards may inhibit cooperation (Johnson, Hollenbeck, Humphery, Ilgen, Jundt, & Meyer, 2006; Organ & Konovsky, 1989). When engineers compete for a limited amount of monetary reward, they will most likely regard each other as obstacles to their own gain. Economic rewards may diminish trust between engineers (Liao, 2008). According to Constant et al. (1994), experienced employees learned the importance of sharing knowledge acquired from their work and they may have a negative attitude toward receiving extrinsic benefits in return for knowledge sharing behavior, which they perceive as a required activity.

Individual learning and organization innovation occur when individuals combine and share their personal knowledge with others (Kogut & Zander, 1992; Nahapiet & Ghoshal, 1998). Thus, there is a growing awareness of the importance of creating an organization's learning culture to promote knowledge sharing and generate knowledge flow. This study examines the determinants of knowledge sharing between R&D engineers in a high performance IT company in South Korea. Findings from a quantitative study showed that individual proactive personality and social exchange perception are positively related to knowledge sharing intentions. In contrast to a positive hypothesis of the relationship between economic rewards and knowledge sharing, economic rewards are negatively related to the knowledge sharing of R&D engineers. This quantitative result was confirmed by the result of a qualitative study, indicating that economic

rewards are considered as a barrier to share their knowledge. Additionally, a sense of duty, trust, and enjoyment to help others were found as facilitators of knowledge sharing in a qualitative study.

Implications

In this section, theoretical and practical applications in HRD fields are recommended. The following implications emerged from the current study, adding new knowledge to HRD research, applying and reinforcing existing HRD theories, and helping HRD practitioners maximize their organizational effectiveness.

Theoretical Implications

The findings of this study extend previous research in four important ways. First, strength of this study lies in the fact that it offers consistent and additional findings across two different methods. In most knowledge sharing research, a quantitative method was mainly used to examine the determinants and outcomes. This study used a sequential explanatory mixed-method approach to understand knowledge sharing processes and practices in the R&D center of a high performance IT company in South Korea. Thus, this study provides comprehensive empirical support to the knowledge sharing research with both quantitative and qualitative data. It addresses quantitatively measure variables, such as proactive personality, economic rewards, and social exchange perception. Other factors, such as trust, sense of duty, and enjoyment, were also found in a qualitative study.

Second, this research includes various factors for determining knowledge sharing in the R&D center. Overall, the results of a quantitative study support past research on knowledge sharing, which shows that proactive personality and social exchange perception are positively related to knowledge sharing intention. Significantly, this research revealed how economic

rewards need to be carefully considered to facilitate knowledge sharing in the R&D center. The result of the relationship between economic rewards and knowledge sharing supported Bock et al.'s (2005) study that shows a negative influence of economic rewards on knowledge sharing intention. The results of a qualitative study also confirmed this finding in a quantitative study. From the perspective of motivation theory, it is possible that extrinsic rewards may negatively affect one's intrinsic motivation. R&D engineers are less likely to share their knowledge for the sake of receiving monetary rewards, and instead, refrain from the sharing behavior. While the extent of anticipated economic rewards was treated as an exogenous variable in this study, it may be endogenous to the process of knowledge sharing. R&D engineers share knowledge over time because they increasingly rely on each other based on the same knowledge base and ideas. As a result, this convergence may make the relationship more competitive, triggering a process of avoiding relations and forming new relationships to share knowledge.

Third, a majority of research based on social exchange theory focuses on a dyadic interpersonal exchange. In the context of this study, knowledge sharing represents a social exchange among a group of individuals who share knowledge in various ways, such as a KMS, emails, conversations, meetings, and seminars. R&D engineers who provide know-hows may not need to receive help from that recipient but from another engineer. The results of the perceived social exchange support existing research, indicating that the more social benefits individuals anticipate receiving from knowledge sharing, the more likely they are to share knowledge with others.

Lastly, the study adds to previous knowledge sharing research as it examined data gathered from South Korea. Considering that the majority of studies in knowledge sharing have been conducted in Western countries, more studies on how cultural difference affects knowledge

sharing in emerging economies that emphasize intellectual capital are needed. The current research could shed light on the cultural differences in the results of the relationship between economic rewards and knowledge sharing. Despite many studies addressing the positive effect of economic rewards on knowledge sharing, only Bock et al.'s (2005) and the current study conducted with the South Korea sample found a negative relationship between anticipated economic rewards and knowledge sharing intention. That is, there are important national cultural similarities and differences in South Korea that result in certain similarities and differences in individual knowledge sharing in Korean organizations.

Practical Implications

The results from this research provide management and HRD practitioners with insight on the relationship among proactive personality, economic rewards, social exchange, and individual knowledge sharing. In terms of practical implications, there are several applications for management and HRD practices that can be drawn from this study and from consistent findings in the existing knowledge sharing literature.

First, a recent focus in management has been on the learning organization and organizational learning activities, and the key roles of learning initiatives have been given to HRD professionals (Gilley & Maycunich, 2000). Corresponding to this demand is the growth of mutual learning through knowledge sharing and knowledge-based development. In this regard, HRD practitioners need to consider the link between learning activities and their applications in the workplace. This research suggests the significant contribution of social exchange and personality traits as influential factors in knowledge sharing intention. In line with these empirical results, HRD professionals could focus more on several critical aspects of knowledge sharing, so as to design more effective applications.

Second, findings from this study should be of interest to those who manage knowledge workers because the results provide important insights into the management of interpersonal exchange. Managing a number of relationships that individuals developed and maintain during the knowledge sharing process is important. Managers and knowledge workers should be aware that an increasing number of partners eventually leads to diminishing returns. While individuals should be encouraged to seek new exchange partners, eventually the effort used in establishing and developing relationships diminishes the amount of knowledge shared. Additionally, an engineer interacting with the same interpersonal exchange relationships may provide benefits up to a point, increasing interactions with the same exchange partners leads to diminishing, then negative returns. Persistent efforts to foster and build human interaction-based knowledge sharing constitute another assignment for HRD professionals.

Third, the results of this study appeared to suggest the importance of individual proactive personality in the intention to share useful knowledge with others. As Bryant (2005) suggested, individual characteristics are among the most influential factors in individual knowledge sharing. The value of taking proactive personality into consideration emerged as a strong predictor of knowledge sharing. It may also be important for HRD practitioners to help employees shape and self-discipline their perceptions of knowledge ownership so as to enhance their knowledge sharing based on their personality traits.

In summary, based on the results of this study, HRD practitioners would benefit from focusing more on personality traits, social exchange, trust, sense of duty, and enjoyment, in designing HRD practices. HRD initiatives should be designed via an alignment of applicable knowledge sharing, which could be linked with individual performance beyond theoretical learning concepts. Considering the results of this study, a practical approach will lead to more

productive outcomes along with more potential for performance improvement through knowledge sharing.

Research Limitations

It is important to identify the limitations of this research to inform further research and enhance the quality of corresponding studies. Certain limitations of this study should be noted.

First, the quantitative data were collected simultaneously, making this a cross-sectional study. To fully understand the potentially causal nature of the scales in this study, a longitudinal study would need to be performed to better understand the temporal nature of the scales. For instance, does a high level of economic reward in the past year lead to an increase in effort to knowledge sharing in the present year? The results of this study show the relationship between effort to improve knowledge sharing and scales at the same time but do not predict how the scales relate to effort to improve it in the future. The results should also not be used to predict how R&D engineers approach improving knowledge sharing at other times as the their environment and beliefs may have changed.

Second, the quantitative study collected data from a single source. Thus, it has a potential common method variance problem. Despite a demonstration of construct validity for the measures, cautious interpretation is still in order as Podsakoff & Orgain (1986) argued. In order to address this issue, Harman's one-factor test was used to determine if one dominant factor emerged from the results pattern. The results showed that one factor could not adequately account for the variance. Additionally, following the suggestions of Podsakoff, MacKenzie, Lee, and Podsakoff (2003), a series of models were tested using factor analysis. Results from these analyses indicated that a model with four factors accounted for 55.71% of the total variance and

improved model fit (χ^2 = 117.67; CFI = 0.98; GFI = 0.94; NFI = 0.96; RMSEA = 0.05). Therefore, common method variance was not a pervasive concern in the studies.

Third, this research investigates the antecedents of knowledge sharing at the individual level rather than focusing exclusively on the group or organizational level. Unmeasured exogenous antecedents may affect knowledge sharing between individuals. For example, organizational structure and leadership that are not included in this study may affect an organization's climate for knowledge sharing. Also, several core studies on learning organizations and knowledge management have been based on group-level perspectives, including group dynamics and processes within an organization (e.g., Nonaka & Takeuchi, 1995; Senge, 1990; Kaplan & Norton, 1997). Different levels of analyses require different perspectives and approaches. Examining group-related concepts would enhance the rationale of the findings. Furthermore, all of these measurements were based on the employees' perception-based self-responses. The nature of the perceptual data increases the possibility of a perception bias (John &Robins, 1994). For greater objectivity in the measurement of knowledge sharing intention, observation data conducted by professionals is desirable. However, individual intention of knowledge sharing remains a useful subjective indicator.

Fourth, the proactive personality scale was developed to measure a dispositional construct that identifies differences among people (Bateman & Crant, 1993). Although this scale provides information related to a personal disposition toward proactive behavior, this was not designed in a work-specific setting—particularly, aiming at measuring proactive personality toward employee's knowledge sharing behavior. Nevertheless, Colquitt et al.'s (2000) meta-analysis showed that employee's personality is associated with knowledge transfer, skill acquisition, and post-training self-efficacy.

Fifth, the qualitative study included a relatively small sample size and highly depended on the interview. In order to investigate the holistic process of the knowledge sharing process, the qualitative study could integrate the research in a more detailed fashion. Particularly, qualitative observational research for a certain period of time could account for the complexity of group behaviors in knowledge sharing and provide a context for those behaviors. It could also reveal interrelationships among multifaceted dimensions beyond those applied by this study.

A final limitation of this study concerns the potential to generalize about findings. Since the sample of this study was restricted to a high performance IT company in South Korea, our results might not be generally applicable to other companies or countries. Because this study was conducted in South Korea, where power distance and collectivism are relatively high (Hofstede, 1996), the findings regarding knowledge sharing may be specific to this cultural context and may not be directly applied in an individualist culture, such as the United States. A more diverse demographic cohort would increase the generalizability of the findings. Thus, increasing the variety among participants could enhance results due to greater sample diversity.

In addition, this study assumed a best-practices approach to studying knowledge sharing in both quantitative and qualitative studies. Even though findings of this study suggested that proactive R&D engineers, who perceived social exchange on knowledge sharing, are more likely to share their knowledge with others in the high performance IT company, this study did not examine whether moderating conditions limited the positive impact of proactivity and perceived social exchange. Thus, this study was unable to determine if a low performance IT company showed the same results.

Recommendations for Future Research

Based on the limitations discussed in the section above, recommendations for future research are provided for corresponding research as follows.

First, this study investigated the individual level, but it did not focus on team-level or group- level variables. Future research may involve group-level participants in investigating knowledge sharing intention and behavior.

Second, as described in the limitations in Chapter 1, knowledge sharing should ultimately be connected to organizational performance. Future research may involve documenting the performance of participants in their organizations. Several researchers (Borman & Motowidlo, 1993; Organ, 1988; Podsakoff et al., 2009) have provided reasons why organizational-level measures of effectiveness are important. For example, experienced employees who exhibit knowledge sharing intention may enhance the productivity of less-experienced colleagues by giving them knowhow and/or teaching them best practices. Similarly, employees who engage in knowledge sharing activity may provide their organizations with useful suggestions that improve organizational effectiveness and reduce costs. Finally, team spirit, morale, and cohesiveness can be heightened by employee's sharing knowledge, leading to enhancing the organization's ability to attract and retain the talent (Senge, 1990).

Third, since the results of this study were derived solely from an engineering company in South Korea, cultural and regional limitations were inevitable. Different industries and countries should be considered in future research. Replicating this study in other countries and industries is necessary for a thorough examination of the antecedents of knowledge sharing. Additionally, cross-cultural studies would facilitate cross-cultural comparisons in this regard. For example, cross-cultural research on organizations in Korea and the United States would be informative..

Fourth, based on the nature of the constructs, more longitudinal studies are recommended along with a more observation-oriented qualitative approach. A longitudinal research design may provide more detailed information, which would enhance our understanding of individual knowledge sharing. It would also be worthwhile to conduct research examining the longitudinal effects of individual knowledge sharing on their performance.

Finally, this study examines the impact of personality, economic rewards, and social exchange perception on knowledge sharing among the R&D engineers of an IT company in South Korea. This approach in a quantitative study was based on middle-range theory, which focuses on selecting variables by integrating theoretical and empirical research (Merton, 1968). This study started with an empirical phenomenon and abstracted from it to create general statements that can be verified by data. However, an analytical-sociology approach based on a qualitative study would be beneficial for elaborating relevant theories into a coherent paradigm at a greater level of abstraction (Jaccard & Jacoby, 2009).

Although the impact of the constructs that are influential in knowledge sharing has been assessed, the relations between those determinants and knowledge sharing have not been applied to the process of motivating employees to share knowledge. In this regard, the presence of motivational constructs, which might influence individual knowledge sharing, could be assumed (Bock et al., 2005). The given research constructs could be inter-correlated with the motivating roles of mediating constructs, creating a more complicated structure in terms of the mediating and moderating factors of those constructs on knowledge sharing (Wang & Noe, 2010).

The links among the determinants studied and knowledge sharing was defined through a literature review-based integration. However, other processes could promote knowledge sharing more than the determinants thus derived. As such, further in-depth research is recommended in

defining the transitional process. In brief, delineating the theory-building research would increase the theoretical reliability of the constructs addressed in the current research, and such theory-building research would constitute a longitudinal process for future research.

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APPENDIX A

IRB APPROVAL LETTER

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Office of Vice Chancellor for Research

Institutional Review Board
528 East Green Street
Suite 203
Champaign, IL 61820

January 16, 2014

K Peter Kuchinke
355 Education Bldg
1310 S 6th St
M/C 708

RE: *The Impacts of Proactive Personality Social and Economic Exchange Perceptions on Knowledge Sharing in the R&D Center of High-Technology Company in South Korea: A Mixed Method Study*
IRB Protocol Number: 14440

EXPIRATION DATE: January 14, 2017

Dear Dr. Kuchinke:

Thank you for submitting the completed IRB application form for your project entitled *The Impacts of Proactive Personality Social and Economic Exchange Perceptions on Knowledge Sharing in the R&D Center of High-Technology Company in South Korea: A Mixed Method Study*. Your project was assigned Institutional Review Board (IRB) Protocol Number 14440 and reviewed. It has been determined that the research activities described in this application meet the criteria for exemption at 45CFR46.101(b)(2).

This determination of exemption only applies to the research study as submitted. Please note that additional modifications to your project need to be submitted to the IRB for review and exemption determination or approval before the modifications are initiated.

We appreciate your conscientious adherence to the requirements of human subjects research. If you have any questions about the IRB process, or if you need assistance at any time, please feel free to contact me or the IRB Office, or visit our website at http://www.irb.illinois.edu.

Sincerely,

Dustin L. Yocum, Human Subjects Research Exempt Specialist, Institutional Review Board

c: Seung-hyun Han

telephone (217) 333-2670 • *fax* (217) 333-0405 • *email* IRB@illinois.edu

APPENDIX B

INVITATION LETTER

Pre-Notification Email (HR)

IRB No. 14440

<<Name>> Seung-hyun Han

<<Affiliation>> University of Illinois

<<Date>>

Dear <<name>>,

In a few days, you will start sending a request email to your employees to fill out a brief questionnaire for a research project being conducted as part of my dissertation at University of Illinois. This request email includes an external hyper-link and may be classified under a spam.

Please let participants carefully check their inbox (or spam folder if you redirect a bulk email) over the next couple of days for the link to the questionnaire. Please do not hesitate to contact me if you find errors or have any questions.

Thank you so much for your cooperation.

Sincerely,

Seung-hyun Han, PhD Candidate

Human Resource Development

University of Illinois at Urbana-Champaign

연구관련 협조 이메일 (인사담당자)

IRB No. 14440

<<성함>> 한 승 현

<<소속>> 일리노이 대학

<<날짜>>

<<성함>> 귀하,

해 연구에 관하여 일전에 말씀 드렸다시피, 본 연구는 일리노이 대학의 한승현(연구자)의 졸업논문과 관련하여 이메일을 통한 온라인 서베이를 이용하여 진행될 것입니다. 발송될 이메일에는 온라인 서베이 링크가 첨부되어 스팸함에 분류될 수 있습니다.

향후 몇 일 동안 진행될 서베이 참여를 독려하실 때에 받은 편지함과 함께 스팸함도 확인토록 해 주십시오. 질문이 있으시거나 잘못된 정보가 포함되어있을 시 연구자에게 연락해 주시길 바랍니다.

다시 한번 참여와 협조에 감사 드립니다.

일리노이대학

한승현 배상

First Contact Email (English)

Subject: SURVEY_KNOWLEDGE SHARING

Dear <<participants>>

I am writing to ask your help with an important study on employee's knowledge sharing at high-technology industry. In today's knowledge driven economy, knowledge sharing between employees plays a key to create and maintain organization competiveness. This study provides you with an opportunity to have your voice. Your participation involves the completion of a brief 10-15 minutes survey.

You were selected for this anonymous, online survey along with XXX institution. Individual results will NOT be reported to your supervisor or to anyone at any time. The researcher will keep completed surveys in a secured manner for a period of five years. There are no know risks associated with your participation.

You may ask any questions concerning this research and have those questions answered before agreeing to participate or during the research. You may contact the researchers, Seung-hyun (Caleb) Han, phone +1-217-418-0000, email han84@illinois.edu, or Dr. K. Peter Kuchinke, phone +1-217-333-0000, email kuchinke@illinois.edu, at any time. If you have questions concerning your rights as a research participant that have not been answered by the researchers or to report any concerns about the study, you may contact the Institutional Review Board, University of Illinois (UIUC), email irb@illinois.edu. You can call the UIUC IRB collect, +1-217-333-2670, if the state you are research participants.

Your participation is voluntary and you can decide not to participate or withdraw at any time without adversely affecting your relationship with the investigator. Your decision will not result in any loss of benefits to which you are otherwise entitled. If you decide to participate, clicking on the link and completing the survey will indicate your consent. You can print a copy of this email for your records.

Please follow the link below to access the survey:

http://kwiksurveys.com/s.asp?sid=ydjts28l8hsn29v273136

Thank you very much for your participation.

Kind regards,

Seung-hyun Han, PhD candidate

Human Resource Development

University of Illinois at Urbana-Champaign

First Contact Email (Korean)

Subject: 지식공유에 관한 설문

<<김선희님>> 귀하

본 연구는 귀하의 조직에서의 지식공유에 관하여 개인의 적극성, 조직의 사회적 경제적 보상과의 관계를 설명하는 것을 목적으로 합니다. 우선 본 연구는 미국 일리노이 대학 기관감사위원회 (Institutional Review Board) 의 승인 하 진행되고 있음을 알려드립니다.

연구에 참여해 주셔서 진심으로 감사 드립니다. 현대의 경제사회, 특히 지신기반의 경쟁사회에서 조직의 경쟁력은 종업원 간의 지식 및 노하우의 공유에 있음이 여러 연구를 통해 밝혀졌습니다. 그러나 개인의 지식공유에 영향을 미치는 변수가 무엇인지 또 어떻게 공유하는지에 대해서는 많은 연구가 필요로 합니다. 본 연구는 이에 관하여 선행연구를 바탕으로 설문을 구성하여 양적 연구를 진행하려고 합니다. 본 설문은 10 분에서 15 분 정도가 소요될 것임을 알려드립니다.

참여자의 답변은 익명을 통해 분류되고 철저한 보안을 통해 유지될 것입니다. 또한 해 정보는 향후 연구 이외의 목적으로 사용되지 않을 것입니다.

설문에 응하시는 동안 혹은 응하신 이후에도 이에 관한 질문이나 의견이 있으신 분은 연구자 (+1-217-418-0000, han84@illinois.edu) 혹은 지도교수 (+1-217-333-0000, kuchinke@illinois.edu) 의 연락처를 이용해 주시면 됩니다.

설문의 참여는 자발적이며 언제든지 중단하시거나 철회하실 수 있습니다. 이로 인하여 주변으로부터 어떠한 불이익도 받지 않으실 것임을 약속 드립니다. 참여를 원하시면 아래의 링크를 눌러 설문을 진행해 주시면 감사하겠습니다.

http://kwiksurveys.com/s.asp?sid=ydjts28l8hsn29v273136

다시 한번 감사 드립니다.

한승현 (韓承炫) 올림

일리노이 대학

Reminder Email (English)

Subject: [Reminder] SURVEY

Dear <<participants>>

About a week ago, I sent you an email inviting you to participate in an important study on employee's knowledge sharing. If you have already completed the survey, thank you so much! If you have not, please do so now.

I am writing to you again because it is important to get your responses for accurate and better results in this research. Your participation will take only 10-15 minutes to complete the survey.

You were selected for this anonymous, online survey along with XXX institution. Individual results will NOT be reported to your supervisor or to anyone at any time. The researcher will keep completed surveys in a secured manner for a period of five years. There are no know risks associated with your participation.

You may ask any questions concerning this research and have those questions answered before agreeing to participate or during the research. You may contact the researchers, Seung-hyun (Caleb) Han, phone +1-217-418-0000, email han84@illinois.edu, or Dr. K. Peter Kuchinke, phone +1-217-333-0000, email kuchinke@illinois.edu, at any time. If you have questions concerning your rights as a research participant that have not been answered by the researchers or to report any concerns about the study, you may contact the Institutional Review Board, University of Illinois (UIUC), email irb@illinois.edu. You can call the UIUC IRB collect, +1-217-333-2670, if the state you are research participants.

Your participation is voluntary and you can decide not to participate or withdraw at any time without adversely affecting your relationship with the investigator. Your decision will not result in any loss of benefits to which you are otherwise entitled. If you decide to participate, clicking on the link and completing the survey will indicate your consent. You can print a copy of this email for your records.

Please follow the link below to access the survey:

http://kwiksurveys.com/s.asp?sid=ydjts28l8hsn29v273136

Thank you very much for your participation.

Kind regards,

Seung-hyun Han, PhD candidate

Human Resource Development

University of Illinois at Urbana-Champaign

Reminder Email (Korean)

Subject: [재공지] 지식공유에 관한 설문

<<김선희님>> 귀하

약 일주일 전, 귀사의 인사직원을 통해 조직의 지식공유에 관한 설문을 요청 드렸습니다. 본 연구는 종업원 간 지식공유에 관한 중요한 연구이기 때문에 여러분의 설문 참여를 다시 한번 독려하려 합니다. 연구에 이미 참여해 주셨다면 진심으로 감사 드립니다. 만약 아직 피치 못할 사정으로 참여치 못하신 분들께는 다시 한번 부탁의 말씀 드립니다. 본 설문은 10 분에서 15 분 정도가 소요될 것임을 알려드립니다.

참여자의 답변은 익명을 통해 분류되고 철저한 보안을 통해 유지될 것입니다. 또한 해 정보는 향후 연구 이외의 목적으로 사용되지 않을 것입니다.

설문에 응하시는 동안 혹은 응하신 이후에도 이에 관한 질문이나 의견이 있으신 분은 연구자 (+1-217-418-0000, han84@illinois.edu) 혹은 지도교수 (+1-217-333-0000, kuchinke@illinois.edu) 의 연락처를 이용해 주시면 됩니다.

설문의 참여는 자발적이며 언제든지 중단하시거나 철회하실 수 있습니다. 이로 인하여 주변으로부터 어떠한 불이익도 받지 않으실 것임을 약속 드립니다. 참여를 원하시면 아래의 링크를 눌러 설문을 진행해 주시면 감사하겠습니다.

http://kwiksurveys.com/s.asp?sid=ydjts28l8hsn29v273136

다시 한번 감사 드립니다.

한승현 (韓承炫) 올림

일리노이 대학

APPENDIX C

SURVEY QUESTIONNAIRE (English)

[Consent Information Sheet for Research Here]

Please indicate your level of agreement by checking the number that best reflects your perception.

This research will use five-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). In this sheet, only the questions were listed.

Knowledge Sharing Intention (Bock, Lee, Zmud, & Kim, 2005)

1. I share my work reports and official documents with members of my organization frequently.
2. I always provide my manuals, methodologies, and models for members of my organization.
3. I frequently share my experience of know-how from work with other members of my organization.
4. I provide my know-where or know-whom at the request of members of my organization.
5. I try to share my expertise from my education or training with other members of my organization in a more effective way.

Proactive Personality Scale (Seibert, Crant, & Kraimer, 1999)

1. I am constantly on the lookout for new ways to improve my life.
2. Wherever I have been, I have been a powerful force for constructive change.
3. Nothing is more exciting than seeing my ideas turn into reality.
4. If I see something I don't like, I fix it.
5. No matter what the odds, if I believe in something I will make it happen.
6. I love being a champion for my ideas, even against others' opposition.
7. I excel at identifying opportunities.
8. I am always looking for better ways to do things.
9. If I believe in an idea, no obstacle will prevent me from making it happen.
10. I can spot a good opportunity long before others can.

Economic Rewards (Siemsen, Balasubramanian, & Roth, 2007)

1. My company rewards me for sharing knowledge with my coworkers
2. My company provides added compensation if I share what I know with my coworkers.
3. My company provides incentives to share knowledge with my coworkers.

Social Exchange Perceptions (Shore, Tetrick, Lynch, & Barksdale, 2006)

1. My relationship is based on mutual trust.
2. The things I do on the job today will benefit my standing in this organization in the long run.
3. There is a lot of give and take in my relationship in my organization.
4. I worry that all my efforts on behalf of [my organization] will never be rewarded. [R]
5. I don't mind working hard today I know I will eventually be rewarded by my organization.
6. My organization has made a significant investment in me.
7. I try to look out for the best interest of the organization because I can rely on my organization to take care of me.
8. Even though I may not always receive the recognition I deserve, I know my efforts will be rewarded in the future.

Demographic Information

1. Gender (Male / Female)
2. Age (younger than 29 / 30-39 / 40-49 / older than 50)
3. Education Level (High school / 2-year college / 4-year college / Masters / Doctor)
4. Hierarchical Position
5. How long have you been working with your current team leader?

Note:
This survey is anonymous. No one, including the researcher, will be able to associate your responses with your identity. Therefore, the researcher could not recognize your emotional distress. However, during a survey, if the questions precipitate recall of personally traumatic events and/or may result in ongoing and/or serious emotional distress, following information about available free counseling services would be helpful.

Employee Assistant Program (Ministry of Labor): http://www.eapkorea.co.kr
Seoul Counseling Psychological Institute: http://www.scpi.kr/

설문지 번역본 (Korean)

[Consent Information Sheet for Research Here]

지식공유에 관한 연구, 본 설문에 참여해 주셔서 감사합니다. 아래 질문의 답변을 라이커트 스케일 1 (매우 그렇지 않다) 에서 5 (매우 그렇다) 에 근거하여 답변해 주십시오.

<u>지식공유의도</u>

현재의 조직에서 동료들과의 지식 공유에 관한 귀하의 행동에 대한 설문입니다. 가장 잘 반영하는 것을 선택해 주십시오.

1. 나는 내가 가지고 있는 각종 보고서나 문서 자료 등을 자주 조직 내 동료들과 공유한다.
2. 나는 내가 가지고 있는 업무 매뉴얼이나 업무처리 방법론을 조직 내 동료들을 위해 제공한다.
3. 나는 내가 업무를 하면서 얻은 경험이나 노하우를 조직 내 동료들과 공유한다.
4. 나는 조직 내 동료들이 요청할 경우, 내가 알고 있는 지식소스를 제공한다.
5. 나는 내가 교육 및 훈련을 통해 익힌 지식을 조직 내 동료들과 효과적으로 공유하려고 노력한다..

<u>적극적 성격 스케일</u>

자신이 가지고 있는 성격의 적극성 및 주도성에 관한 설문입니다. 가장 잘 반영하는 것을 선택해 주십시오.

1. 나는 나의 삶을 개선할 새로운 길을 늘 염두해 두고 있다.
2. 나는 속한 곳이 어디든, 건설적 변화의 주도적 역할을 한다.
3. 나의 생각이 현실화되는 것보다 흥분되는 것은 없다.
4. 내가 좋아하지 않는 것을 보았을 때 나는 그것을 수정한다.
5. 무엇이 잘못되었든, 내가 믿는 것에 대해 나는 실천한다.
6. 나는 다른 이의 반대에도 불구하고, 나의 아이디어에 관철 되는 것을 좋아한다.
7. 나는 기회를 포착하는 능력이 뛰어나다.
8. 나는 늘 더 나은 방안에서 대해서 고심한다.
9. 만약 나의 아이디어에 믿음이 있다면 어떠한 장애물도 이를 실현하는데 방해가 될 수 없다.
10. 나는 다른 사람이 하기 전에 좋은 기회를 발견할 수 있다.

인지된 경제적 보상

현재의 조직에서 동료들과의 지식 공유 시 인지된 경제적 보상에 관한 설문입니다. 가장 잘 반영하는 것을 선택해 주십시오.

1. 내가 속한 조직은 동료들과의 지식 공유에 관하여 보상을 해 준다.
2. 내가 속한 조직은 내가 알고 있는 지식에 관하여 동료들과 공유했을 시 더 많은 임금을 제공한다.
3. 내가 속한 조직은 동료들과의 지식 공유에 관하여 인센티브를 제공한다.

.

인지된 사회적 교환

현재의 조직에서 동료들과의 지식 공유 시 인지된 사회적 교환에 관한 설문입니다. 가장 잘 반영하는 것을 선택해 주십시오

1. 조직 내 동료들과의 관계는 신뢰를 바탕으로 한다.
2. 내가 조직에서 하는 직무는 장기적으로 나에게 이익이 되는 것들이다.
3. 나는 조직 내에서 나의 관계는 많은 부분 상호간 교환을 기초로 한다.
4. 나는 상호 관계에 관한 노력이 보상받지 않을 것이라는 걱정이 있다.
5. 주어진 직무에 열심히 임하는 것이 결국은 조직에 의해서 보상되어질 것이다.
6. 조직은 나에게 중요한 투자를 하고 있다.
7. 나는 나에 관하여 신경을 쓰는 조직에 의탁하기 때문에 조직의 관심에 주의를 기울인다.
8. 비록 내가 합당한 인정을 받지 못하더라도 나는 나의 노력이 장래에 보상받으리라 믿는다.

인구통계학적 정보

1. 성별 (남 / 녀)
2. 나이 (20 대 / 30 대 / 40 대 / 50 대 이상)
3. 학력 (전문대졸 / 학사 / 석사 / 박사)
4. 지위
5. 직장경력

주:

본 설문은 무기명 방식입니다. 연구자를 포함하여 아무도 당신의 정보나 응답에 관하여 알 수 없습니다. 그러므로, 연구자는 해 참여자의 심리적 스트레스에 관하여 알 수가 없습니다. 그러나 만약 그러한 것을 느끼신다면, 아래 정보가 도움이 되실 것입니다.

노동자 보호 프로그램 (노동부 산하): http://www.eapkorea.co.kr

서울 노동자 심리치료 센터: http://www.scpi.kr/

APPENDIX D

INTERVIEW QUESTIONS

1. Please start by telling me about your background

2. (sub) What is your job duty and task in the workplace? What is your role?

3. Knowledge is a word that means the different range to different people. In terms of R&D center of high-technology company, what does this mean to you?
   (sub) how do you define knowledge at your work?

4. How do you share knowledge with your colleagues? When do you share your knowledge? Of the projects you have experienced, what was the best knowledge sharing?

5. What makes engineers share their knowledge with others among projects? What is facilitators? and barriers?

6. Do you have any other thoughts or ideas about how to motivate employees to share knowledge?

Informed Consent

To Whom It May Concern, OO/OO, 2014

I am writing to you today to ask your help with an important study on knowledge sharing in organizations. This study provides you with an opportunity to have your voice included as part of this important conversation. Your participation involves the completion of a brief hour interview.

You are selected to participate in this study because you are a R&D engineers at Samsung, who are expected to share you knowledge with you coworkers to improve organizational performance. Your responses will be confidential and will be used in a research. Individual results will NOT be reported to your advisor or to anyone at any time. The researcher will keep this interview record on own password secured computer in the research office until the completion of this study. There are no known risks associated with your participation.

You may ask any questions concerning this research and have those questions answered before agreeing to participate or during the research. You may contact the researchers, Seung-hyun Han, phone (217) 418-0000, email han84@illinois.edu, Dr. K. Peter Kuchinke, phone (217) 333-0000, email kuchinke@illinois.edu at any time. If you have questions concerning your rights as a research participant that have not been answered by the researchers or to report any concerns about the study, you may contact the University of Illinois (UIUC) Institutional Review Board, email irb@illinois.edu. You can call the UIUC IRB collect, +1-217-333-2670, if the state you are research participants.

Your participation is voluntary and you can decide not to participate or withdraw at any time. Your decision will not result in any loss of benefits to which you are otherwise entitled. If you decide to participate, signing your name this form will indicate your consent.
Thank you very much for helping with this important research!

Sincerely,

Caleb Seung-hyun Han, PhD Candidate
1310 S. Sixth St. Champaign, IL 61821
University of Illinois at Urbana-Champaign

K. Peter Kuchinke, PhD
Professor and Coordinator of HRD

Name:_____ Signature: _____

APPENDIX E

OBSERVATION FORM

Describe employee's knowledge sharing	Describe the office setting
How did they engage in knowledge sharing?	What kinds of behavior occurred during…?
Any unusual events during the observation?	Anything else worth nothing?

APPENDIX F

SKEWNESS AND KURTOSIS

	Mean	Std. Deviation	Skewness	Kurtosis
KS1	3.78	0.953	-0.296	-0.797
KS2	3.84	0.897	-0.408	-0.487
KS3	3.94	0.871	-0.358	-0.615
KS4	4.18	0.854	-0.816	0.170
KS5	3.84	0.853	-0.302	-0.356
PP1	3.72	0.938	-0.500	0.001
PP2	3.26	0.837	0.187	-0.211
PP3	3.44	0.897	-0.110	-0.183
PP4	3.56	0.835	-0.237	-0.045
PP5	3.34	0.897	-0.078	-0.208
PP6	3.03	0.969	-0.045	-0.434
PP7	3.21	0.784	0.274	-0.135
PP8	3.67	0.839	-0.401	-0.009
PP9	3.28	0.840	-0.010	-0.073
PP10	3.31	0.736	0.236	0.052
ER1	2.76	1.033	-0.084	-0.549
ER2	2.29	1.059	0.409	-0.590
ER3	2.37	1.106	0.398	-0.629
SX1	3.88	0.907	-0.655	0.269
SX2	3.60	0.936	-0.545	0.213
SX3	3.65	0.898	-0.397	0.035
SX4	2.81	1.009	-0.062	-0.534
SX5	3.41	0.883	-0.298	-0.130
SX6	3.10	0.916	-0.194	-0.024
SX7	3.29	0.861	-0.359	0.497
SX8	3.43	0.953	-0.199	-0.253
Gender	1.19	0.391	1.607	0.585
Age	2.56	0.940	0.154	-0.936
Education	1.48	0.688	1.116	-0.066
Position	1.81	0.993	1.007	-0.091
Tenure	11.10	6.295	0.240	-1.399

Note: Valid number was listwised (N=432)

APPENDIX G

Job position Distribution by gender

	Frequency	Percent	Total	Chi-square
Assistant research engineer				
Male	158	71.82%	36.60%	
Female	62	28.18%	14.40%	
Associate research engineer				
Male	105	90.52%	24.30%	
Female	11	9.48%	2.50%	
Research engineer				
Male	49	87.50%	11.30%	
Female	7	12.50%	1.60%	
Senior research engineer				
Male	38	97.44%	8.80%	
Female	1	2.56%	0.20%	
Principal research engineer				
Male	1	100.00%	0.20%	
Female	0	0.00%	0.00%	
Total				27.76**
Male	351	81.20%		
Female	81	18.80%		

Note: ** $p < .001$

APPENDIX H

Age Distribution by gender

	Frequency	Percent	Total	Chi-square
20 to 29 years				
Male	36	73.47%	8.30%	
Female	13	26.53%	3.00%	
30 to 39 years				
Male	136	75.56%	31.50%	
Female	44	24.44%	10.20%	
40 to 49 years				
Male	99	86.09%	22.90%	
Female	16	13.91%	3.70%	
50 or higher years				
Male	80	90.91%	18.50%	
Female	8	9.09%	1.90%	
Total				12.93*
Male	351	81.20%		
Female	81	18.80%		

Note: * $p < .01$

APPENDIX I

Education Distribution by gender

	Frequency	Percent	Total	Chi-square
Bachelor				
Male	216	78.86%	50.00%	
Female	58	21.17%	13.40%	
Master				
Male	95	86.36%	22.00%	
Female	15	13.64%	3.50%	
Doctor or higher				
Male	40	83.33%	9.30%	
Female	8	16.67%	1.90%	
Total				3.08
Male	351	81.20%		
Female	81	18.80%		

APPENDIX J

Years of working Distribution by gender

	Frequency	Percent	Total	Chi-square
5 years or less				
Male	129	76.33%	35.30%	
Female	40	23.67%	10.50%	
5 to 10 years				
Male	68	79.07%	15.70%	
Female	18	20.93%	4.20%	
10 to 15 years				
Male	61	82.43%	14.10%	
Female	13	17.57%	3.00%	
15 to 20 years				
Male	93	91.0%	21.50%	
Female	9	9.0%	2.10%	
20 years or more				
Male	1	0.20%	0.20%	
Female	n/a	n/a	n/a	
Total				15.10*
Male	351	81.20%		
Female	81	18.80%		

Note: * $p < .05$