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Exploring Knowledge Management Models on Information Technology Projects

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This is to certify that the doctoral dissertation by

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Walden University
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Abstract

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MBA, University of Baltimore, 1986

BBA, The Pennsylvania State University, The Capitol Campus, 1981

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

One way an organization manages the knowledge of its people is in information technology (IT) projects. Organizations develop IT projects for many socially responsible reasons, including improved health care services and better community services. IT projects do not always achieve the goals of the organization when the knowledge of the stakeholders is not managed for these objectives. For this study the purpose was to address the use of knowledge management (KM) in project management (PM) to improve the success of IT projects in achieving the organizational goals. The research questions were based on KM including its tools and techniques to improve the success rate for IT projects. The conceptual framework included the project knowledge management (PKM) model, which helped identify the knowledge sharing in IT software projects for a local insurance company in Baltimore, Maryland. Interview data were collected from 26 IT project stakeholders about KM in PM. Analysis revealed 4 themes of managing knowledge in the requirement process, code development process, testing process, and the helpdesk process for the success of the IT project. Each of the 4 processes used different KM repositories and face-to-face tools. Improving the rate of successful IT projects benefits organizations and society with better products and services for lower costs. This study may affect social change by providing information for managers of other organizations about achieving success of their IT projects.

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Dedication

This study is dedicated to my family with sincere appreciation for being by my side. To my wife, Janet, who unselfishly supported me and encouraged me throughout this journey. Thank you for understanding the effort that was needed to finish the project and providing insights along the way. To my children, who have believed in me and cheered me through the process. Without the support from all of you, this work would not have started nor been completed.

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Chapter 1: Introduction to the Study

Introduction

The purpose of this research was to explore the gap between the uses of project management (PM) and knowledge management (KM) tools and techniques in information technology (IT) projects. Organizations have been using projects in engineering, construction, defense, and IT to bring about strategic change and create competitive advantage for over 50 years (Bredillet, 2010). Today's organizations have been developing many more projects than in the past because of changing market conditions, technological advances, and legal requirements (Bredillet, 2010). In today's global economy, 20% of the activity is performed in a project environment (Bredillet, 2010) and can involve many people from different countries who speak different languages and have different cultures. The projects may continue for a number of years. These factors, along with the rapid changes in technology, increase the complexity of the process. As a result, the failure rate of IT projects has become high. In 1994, the Standish group issued its *Chaos Report,* which indicated that 31% of the IT projects that year failed; only 16% were completed successfully, while the other 53% were considered "challenged" (Eveleens & Verhoef, 2010). These numbers have improved since 1994. In 2009, 24% of projects failed while 32% were considered successful; however, there is still cause for concern (Eveleens & Verhoef, 2010).

Along with the problems outlined by the *Chaos Report*, Koskela and Howell (2002) issued a report that the theory of IT PM at that time was obsolete. They argued that this theory was based on out-of-date concepts of a project and out-of-date definitions

of planning, execution, and control. They called for new theories to address some of the problems that were occurring in the PM process (Koskela & Howell, 2002).

Although PM is used in engineering, construction, and business development, this research focused on IT projects and the use of KM in the process. IT PM today means the application of knowledge, tools, and techniques for a given project to be delivered based on the requirements of the project (Project Management Institute [PMI], 2013). For the most part, organizations use PM practices to organize and plan the work of IT projects. Thus, a significant amount of knowledge must be managed among the different stakeholders in the project. The large amount of knowledge managed in an IT project suggests that it could be perceived by project team members as a knowledge process project in organizations (Reich, Gemino, & Sauer, 2008). KM involves how knowledge is used throughout an organization. When KM is examined in the PM process, this is referred to as project knowledge management (PKM).

This study may provide insight into the emerging paradigm of PKM. A number of authors have discussed KM in the PM process, but Gasik (2011) developed a model for managing knowledge in an IT project; the model examines knowledge processes at the project level, organization level, and even outside the organization. This model provides a technique to analyze the flow of knowledge in the project and to manage problems that may occur (Gasik, 2011).

I examined the role of KM tools and techniques in the flow of knowledge in IT projects. By understanding the flow of knowledge in an IT project, the model for IT PM can be improved and IT projects can be more successful than in the past. The purpose of

this research was to address the major problem of how to use KM tools and techniques to help improve the performance of IT projects.

Background

PM developed as a separate area of an organization from engineering in the late 1990s. The focus of the PM process was on planning and on the schedule of the project and controlling costs (Winter, Smith, Morris, & Cicmil, 2006). With increased complexity and the failure of the process to include the people working on the project, this paradigm began to fail in the early 2000s (Winter et al., 2006). In a report claiming that the theory of PM was obsolete, Koskela and Howell (2002) argued that PM used the planning-execution-controlling processes of managing a project, and they converted these processes to planning, task dispatching for the execution of the project, and a thermostat model for controlling the project. According to this model, all PM involves planning the project, assigning tasks, and then monitoring the project to be sure it stays on schedule. That has changed and there is more focus on managing knowledge in the project. As an example, *A Guide to the Project Management Body of Knowledge* (*PMBOK*®) includes 10 knowledge areas of (a) integration management, (b) scope management, (c) time management, (d) cost management, (e) quality management, (f) human resources management, (g) communications management, (h) risk management, (i) procurement management, and (j) stakeholder management (PMI, 2013).

Most recent IT projects are managed using the PM model as outlined in the *PMBOK*®. This model manages the scope, costs, and time goals to deliver a project that meets the requirements of the user and stakeholder (Schwalbe, 2010, p. 8). PM handles

issues from the business, organization, and technology perspectives while managing the goals of the project and balancing scope, costs, and time (Schwalbe, 2010, p. 46). The PM model uses the IT project life cycle that begins with a conceptual phase, followed by a development phase, implementation, and a closing phase (Schwalbe, 2010, p. 57). The PM process is easy for members of an organization to follow, as discovered by Chou, Irawan, and Pham (2013) in their study of the use of the PM process in construction industry in Taiwan, Indonesia, and Vietnam.

KM is the management of knowledge in an organization. KM has developed as organizations have discovered the value of knowledge and how they could use it for a competitive advantage (Tiwana, 2002, p. 6). According to Davenport and Prusak (1998), knowledge is a mix of experiences, values, contextual information, and expert insights that provide a basis for evaluating new experiences and information (p. 3). Information is the basis for knowledge. Nonaka and Takeuchi (1995) defined information as the flow of messages with meaning to the individual and knowledge is created by the flow of information (p. 58). Tiwana (2002) considered knowledge to be actionable information. Information is created from data, which are a set of objective facts about an event (Tiwana, 2002). In the process of creating knowledge, Boisot (1998) discussed the creation of a set of expectations for an event (p. 20). Based upon these expectations, an individual will take actions. Knowledge is based upon information that provides the set of expectations. Information is data that modify the set of expectations. As more information is gathered, the set of expectations and knowledge is improved. In Chapter 2,

the differences between data, information, and knowledge from the perspectives of the epistemologies of cognitive, connectionist, and autopoietic are discussed.

The PM model includes tools and techniques—for example, Gantt charts, work breakdown structure, scope statements, and flow charts (Patanakul, Iewwongcharoen, & Milosevic, 2010). These tools differ from the KM tools identified by Wang and Jacobson (2011), which include mind maps, concept maps, conceptual diagrams, and visual metaphors that are of use in KM.

Table 1

PM Tools and KM Tools used in IT PM

Project Management Tool	Use	KM Tool	Use
Gantt chart	Time Management	Mind map	Organization
Work breakdown structure	Time Management	Concept map	Organization
Flow chart	Integration Management	Data repositories	Acquiring information
Cost/benefit analysis	Cost Management	Discussion boards	Communication

KM and PM tools are used to organize and share knowledge about a project. Table 1 identifies some of the KM and PM tools. Different tools are used to share knowledge with different stakeholders. Patanakul et al. (2010) divided the tools into the different knowledge areas of the *PMBOK*®. The knowledge areas of the *PMBOK*® are (a) integration management, which coordinates the processes of the project, (b) scope management—what is and is not part of the project, (c) time management, (d) cost management, (e) quality management, (f) human resources management, (g)

communications management, (h) risk management, (i) procurement management for the purchase of resources, and (j) stakeholder management for the processes that involve the stakeholders and their expectations (PMI, 2013, p. 61). Figure 1 shows the 10 knowledge areas and the five processes of PM in the *PMBOK*®. In this framework, stakeholders are involved with the different knowledge areas and use different tools to control, schedule, and share knowledge about an IT project.

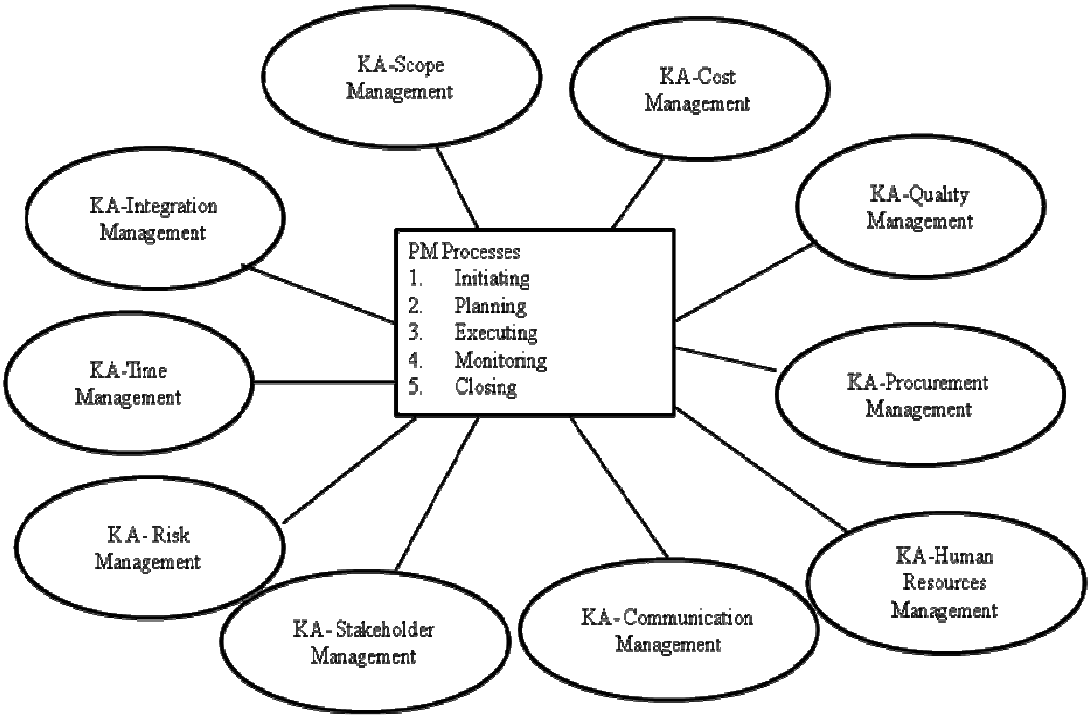

Figure 1. KM and PM processes. KA=knowledge area. Adapted from *A Guide to the Project Management Body of Knowledge* (PMBOK guide; 5th ed.), by PMI, 2013.

Gasik's (2011) model for PKM and the knowledge-sharing process between stakeholders does not divide the model by the different knowledge areas as was done with the tools. Instead, as shown in Figure 2, it examines knowledge sharing that is part of an IT project among (a) the individuals who are developing the project, (b) the project

leaders, (c) the stakeholders and customers, (d) the management of the organization, and (e) individuals outside of the organization.

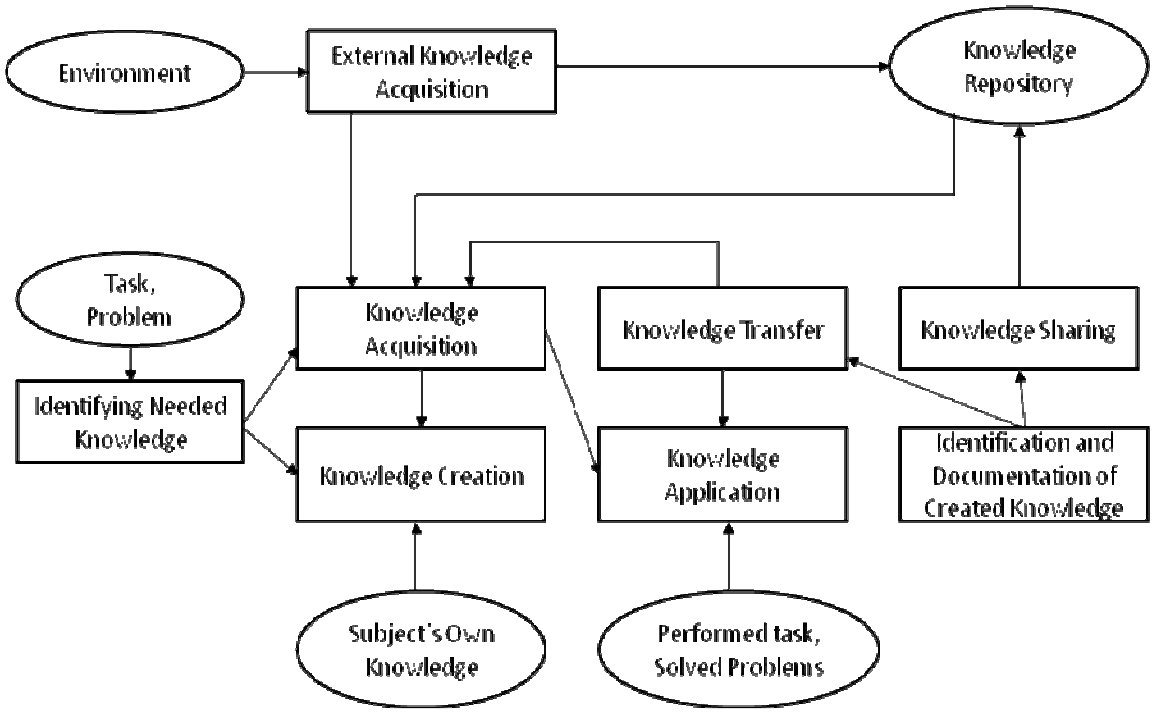

Figure 2. KM processes in IT PM—PKM. Adapted from "A model of project knowledge management." by S. Gasik, 2011, *Project Management Journal, 42*(3), p. 28.

According to the *PMBOK*® (PMI, 2013, p. 30), PM involves knowledge sharing with all stakeholders in a project according to either the knowledge area or the different levels of the project. Knowledge sharing is the process of moving knowledge from the individual to others (Islam, Low, & Rahman, 2012). Knowledge sharing is more than project communications, which is one of the 10 knowledge areas of the *PMBOK*®. Project communications of the *PMBOK*® focus on communications of information in the project (PMI, 2013, p. 287). Knowledge sharing uses information to construct knowledge, and that knowledge is shared with others (Nonaka & Takeuchi, 1995, p. 58).

In the process of sharing knowledge, whether done in the knowledge areas, about a knowledge type, or at the different levels of the projects, the knowledge spiral of Nonaka and Takeuchi (1995) is used as a model of sharing information for the creation of knowledge. As information is shared, it flows from socialization (S), that is, sharing information between individuals, to externalization (E) for the information to be shared by a group, to combination (C) for the information to be available for a larger group, to internalization (I), which is when the information is understood by members of the group, and back to socialization. Socialization occurs by bringing together tacit knowledge through shared experiences in an informal setting. Externalization occurs when tacit knowledge is converted into explicit knowledge by writing it down or entering the ideas into a computer database. Combination occurs when elements of explicit knowledge are connected with other explicit knowledge to create a system. Internalization is the process of embodying the explicit to tacit knowledge to take action (Nonaka & Takeuchi, 1995).

Managing knowledge that is provided by the PM and KM tools includes making it available for all stakeholders to use. Knowledge articulation or codification is the process of converting tacit knowledge into explicit knowledge (Desouza & Evaristo, 2004). Codification involves knowledge being encoded for storage in data repositories such as databases, reports, and books. A data repository is a tool used to share knowledge among many stakeholders. In the process of sharing knowledge by using a data repository, tacit knowledge is often converted to explicit knowledge. Nonaka and Takeuchi (1995) referred to this process as externalization in their knowledge spiral model. In this process,

knowledge is added to a repository or database and becomes available to a large number of people.

Social network analysis is a KM technique that is used to study the relationships between people involved in the personalization strategy of knowledge sharing in face-to-face meetings. It examines the connections between people in the organization to understand the quality of the knowledge in the network, by developing a network diagram (Borgatti & Halgin, 2011).By using social network analysis and data repositories, it is expected that there will be improvement in project knowledge. This increases the likelihood that the project will meet the requirements of the system. The traditional PM approach is missing the tools and techniques of KM to analyze the flow of knowledge and understand how knowledge is used in the PM process (Gasik, 2011).

Researchers have identified how KM could improve the PM process for IT, but further research is needed to determine if KM is improving the PM process. Gasik (2011) and *PMBOK*® (PMI, 2013) have presented different theories on the use of KM in organizations. This study examined one organization's use of KM in PM and the impact on the success of IT projects.

Problem Statement

The problem studied in this research was the use of KM in the PM process to improve the success rate for IT projects. This problem was presented (a) to discern any essential attributes, characteristics, and knowledge from a managerial perspective that may need to be present for IT projects to succeed and (b) to identify the challenges that

will drive conventional IT projects to expand their process to one in which knowledge is freely transferred.

The traditional approach to PM has led to a high rate of project failures. Although the number of projects considered successful in 2009 rose to 32% according to the Standish group's *Chaos Report*, there is still cause for concern given that 68% of the projects were not considered successful (Eveleens & Verhoef, 2010). In 2003, the government of the United Kingdom created a research project, titled *Rethinking Project Management*, to update the current ideas of PM and make the field usable for the complexities of the current environment. The study called for the following five new directions: complexity, social process, value creation, broader conceptualization of a project, and reflective practice (Winter et al., 2006). These five new directions are part of the KM process, and KM concepts need to be part of the PM process (Sauer & Reich, 2009).

In the current PM process, as discussed in the *PMBOK*®, there are 10 knowledge areas identifying the different concepts and activities that are a subset PM: (a) integration management, (b) scope management, (c) time management, (d) cost management, (e) quality management, (f) human resources management, (g) communications management, (h) risk management, (i) procurement management, and (j) stakeholder management. These knowledge areas are mapped to five process groups: initiating, planning, executing, monitoring and control, and closing (PMI, 2013, p. 61). Although communications management is part of these areas, the PM model needs to include the management of the flow of knowledge to the stakeholder (individual or group) that

requires the knowledge. PM is missing the discussion on the process of finding knowledge and making it available to the right stakeholder in a timely manner.

According to Reich et al. (2008), understanding how knowledge is integrated and shared in a project can improve the performance of the project. Spalek (2015) suggested the inclusion of KM in the assessment of the project maturity model. This model is used to determine the effectiveness of the PM process in an organization. Along with managing the knowledge of an IT project, there also is a need to study the tools and techniques used in PM. Traditional PM tools include Gantt charts, work breakdown structure, earned value management, and cost/benefit analysis. These tools do not focus on sharing knowledge and the flow of knowledge during PM. Their purpose is to keep the project on schedule and to control its costs (Patanakul et al., 2010). They differ from the KM tools identified by Wang and Jacobson (2011), which include mind maps, concept maps, conceptual diagrams, and visual metaphors that are of use in KM for organizing and sharing information. These KM tools are simple models that display the information to be shared with other members of the project. There is a need to bridge the gap between the different uses of PM and KM tools. Research is needed to determine if organizations are using KM and PM tools together in the PM for IT.

Current scholars have identified the challenges of PM in IT, and there is a need for KM to be included in the PM process. The gap that this study analyzed was how an organization implemented KM in the PM process for IT. The reasons for KM being part of the PM in IT have been addressed in the current literature, but this research examined how KM was being implemented in the PM process.

Purpose of Study

The purpose of this case study was to understand the role of KM in projects holistically. The purpose of this case study was to explore the gap between the uses of PM and KM tools and techniques in IT projects. To accomplish this goal, I investigated and analyzed how KM tools and techniques are used in PM. In this study, I documented the evolution of PM tools and techniques and compared them with KM tools and techniques to determine where they can be combined to improve the performance of IT projects. Additionally, I documented and evaluated the use of KM in PM in an insurance company. When I proposed this research, I expected that the outcome of this analysis would have significant implications, from a strategic and organizational point of view, for future projects. The evaluation was carried out through a qualitative analysis; the subjects were the people involved in different IT projects within the insurance company. The research structure, audience, and methodology are described in Chapter 3. In this project, I also reviewed the tools and procedures used for PM in the insurance organization and compared them with the PKM model. The results and analysis of the tools and procedures were used to analyze the usefulness of PKM from users' points of view.

Research Questions

This research examined the following questions:

RQ1: How is KM used in PM for IT projects?

RQ2: How are the tools and techniques for KM used in IT PM to improve the success of an IT project?

RQ3: How is the current PM process managing knowledge for an IT project?

RQ4: How does the PKM model for managing knowledge improve the success of an IT project?

Conceptual Framework

The conceptual framework of this research consists of three primary parts. First is an understanding of the use of traditional PM techniques in IT PM, both successes and failures. These PM techniques use a project life-cycle approach of four phases. The first phase is the conceptual stage to begin the project, with tools such as scope statements and brainstorming. The second phase is the planning phase, with flowcharts and milestone charts being used. The third phase is the execution phase, with milestone analysis, Gantt charts, and project change requests, and the fourth phase is the termination phase, with cost analysis and code analysis (Patanakul et al., 2010, p. 51).

The second aspect of the conceptual framework is an understanding of the use of KM tools and techniques in PM projects in non-IT environments, including the successes and failures. Buzan and Griffiths (2010) discussed the use of mind maps to develop a business project for the development of business centers in Asia. The project started with the vision phase to develop the concept of the project. The second phase was the planning stage to develop the centers. The third phase was the development of the project. Mind maps were used throughout the project to exchange knowledge. These mind maps provided clarity and accountability for the project. In the construction industry, KM tools, such as expert systems, are used in PM for product delivery strategies and the management of design changes (Buzan & Griffiths, 2010, p. 166).

The third aspect of the conceptual framework builds on Gasik's (2011) model for PKM, which lays out a system for sharing knowledge in a project. This model breaks KM into the individual level, the project level, the organizational level, and the global level of an IT project. By studying these four levels of knowledge exchange, a determination can be made about the amount and structure of KM in the project. Different tools for KM and PM were analyzed to evaluate their use in the model.

The PKM model for knowledge sharing in a project uses the framework for the flow of knowledge. In an IT project, the flow of knowledge begins with the knowledge creation process as discussed by Nonaka and Takeuchi (1995) and the socialization (S) to externalization (E) to combination (C) to internalization (I) framework. This spiral of knowledge flow, the SECI model, is the basis for creating knowledge, and that knowledge flows through the company (Nonaka & Takeuchi, 1995). Nonaka, Toyama, and Nagata (2000) discussed *ba*, which means *place* in Japanese, as a place where knowledge is shared, created, and utilized. New knowledge is created from existing knowledge by new information being added to what is known. From this model of knowledge creation and flow in an organization, Gasik's (2011) model for PKM is the theoretical framework for the flow of knowledge from the individual to the project level, organizational level, and global level.

The PKM model involves knowledge sharing with all stakeholders in a project, including people who are internal and external to the organization. A business partner and a vendor that supplies services for the project are considered external stakeholders. The project manager and the people who work on the project to achieve its objectives (i.e., the

project team) are internal stakeholders. Internal stakeholders on a project also include the sponsor that provides the resources and support for the project, customers who will use the end product of the project, and organizational groups that are affected by the project. Stakeholders have varying responsibilities and involvement in the project but are critical to its success (PMI, 2013). The stakeholders are the primary source for the requirements of the project, which can be used to determine its success. As the project is being developed, the stakeholders monitor the progress by reviewing prototypes and models. They have a role in managing the project and making sure that it meets their needs (Ballejos & Montagna, 2011). The appropriate amount of knowledge about the project must be shared with them throughout the PM process. How stakeholders share knowledge with different tools and techniques can have an impact on the management of the project (Desouza & Evaristo, 2004).

Knowledge Sharing

For all of the different stakeholders, knowledge sharing is the process of moving information from the individual to others. The process can be studied as a cycle from the provider to the receiver and back to the provider, with an objective of passing the information in a timely manner with limited costs (Islam et al., 2012). Part of the PKM model is the KM software tools, such as mind maps, concept maps, conceptual diagrams, communities of practice, and visual metaphors to organize and communicate information. These tools are valuable for sharing knowledge between participants in the IT project (Wang & Jacobson, 2011). Jasimuddin, Connell, and Klein (2012) added to the knowledge-sharing process repositories and an administrator, thereby creating a five-

component process for knowledge sharing. Repositories are a tool for the storage of knowledge that can be shared with different receivers of the knowledge. An administrator who facilitates the knowledge sharing helps the receiver find the best provider for the knowledge and keeps knowledge repositories current. The five components of the knowledge-sharing process are (a) the provider and receiver, (b) knowledge, (c) the mechanism, such as face-to-face meetings or e-mail, (d) the repository for the storage of knowledge, and (e) an administrator who facilitates the knowledge transfer (Jasimuddin et al., 2012). The research with users of knowledge repositories found that knowledge not being up to date was a major issue in the process of knowledge transfer (Jasimuddin et al., 2012).

Knowledge articulation or codification is used to convert tacit knowledge to explicit knowledge and add the explicit knowledge to a knowledge repository (Desouza & Evaristo, 2004). Although this process makes knowledge available for a large number of people, the level of understanding and the ability to use the knowledge that has been transferred are not very high. There also is a loss of control about who is receiving the information that is used to create knowledge in comparison with the face-to-face process (Desouza & Evaristo, 2004). Knowledge articulation using a data repository to share data is an effective way to share knowledge, but the level of understanding may be higher in face-to-face meetings. Most people in the IT area would rather have information shared with a person in a face-to-face meeting than from accessing a data repository or database (Cross, Parker, Prusak, & Borgatti, 2004). Brown, Dennis, Burley, and Arling (2013), in their study of Canadian government office employees, found the same results.

A technique that organizations use to identify sources of knowledge for face-to-face meetings is the knowledge map. The issues of language and trust have a negative effect on the knowledge sources found with a knowledge map, and this causes people not to use the knowledge map. Because information is used to construct knowledge (Nonaka & Takeuchi, 1995, p. 58), the question becomes this: Who shares the information that is used for knowledge with the project team member or stakeholder? Cross et al. (2004) identified four features of effective relationships for knowledge sharing: (a) knowing what another person knows, (b) access to that person in a timely way, (c) willingness of the other person to help, and (d) a degree of safety and trust in the relationship. Knowledge sharing by either a data repository or a face-to-face meeting is influenced by the relationships between the people involved.

Knowledge Sharing Issues

Although there are many reasons for organizations to encourage knowledge transfer and sharing, individuals have reasons not to share knowledge. Without strong personal motivation and the belief that the knowledge sharing process will be returned, individuals are hesitant to share knowledge. Yi-Shun, Hsin-Hui, Ci-Rong, and Shin-Jeng (2014) found that knowledge sharing can have a positive effect on social identity, but only for individuals that want to increase their social identity. Personality traits such as extraversion and openness to experience can influence social identity and encourage knowledge sharing, but other personality traits may not encourage knowledge sharing. Swart, Kinnie, Rossenberg, and Yalabik (2014) suggested that, besides the personality traits, commitment to the team, organization, or profession has a positive impact on

knowledge sharing. Nokes-Malach and Mestre (2013) created a framework for the sharing of knowledge based upon sense-making. They suggested that the proper amount of knowledge is transferred to make sense of it and be able to solve a problem. The process of transferring knowledge is cyclical and continues until the receiver does not always develop the optimal solution, but a solution that solves the problem. Swart et al. (2014) emphasized the cyclical aspect of knowledge sharing in their study of the quality of the knowledge being shared. They found that the quality may not be high if knowledge sharing will not be reciprocated.

One technique that has been considered to increase knowledge sharing is the practice of providing incentives for employees to transfer knowledge. In the IT field, programmers who are valued for their ability to write code and create systems are compensated based on these unique skills. Knowledge sharing in IT projects suggests that they transfer these skills to others. With the skills of the programmer no longer being unique, there may be less compensation. This is motivation not to share knowledge in a project. However, sharing knowledge is critical for the success of the project, and organizations need to provide incentives for exchanging information (Dalkir, 2011, p. 169).

Minbaeva, Mäkelä, and Rabbiosi (2012) researched providing incentives for knowledge sharing, and they concluded that incentives were not an effective practice for knowledge transfer. Their research indicated that the relationship between the provider and the receiver was important for knowledge transfer. Procedures were needed to encourage the relationship between the provider and receiver of organization policies and

practices. Their research also indicated that embedded knowledge that was part of the organization was more effective than offering rewards for knowledge transfer. Zhang and Ng (2013) also found that economic reward was not an incentive for knowledge sharing in the construction industry. They found that reciprocity of knowledge and developing confidence and capability of themselves were the incentives for knowledge sharing. Yi-Shun et al. (2014) would suggest that personality traits would have an influence on providing incentives. More incentives will be needed to encourage introverted individuals than extroverted individuals. Haas, Criscuolo, and George (2015) studied knowledge sharing on online social platforms such as discussion boards. The personality trait of extraversion is not observed, and the social identity did not provide an incentive for knowledge sharing. The incentive for most knowledge providers was that the knowledge provider at some time in the future would be the knowledge receiver on the online social platform.

Although knowledge sharing is the responsibility of the individual, Sharma, Singh, Neha (2012) found that management policies have the largest impact on motivating knowledge sharing. They developed an interpretive structural model of organization knowledge sharing. At the top of the model is top management's commitment and not understanding knowledge sharing as the main barriers to knowledge sharing. The other issues such as personal motivation and personality concerns are less of an issue than top management commitment to knowledge sharing.

While most discussions on knowledge sharing focus on the individuals involved, Zhao and Anand (2013) suggested that there is a collective aspect of knowledge transfer,

too. Grant (1996) defined collective knowledge as the knowledge embedded in individuals regarding how to coordinate, share, distribute, and recombine individual know. Zhao and Anand's discussion focused on knowledge sharing between organizations and the need to understand the organization-to-organization knowledge transfer and not just the individual-to-individual transfer. When knowledge is transferred from one individual to another within an organization, embedded in the skills that are being transferred is the organizational knowledge on coordinating and sharing. If the organizational knowledge is not also transferred, the individual knowledge is not likely to be successful. It is important not only that the individual is in a position to transfer knowledge but that the organization has a knowledge-sharing culture, technology, and leadership. Zhao and Anand examined boundary spanning by individuals to share knowledge between groups and organizations. A collective knowledge bridge is a set of connections between the two groups for the exchange of knowledge.

With collective knowledge, Vissers and Dankbaar (2013) examined the proximity and knowledge sharing. Zhao and Anand (2013) focused on an organization, but Vissers and Dankbaar extended the knowledge sharing to other organizations in the region. Knowledge sharing beyond the organization occurs because of the individuals of the organization sharing with individuals in other organizations in the region. More effort is needed to share knowledge with organizations outside of a region (Vissers & Dankbaar, 2013). Although knowledge sharing between organizations in a region does not always occur, it is more likely to have knowledge sharing within a region than outside of the region. The issue of knowledge sharing outside of a region is included in the social

network analysis concept of centrality. In Kane and Borgatti's (2011) study of centrality with information systems proficiency, indicated that having a strong user of technology at the center of a social network will impact the others in the network for improved proficiency. Centrality is also true for organizations in a region. Knowledge sharing in one organization in a region will impact the others organizations in the region.

Individuals perform knowledge sharing, but the process of knowledge sharing has an impact on the organization. By the individuals sharing knowledge with others that may be part of a different organization, knowledge is spread throughout the region. The organization and region can impact the knowledge sharing process. The management of an organization needs to promote knowledge sharing for it to occur.

Nature of the Study

This case study was designed to understand the tools and techniques used to share knowledge among stakeholders in PM. The case study approach is used to understand the how and why of an event (Yin, 2013a). By using a case study approach, the how and why of PKM in the project environment was studied. PKM is a new area of PM. The information gained yielded suggestions for this new area (Gasik, 2011). A qualitative case study process helps the PKM process to be understood. By studying one organization and the processes it used, an understanding of the implementation of PKM is gained. In this research, I focused on sharing knowledge between individuals and the project team, between the project team and the organization, and between the project team and external organizations.

Definition of Terms

Several of the key terms used in this research study are defined in this section.

Data: A set of discrete, objective facts about events (Dalkir, 2011, p. 60).

Epistemology: The origin, nature, and validity of knowledge; the theory of knowledge (von Krogh & Roos, 1995, p. 7).

Information: The flow of messages with meaning for the individual (Nonaka & Takeuchi, 1995, p. 58).

Knowledge: The fluid mix of framed experiences, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates in and is applied in the mind of knowers. In organizations, it often becomes embedded not only in the documents and repositories but also in organizational processes, practices, and norms (Davenport & Prusak, 2000, p. 3).

Tacit knowledge: Knowledge that is not written down but is known by the individual. It is highly personal and hard to formalize (Nonaka & Takeuchi, 1995, p. 8).

Explicit knowledge: Knowledge that is written down and is available in the databases or written policies of the organization (Tiwana, 2002, p. 45).

Knowledge sharing: Disseminating and making available to others what is known (Tiwana, 2002, p. 50).

Knowledge management (KM): Management of fragmented knowledge throughout the organization to facilitate opportunistic application through integration (Tiwana, 2002, p. 4).

Knowledge transfer: The strategy of facilitating learning and exchange between individuals for understanding and action (Tiwana, 2002, p. 91).

Project management (PM): The application of knowledge, skills, tools, and techniques to project activities to meet project requirements (PMI, 2013, p. 5).

Assumptions

The insurance organization under study aided with the selection of the participants, and the background of the participants had to be assumed. For this study, it was assumed that the participants were well-trained IT employees who had participated in some IT projects. The participants were employed in the IT area of the insurance organization and had a formal education background that suggested they were well-trained. Another assumption was that the participants' answers to the interview questions were truthful, and all documents that were provided for the research were being used in managing IT projects. The research methodology helped identify differences between the answers of the participants, but I assumed that the participants were giving truthful answers.

Scope and Delimitations

This research provides information about IT projects in a United States insurance firm, how KM is involved in the projects, and possible improvements that KM provides in this environment. Although the information from this research is valuable to other insurance organizations, the recommendations from this research may not be readily transferable to all contexts where PKM initiatives are being considered or have been implemented Additional research may be required to use further the findings and

observations made beyond those specifically attributed to an insurance organization in America. PM in the United States and the exchange of knowledge in this process was studied in this research. The exchange of knowledge outside of the United States may not be the same, and PKM may need different techniques and process outside of the United States.

Limitations

The main limitation to the dissertation was that PKM is a new and emerging technology. Little literature is available, and there are no universally accepted techniques for PKM and how it is implemented in IT projects. For this research, one insurance organization in the United States was studied to understand how KM was part of IT projects. Insurance organizations are regulated by the government and have restrictions on some business practices. The process of KM in the PM process cannot easily be compared with another organization's process either in the United States or another country.

Another challenge was that the participants were busy at their work and not always available. Therefore, the interview questions were distributed in advance, and the participants were given time to prepare. The software tools that were evaluated for their functionality in the organization were not being used by all participants. Some of the participants were unable to provide a proper analysis of the software tools and their usefulness.

Potential researcher bias in this process was managed by having the findings reviewed by individuals external to the project—some involved in IT and some not.

Although not all of the individuals who review the research were familiar with the research methodology of a case study, some were, and their perspective provided a reference for managing the bias of the researcher

Transferability of Findings

The findings of this research can be used by other researchers to study the KM part of the PM process at organizations. This research was with an insurance organization and there are differences with other businesses, but the analysis provides a basis for more research in other organizations. The context of this research on IT PM in an insurance organization that could be transferred comprises (a) the use of a data repository for the sharing of standards for the organization, (b) a project environment that includes a project team of at least two people and stakeholders who are not part of the project team, (c) an organization that has multiple projects with different project managers being developed at the same time, and (d) an organization with a background of developing projects that is longer than the past 2 years. Many organizations are developing IT projects and are using the current PM model that does not focus on KM, and this research could be important.

Transferability has limits in qualitative research. Lincoln and Guba (1985) commented that the researcher does not know the details about the project environment to which the research is being transferred. This makes any claims about transferability or generalization to another project unreliable. To improve the transferability of the research, Lincoln and Guba recommended that the case study provide a methodological report (p. 360). The methodological report for this research includes a complete description of the investigator, methods, and measures used in the research.

Significance of the Study

Project success is defined as when the project is completed and performs the requirements of the user. The project is completed within time and budget requirements and with all stakeholders feeling satisfied. Stakeholders include project team members, the users of the completed software project, and the organization. The authors of current literature discussed how KM should improve PM in IT, but they did not address how it was implemented in the organization. This research examined the gap in literature by studying how KM is being used in PM in IT for an insurance company. I examined KM in the different phases of an IT project and the impact on the success of the project. The research focused on determining whether the KM tools and techniques can help the project be successful.

Significance to Practice

IT projects are developed by programmers who are valued because of their ability to write code and create systems. They are not compensated for knowledge sharing in IT projects. Sharing knowledge is critical for the success of the project, and this suggests that a change is needed in the way software developers are compensated. The PKM model identifies where knowledge must be managed in the PM process. It identifies the critical aspects of the process in which sharing knowledge is needed for a successful project.

Significance to Theory

This research is critical for improving PM. By an improved sharing of knowledge with the stakeholders and team members, the project will be better understood. The

sharing of knowledge will resolve differences in perspectives, as discussed by Adolph and Kruchten (2011). Hanisch and Wald (2011) suggested that in a project, learning is a key activity of the team members, who learn from the knowledge of the project to create a successful project. As Karpicke and Grimaldi (2012) point out, retrieval of the information is critical to learning. The tools and repositories an organization use for KM must have appropriate ways to retrieve the information or learning by the project team members will be challenged.

Significance to Social Change

According to Anantatmula and Kanungo (2008), successful IT projects create opportunities for the organization. These opportunities can lead to improved social conditions. Organizations can develop a variety of different types of IT projects. The success of any project is affected by how the knowledge of the project is managed. This includes projects for the improvement of society (Schwalbe, 2010, p. 5).

This research may change the way in which PM is taught in the classroom. As a college faculty member, I have been teaching courses aligned to KM and PM for the past 10 years. I have seen the importance of KM in the PM process and the problems that can occur when KM is not part of the process. There is a need for IT project teams to include KM in the project process and this research will provide a model for organizations. The KM concepts need to be included in coursework on PM to help students learn about knowledge sharing issues and the impact they can have on the project. Students need to know how to plan for and correct the KM issues in the PM process.

Summary

The focus of this study was to better understand how KM may be used to improve PM using the PKM model. This study focused on PKM in an insurance organization. These exchanges of knowledge were analyzed at the project level with the individuals developing the project. The knowledge also was studied with the project stakeholders, who would be using the end product and the knowledge exchanged with other projects being developed by the IT area. The exchange of knowledge also includes the knowledge flow to the upper management of the organization and outside of the organization. This research included the different tools used for PM and KM to analyze the flow of knowledge during the project.

The field of KM is relatively new and broad in scope. Chapter 2 provides background from the literature in the field of KM as it relates to the understanding required to conduct the case study. Chapter 3 will detail the method that was employed to determine the enabling effects of concepts from the field of KM in PKM. The methods section includes a discussion of the various research methods, however, a case study approach that included both interviews and document reviews was used.

Chapter 2: Literature Review

Introduction

The purpose of this study was to explore the uses of KM tools and techniques in the PM process for IT projects. The purpose of this chapter is to examine KM and PM in IT and to understand how KM can be part of PM. This literature review begins by presenting different theories of KM and PM in the IT field, as well as PKM, which combines KM and PM. The chapter includes a discussion of tools and techniques for PM and KM and concludes by examining knowledge sharing in an organization. To explain sharing of knowledge in a project, three models of KM—cognitivist, connectionist, and autopoietic epistemologies—will be discussed. Wiig's (1999) knowledge-evolution cycle, Nonaka and Takeuchi's (1995) knowledge spiral using SECI, and Boisot's (1998) social-learning cycle will be used to understand knowledge processing, both within the organization and in an IT project. PM provides the frameworks of the systems development life cycle and agile development process for the development of IT projects. Using these frameworks for software development has not always guaranteed a successful project, and organizations are searching for new ideas to improve the process. During the development of IT projects, there are opportunities for KM to improve the process. Gasik's (2011) PKM provides a model for knowledge acquisition, knowledge sharing, and knowledge transfer within the project development process. In this literature review, the concepts of tools and techniques for PM and KM, the knowledge sharing issues of trust for knowledge exchange, incentives to encourage the sharing of knowledge, and the PM office for sharing knowledge will be presented.

Literature Search Strategy

The peer-reviewed articles and the dissertations in this literature review were identified using the following academic and industry databases: EBSCO, ProQuest ABI/INFORM Complete, SAGE Premier, Business Source Premier, Computer and Applied Sciences Complete, and IEEE Xplore Digital Library. The following keywords were used for the primary research: *knowledge management models*, *frameworks*, *epistemologies*, *project management*, and *project knowledge management*. The Business Source Premier database was first searched for the keywords and then followed by the other databases. The research focused on the business perspective on KM in IT projects. When more information was needed on a keyword, Computer and Applied Science was used for computer project related information and the other databases supplemented what was found in Business Source Premier.

Conceptual Framework: KM Models, Frameworks, and Epistemologies

Managing the knowledge in an organization begins with the individual and is expanded to the organization. Data as raw facts are the basic elements of knowledge. The data will be converted to information and knowledge, but in different ways due to the perspectives of knowledge and how it will be used in the organization. The literature on this conversion includes three epistemologies and three frameworks that begin with knowledge creation for the individual and progress to knowledge creation for the organization.

The first epistemology, cognitivism, focuses on logic and deduction and views the world as an objective set of facts. According to von Krogh and Roos (1995), knowledge

is a set of rules following if-then logic, and it is the basis for artificial intelligence and the development of machines for knowledge creation. Knowledge in this framework is being used for problem solving and decision making. Using a cognitivist epistemology, Ginevičius, Kaklauskas, and Kazokaitis (2011) developed a six-stage knowledge model for the construction industry in Lithuania. The model begins by comparing the economic, legal, regulatory managerial, technical, cultural, political, and educational environments in Lithuania with those in other countries. The authors used the model to analyze the world in which the firm operated. The process includes recommendations to improve the knowledge levels of construction managers and construction firms. The final stage of the model suggests how behaviors will be changed to incorporate the new knowledge that is being gathered. The new behaviors will be used to solve problems within the firm (Ginevičius et al., 2011).

The second epistemology, connectionism, is different from cognitivism because of the knowledge that resides in the individuals and contains a subjective perspective. Cognitivism is based upon logic, but connectionism includes the individuals and the social process of knowledge (Dalkir, 2011). According to von Krogh and Roos (1995), connectionism also models knowledge development based upon the human brain, but this epistemology focuses on the connections between the components. Learning and knowledge creation occur when new components are added to the connections (von Krogh & Roos, 1995, p.24). Connectionists use neural networks as representations of the brain, while cognitivists look at rules based systems as a model of the brain (von Krogh & Roos, 1995, p. 25).

Connectionists and cognitivists use a logical process based upon specific input to create knowledge. The third epistemology, autopoietic, uses a more open process for input into knowledge creation. According to von Krogh and Roos (1995), autopoietic systems are characterized by being (a) autonomous, (b) simultaneously open and closed, (c) self-referential, and (d) observable. In the autopoietic system, "knowledge is what brings forth a world and the world is what brings forth knowledge" (von Krogh & Roos, 1995, p. 69). The system is open because it permits data to come into the system, but the system is closed in the process by which data will create information and knowledge. Individuals interpret data to develop information and knowledge (von Krogh, Roos, & Kliene, 1998, p. 42). In the autopoietic system, input knowledge that may be either tacit or explicit will be viewed as data. Knowledge is not imported but is produced by the individual. To explain this concept, von Krogh and Roos (1995, p. 133) discussed a document as explicit knowledge about the organization. The document also is data for the reader. The reader adds meaning to the document to create information. Using the information, the reader creates knowledge about the organization by observation and socialization with others to "bring forth a world."(p. 133).

Berger and Luckman (1966) discussed the world of the individual being constructed by social interactions. The interactions create reality and what the individual knows. Each individual creates knowledge from social interactions and helps others create knowledge by interactions with others. In this process, the knowledge of the individual is passed on to the group and it becomes knowledge of the group. Morris (2013b) considered PM as a social construct based upon the social interactions of the

people involved in the project. In different organizations, the process may be different depending on the social interactions of the people involved.

In the process of creating knowledge from social interactions, Boisot (1998) discussed the creation of a set of expectations for an event (p. 20). Based upon these expectations, an individual will take actions. Knowledge is based upon information that provides the set of expectations. Information is data that modify the set of expectations. As more information is gathered, the set of expectations and knowledge is improved.

Knowledge from the Individual to the Organization

Knowledge creation in an autopoietic system for the individual is similar to that for the group (von Krogh & Roos, 1995, p. 87). The difference is the scale upon which knowledge creation is performed. At the different levels of scale, either the individual or the group is an autonomous, simultaneously open and closed, self-referential, and observing system. One of the differences between the individual and the group is that knowledge resides in the individual and is always personal (von Krogh et al., 1998, p. 255). The tacit knowledge of the individual is used to create knowledge for the group. To expand the tacit knowledge of the individual to the larger group, language and trust are very important for the autopoietic epistemology. Language and trust are significant factors that are used by members of the group to accept the knowledge of the individual presenting it (von Krogh & Roos, 1995, p. 95). To analyze the knowledge creation process from the individual to the group, there are three models. Wiig's (1999) knowledge-evolution cycle, Nonaka and Takeuchi's (1995) knowledge spiral, and Boisot's (1998) social learning cycle are the frameworks for this process.

Knowledge-Evolution Cycle

Wiig's (1999) framework for the flow of knowledge from the individual to the organization starts with a five-stage knowledge-evolution cycle for the individual. The first stage of the personal knowledge-evolution cycle is tacit subliminal knowledge that usually has a first glimpse of a new concept. The second stage is idealistic vision and paradigm knowledge that has an explicit awareness, but it is not well known and requires a conscious effort. The third stage is the systematic schema and reference methodology knowledge. At this stage, the personal knowledge includes underlying systems and problem-solving strategies. The fourth stage, pragmatic decision making and factual knowledge, indicates that decision making is practical and supports everyday work. In the fifth and highest stage, automatic routine working knowledge, the knowledge is at such a high level that it is automated and has become tacitly used without a conscious effort.

While the individual has a personal knowledge-evolution cycle, Wiig (1999) also suggested a five-stage institutional knowledge-evolution cycle in which to pass knowledge from the individual to the organization. The first stage is knowledge development, where knowledge is acquired by learning, innovation, and creativity. The second stage is knowledge acquisition, where it is captured and retained for further use. The third stage is knowledge refinement, where it is organized and available for use. In the fourth stage, knowledge distribution and deployment, knowledge is distributed to where it is needed in the organization by training and knowledge-based systems. In the fifth stage, knowledge leveraging, it is applied and is the basis for innovations and for creating new knowledge. The individual acquires knowledge using a five-stage process

from subliminal knowledge to a routine, and that knowledge is used in the organization in a similar five-stage process from learning to application.

Knowledge Spiral

Nonaka and Takeuchi's (1995) knowledge spiral is a model of how knowledge is transferred from the individual to the group and the organization. Their framework for knowledge creation is a process of information flowing from socialization (S) to externalization (E) to combination (C) to internalization (I) and back to socialization. Socialization occurs by bringing together tacit knowledge through shared experiences in an informal setting. Externalization occurs when one converts tacit knowledge to explicit knowledge by writing it down or entering the ideas into a computer database. Combination occurs when elements of explicit knowledge are connected with other explicit knowledge to create a system. Internalization is the process of embodying the explicit to tacit knowledge to take action. This spiral of knowledge flow is the SECI model and is the basis for creating knowledge, and that knowledge flows through the company (Nonaka & Takeuchi, 1995). Nonaka et al. (2000) discussed *ba*, which means *place* in Japanese, as a location where knowledge is shared, created, and utilized. New knowledge is created from existing knowledge by new information being added to what is known. The autopoietic epistemology would suggest that the exchange of information and knowledge in this spiral be influenced by the individual transferring the knowledge, whereas the cognitivist and the connectionist would suggest that the logical information being exchanged is always the same and the individual does not alter the logical information. The difference is the tacit knowledge, language, and trust of the individuals

involved in the exchange of knowledge. Polanyi (1962) broke tacit knowledge into two kinds of awareness—focal and subsidiary—of the same information being exchanged. Focal awareness is seeing in the context of visual attention. Subsidiary awareness is the use of tools to determine meaning (Polanyi, 1962, p. 55). Language and trust are tools used with subsidiary awareness to provide meaning to the individual. The explicit information is written down and cannot change, but the other factors can influence the knowledge being transferred (von Krogh et al., 1998). Polanyi (1962) also suggested that knowledge can only be exchanged within a framework with which the individual identifies for the time being (p. 57). That framework is based upon experience. Because individuals who share information have different experiences, the information may have different meanings.

Eservel (2014) connected the four phases of the knowledge spiral with the information development process. The study found that the externalization phase of converting tacit knowledge to explicit was the most used phase. This phase converted tacit knowledge to a database and documented the project information. The socialization phase was the second most used phase, indicating the importance of the exchange of tacit knowledge between the team members and others.

Social Learning Cycle

Boisot (1998) discussed knowledge sharing in the organization based upon abstraction, codification, and diffusion. Codification gives a form for the knowledge. Abstraction provides a structure for the knowledge that can be shared with others. While codification provides a technique to identify the different categories of the knowledge,

abstraction provides a way to combine and simplify the different categories. Diffusion provides the manner by which the knowledge can be distributed in the organization. Boisot (1998) discussed three versions of tacit knowledge. Tacit knowledge may be easily codified, abstracted, and diffused throughout the organization; as discussed by Polanyi (1962), knowledge may not be able to be codified and abstracted, or, as discussed by Nonaka and Takeuchi (1995), knowledge can be codified and abstracted, but the knowledge is not easily diffused throughout the organization.

Based upon codification, abstraction, and diffusion, Boisot (1998) presented the social learning cycle as a framework for the process of knowledge creation in the organization. The six-stage process begins with scanning for threats and opportunities. The second stage, problem solving, provides form for the knowledge and is codified. The third stage, abstraction, gives a general application of the knowledge. The fourth stage is the diffusion of the knowledge in the organization. The fifth and sixth stages are absorption and impacting, where the new knowledge is incorporated in the organization by embedding it in standards and procedures.

Knowledge Acquisition, Capture, Exchange, Integration, Sharing, Transfer, Utilization, and Learning

Tiwana (2002) identified the three fundamental process of KM as (a) knowledge acquisition, (b) knowledge sharing, and (c) knowledge utilization (p. 50). Knowledge acquisition is the process of developing skills and relationships. Knowledge sharing is the process of dissemination and making available what is known in the organization. Knowledge transfer and knowledge integration are two implementations of knowledge

sharing. Knowledge transfer refers to a process of exchange and learning as part of knowledge sharing. This is different from knowledge integration for knowledge sharing, which does not include learning and the exchange of knowledge. It involves making the knowledge available, and the individual needs to make a decision from the knowledge that is presented by others (Tiwana, 2002). Knowledge utilization integrates knowledge throughout the organization. Learning occurs in the knowledge utilization process as the knowledge that was shared is learned and integrated into the organization.

Dalkir (2011) presented the integrated KM cycle involving (a) knowledge capture, (b) knowledge sharing, and (c) knowledge acquisition. Knowledge acquisition occurs before learning and a reflection process, enabling the individual to understand the knowledge that has been acquired (p. 98). Although Dalkir referred to the process as knowledge acquisition and Tiwana called it knowledge utilization, learning occurs after knowledge has been shared within the organization.

Boisot's (1998) social learning cycle, Wiig's (1999) knowledge-evolution cycle, and Nonaka and Takeuchi's (1995) SECI model provide a framework for how knowledge is acquired, shared, and utilized in an IT project. The framework includes a social process that Dalkir (2011) identified in the learning process also (p. 103). Knowledge is acquired by individuals, is shared with other members of the project team and the organization, and becomes integrated into the project. The different models also suggest the important role of the social connections of the individuals in the ways knowledge is shared in the organization. Another KM model using social connections for knowledge adoption was presented by Brown (2013). This model focused upon the relationships with the policy

makers and the view of the policy makers on the favorability of the idea. There are a number of factors, such as the clarity of the presentation and the credibility of the source, that vary in importance depending on the relationships with the policy makers. Suorsa and Huotari (2014) agreed with the importance of social connections, but their study also included the importance of experience, openness, and creativity in exchanging ideas with others for knowledge creation.

Although Boisot (1998), Wiig (1999), and Nonaka and Takeuchi (1995) discussed organizational knowledge beginning with the individual, Jain's (2011) research with the faculty at a university found that a large number of people in the organization were not aware of this. The individuals in the study performed a number of tasks to increase their own knowledge, but they were not aware of how this knowledge acquisition helped the university. Knowledge acquired by the individual is shared with others in the organization. Abu-Shanab, Knight, and Haddad (2014) found that this process leads to a learning organization. Jain's study recommended that employees of an organization need to be aware of their personal KM and the impact it has on the organization.

Manganello, Falsetti, Spalazzi, and Leo (2013) presented a model to help with personal KM and knowledge adoption. This personal knowledge system is a computer-based model using ontological tools to help the knowledge worker acquire knowledge from different resources. The model provided resources for lifelong learning, and the knowledge acquired would be shared with others for the benefit of the organization.

Information Technology (IT) Project Management (PM)

IT projects apply knowledge, tools, and techniques to develop projects used for project requirements (Schwalbe, 2010, p. 10). Projects often are used to achieve objectives for the organization's strategic plan, such as customer service, a business need, or an environmental consideration (PMI, 2013, p. 10). IT projects must manage the scope, costs, and time goals to deliver a project that meets the requirements of the user and stakeholder (Schwalbe, 2010, p. 9). Project development must include issues that occur from the (a) business, (b) organization, and (c) technology when managing the goals of the project and balancing scope, costs, and time (Schwalbe, 2010, p. 46). IT projects are usually unique projects for an organization and are not performed in a routine manner. This adds to the complexity of an IT project, and the knowledge should be managed.

The traditional IT project life cycle begins with a conceptual phase, followed by a development phase, implementation, and a closing phase (Schwalbe, 2010, p. 57). In each of the phases are deliverables from the project development team such as software code, a training session, or a technical report that indicates progress on the project (Schwalbe, 2010, p. 57). There are different frameworks for the life cycle, including a predictive life cycle and an adaptive life cycle (Schwalbe, 2010, p. 60). One of the frequently discussed predictive life cycles is the systems development life cycle, with requirements-gathering, analysis, design, and implementation phases. These phases may work as a linear process, with each phase following the other, or there may be a spiral or prototyping process that moves from one phase to another as required by the project (Schwalbe, 2010, p. 60). For

the adaptive life cycle, an agile software development framework is discussed, with the IT team being a part of the user's group. In this model, the phases as defined in the predictive framework are not clear because the different phases are being performed at the same time. Being able to develop the project quickly is the priority. Early versions of the project are developed for the client. The client provides feedback for improvement, and an updated version of the project is developed quickly (Schwalbe, 2010, p. 61).

All of the people involved in a project are referred to as stakeholders. This group includes the project manager, who is responsible for the development of the project; project developers, who create the project and put it together; clients or users who will use the project; organizational management, which determines the budget for the project; and suppliers, who provide materials for the project (Schwalbe, 2010, p. 11). The stakeholders change over the lifetime of the project. They can have different amounts of responsibility and authority on the project. These groups add different skills to the development of the project. Even within the project development group, there may be different skills that create many perspectives on the project. The groups do not always have the same priorities for the work performed in the project, and differences can be an issue. Balancing the skills, priorities, demands, and expectations of the stakeholders is a critical process (PMI, 2013, p. 31).

Success for a project can be viewed differently by the project stakeholders. One way to define the success of the project is meeting the scope, time, and cost goals. A second definition is customer satisfaction with the end product. A third definition is meeting the main objective of the project, such as reducing costs for the customer or

providing a good return (Schwalbe, 2010, p. 15). The criteria for the success of the project should be determined in the first phase of the project. When the scope of the project is being determined, the objectives for success should be identified (Schwalbe, 2010, p. 9). According to the research of Lee, Keil, and Kasi (2012), the cost and scheduling goals established at the beginning of the project had a significant impact on the success of the project. Having practical estimates for the project reduces the possibility that the cost and time allocation will be escalated. With the cost estimates not being increased, the scope is adjusted for the success of the project.

Over the past few years, the failure rate for projects was a concern for many organizations. According to the Standish Group's *Chaos Report*, the percentage of project failures for 2009 was 24%. This was an improvement from 31% in 1994, but there was a need for further improvement (Eveleens & Verhoef, 2010). Some of the factors that lead to project failure include lack of support by top management, inexperienced project leaders and team members, unrealistic scope and expectations, inadequate resources, and lack of tools for managing the project (Schwalbe, 2010, p. 16). In 2003, the government of the United Kingdom created a research project titled *Rethinking Project Management* to update the current ideas of PM and make the field usable for the complexities of the current environment (Winter et al., 2006). The report discussed new concepts to be added to the PM process, and these new concepts are part of the KM process (Sauer & Reich, 2009).

KM in IT Projects

According to the DeLone and McLean IS Success model, and as verified by Petter and McLean (2009), the quality of the information produced by an information system (IS) is highly correlated with user satisfaction and net benefit for the organization. The model uses net benefit for the organization as an indicator of the success of the IS project. To achieve a high quality of the information in the IS project, the information and knowledge of the project must be included in the project development process.

Project members must acquire the knowledge needed for the project as part of the knowledge acquisition process. Knowledge sharing occurs among technology specialists, the project manager, users, upper management, and other stakeholders. It helps everyone involved in the project manage the goals of scope, time, and costs. The knowledge utilization process is used to integrate into the project the knowledge that has been shared. Although the PM theory of software development is a rational process with defined tasks and procedures that must be accomplished, this is not the case in practice. Research has shown that the logical cognitivism approach to IT is not always successful. IT projects are sensitive to interpersonal relationships that are part of the autopoietic epistemology and affect the sharing of knowledge of a project (Sewchurran, Smith, & Roode, 2010). Boisot's (1998) social learning cycle, Wiig's (1999) knowledge-evolution cycle, and Nonaka and Takeuchi's (1995) SECI model were part of knowledge sharing in PM. The different groups of stakeholders must work together on business issues, organizational issues, and technology issues for the success of the project. Hanisch and

Wald (2011) suggested that the importance of knowledge for a project team is that it creates an embryonic community of practice.

Tools and Techniques of IT PM

For a project to be successful, initiating, planning, executing, monitoring, and controlling the project must occur. There are different tools and techniques that help the project team with these activities and with the sharing of knowledge. These tools, as discussed by Boisot (1998), codify, abstract, and diffuse project information. To manage the scope goals of the project, tools such as a work breakout structure, a scope statement, a quality function deployment process, and a lessons-learned statement are used. For cost management, tools include earned value management processes, cost/benefit analysis, and cost change control systems. For time management, tools such as Gantt charts, critical path method, and milestones are used. Flowcharting, benchmarking, and trend analysis are used for managing the quality of the project (Patanakul et al., 2010). These tools and techniques provide the knowledge that is shared about the project with team members and stakeholders.

Besner and Hobbs (2012) studied PM tools and organized them based upon a panel of 45 PM experts that used the tools. These tools were then studied to see if different project types used the tools differently. Their analysis found that the panel organized the tools similarly to the knowledge areas of the *PMBOK*®. The panel found it necessary to include new groups for managing more than one project, and more groups for financial analysis management. The analysis also showed there is a difference in the tools that are needed for each project and their amount of use.

To measure the effectiveness of tools and techniques, standards were developed. According to Crawford and Pollack (2007), these standards were descriptive, normative, or prescriptive and provide a basis for the work. These standards were usually set not by official government organizations but by the individuals involved in projects from their experience. This knowledge was shared with the members of the project and becomes part of the objective of the project. Crawford and Pollack (2007) determined that there are differences between types of projects, such as IT and construction, but that there also are a number of similarities. They suggested that tools and techniques for one industry may work in another.

Tools and Techniques of KM

Besides the PM tools to codify, abstract, and diffuse the information of a project, there are a number of KM tools. Tiwana (2002, p. 50) identified (a) knowledge acquisition, (b) knowledge sharing, and (c) knowledge utilization as the fundamental processes of KM. There are tools that are used for the different processes. Knowledge acquisition uses data-capturing tools such as note-capturing, databases, and scanners. Knowledge-sharing tools are discussion boards, frequently asked questions databases, and expert systems that disseminate information. Knowledge utilization involves tools that integrate learning throughout the organization. Buzan and Griffiths (2010) discussed the use of mind maps as a KM tool to provide clarity and share knowledge about projects. Wang and Jacobson (2011) discussed KM use of software tools such as mind maps, concept maps, conceptual diagrams, and visual metaphors to organize and communicate information. Dutt (2014) suggested techniques for using mind maps for creativity in the

knowledge areas of the *PMBOK*®. Dalkir (2011) referred to concept maps as a tool in the codification process for data sharing. Concept maps are a tool for the taxonomic approach to knowledge codification. Information is organized by taxonomy for use in the organization. Concept maps along with decision trees and automated taxonomy generators are tools for developing taxonomy of the knowledge in the organization (Dalkir, 2011, p. 128). These tools are valuable for sharing knowledge between participants in the IT project. A wiki is used by some organizations to share the knowledge learned in the lessons-learned process of a project (Frey, Lindner, Müller, & Wald, 2009, p. 4).

Two techniques that are used by organizations for knowledge sharing are knowledge mapping and social network analysis. A knowledge map identifies where knowledge is located in an organization, and social network analysis is the tool that is used to understand where knowledge transfer is occurring. Knowledge mapping develops diagrams of where knowledge is located in the organization, while social network analysis develops diagrams of where individuals obtain knowledge.

Krishnaveni and Raja (2011) discussed a number of KM tools such as search engines, knowledge portals, communities of practice, lessons learned, and best practices repositories. Groupware tools—group messaging, event planning, and alerts about new information and who is online—are also KM tools that are used for knowledge sharing (Evans, Gao, Martin, & Simmonds, 2015). Krishnaveni and Raja studied these tools to understand their use in (a) knowledge acquisition, (b) knowledge storing, (c) knowledge

creation, and (d) knowledge sharing in the IT area of an organization. Their analysis found that the KM tools aid the IT area and are a success factor for the organization.

PKM Model

Although a study by Reich (2007) suggested that project managers do not have a common understanding of KM in PM, the research of Frey et al. (2009) on project-based organizations and techniques used to manage knowledge between projects indicated the link between project success and managing project knowledge. Gasik (2011) observed the positive connections between KM and PM and developed a model for PKM. It used knowledge transfers (a) between individuals, (b) between individuals and external structures, (c) between individuals and internal structures, (d) between internal and external structures, and (e) within the internal structure as discussed by Sveiby (2001). This model focuses on KM, including knowledge sharing, knowledge acquisition, knowledge creation, and knowledge application during a project at the individual level, project level, organizational level, and global level. At the individual level, acquiring knowledge to perform the needed task is the first KM process. After the knowledge is acquired, it must be applied and then shared with others, including the project manager (Gasik, 2011, p. 27). At the project level, knowledge acquisition may occur from outside of the project team and may be transferred to the project team members. This type of knowledge will comprise business and organizational issues. There also may be knowledge sharing at the project level on the technology issues that will affect the way the technology is applied to the project. At the organizational level, knowledge acquisition may occur when a different organization is involved in the project and

knowledge is needed from the other organization (Gasik, 2011, p. 30). At the global level, knowledge sharing is performed to permit other organizations outside of the firm to create global knowledge (Gasik, 2011, p. 30). By studying the different types of knowledge processing, a determination can be made about the amount and structure of KM in the project.

Project Management Knowledge Flows

Gasik's (2011) model used Sveiby's (2001) five types of knowledge transfer: (a) between individuals, (b) between individuals and external structures, (c) between individuals and internal structures, (d) between internal and external structures, and (e) within the internal structure. These types of knowledge transfer are combined with the flow of work in a project. The workflow for a project is not restricted to one area, and the knowledge of a project is also not restricted to one area. The flow of work and knowledge must be managed for the success of the project.

Another perspective on the knowledge in a project was suggested by Grant (1996) when he presented the concept that the firm is an institution for integrating knowledge. He viewed knowledge as a resource that needs to be managed by the firm. Specialists in the firm have knowledge, and the organization's role is to find ways to use that knowledge for a competitive advantage. Iuga and Kifor (2014) suggested that the use of knowledge as a resource is the difference between KM and information management. While information management is concerned with information retrieval and dissemination, KM involves knowledge as a resource for business benefit.

PMBOK® Knowledge Areas in IT Projects

Using Grant's (1996) concept of knowledge as a resource, the *PMBOK*® identified 10 knowledge areas for IT projects (PMI, 2013). The last area is stakeholder management. Stakeholder management was added in the fifth edition of the *PMBOK*® to emphasize the importance of sharing knowledge with stakeholders. Stakeholder management used to be part of the communication management knowledge area, but there is a need to increase the importance of KM with the stakeholders (PMI, 2013, p. 470). In this framework, the different knowledge areas are used in the IT life cycle that consists of the following processes: (a) initiating, (b) planning, (c) executing, (d) monitoring, and (e) closing. The 10 knowledge areas provide resources for the input and output of the processes along with the tools needed (PMI, 2013). The knowledge areas do not include Tiwana's (2002) fundamental processes of knowledge sharing, knowledge acquisition, and knowledge utilization. Reich, Gemino, and Sauer (2012) suggested that the KM creates the knowledge areas, and some of this knowledge is tacit and some is explicit for the project (p. 666).

Knowledge Perspective Model in IT Projects

Reich et al. (2008) presented the knowledge perspective model as another model of KM in IT projects that used Grant's (1996) concept of knowledge as a resource. Instead of focusing on knowledge sharing, knowledge creation, and knowledge acquisition as in the PKM model, the knowledge perspective model focused on knowledge as a resource and how that resource changed during the project life cycle (Reich et al., 2008). The model identified (a) process knowledge, (b) domain knowledge,

(c) institutional knowledge, and (d) cultural knowledge. Process knowledge was about the process of creating a project and the tasks and time frames. Domain knowledge was about the process of completing the tasks of the project, which would include writing programs and creating Web pages. Institutional knowledge focused on the institution with knowledge of the organization's hierarchy and values. Cultural knowledge was about the different cultural factors that may be part of the project when people from different backgrounds or external organizations were involved (Reich et al., 2008, p. S5). The culture was also the ability for individuals to share knowledge within the organization. The model identified the knowledge resources that were present when the project was started. With changes to the project as individuals were added to it and removed from it, the knowledge resources change. At the end of the project, the different knowledge resources were identified (Reich et al., 2008, p. S11).

Reich (2007) discussed five broad principles of KM for IT PM. The first principle was to establish a learning climate that encourages knowledge sharing and the exchange of information. The second principle was to establish and maintain the knowledge level for the project based upon the skills and experience that are needed for the project to be successful. The third principle was to create channels of knowledge flow that encourage knowledge sharing. The fourth principle was to create a team memory by sharing stories and experiences of the project. The last principle was to manage the knowledge-based risks of the project by using a methodology. The knowledge-based risks were (a) lessons from previous projects not being learned, (b) a flawed team selection process, (c) changes in the stakeholders that govern the project, (d) the lack of role knowledge by project

sponsors, (e) inadequate knowledge integration, (f) incomplete knowledge transfer, (g) the exit of project team members, (h) the lack of a knowledge map to help team members connect with experts, (i) the loss of knowledge between phases of the project, and (j) the failure to learn (Reich, 2007). These five principles were included in Tiwana's (2002) three fundamental processes of KM and Dalkir's (2011) KM cycle. Learning was part of Tiwana's (2002) process of knowledge utilization, and selection of team members was part of knowledge acquisition. The focus of the current research was on knowledge sharing, and the research will not focus on all five principles and risks. The processes of knowledge sharing and knowledge flow are critical for ensuring knowledge transfer to the organization, but those processes do not manage the assimilation of the knowledge.

Reich et al. (2012) identified (a) the knowledge stock, (b) the enabling environment, and (c) knowledge practices for the development of knowledge in a project. The knowledge stock involved the knowledge that was needed for the success of the project. The enabling environment was for the culture and the processes to share knowledge. This included both tacit and explicit processes. The last area of knowledge that needed to be managed in a project was the knowledge practices that are the activities that generate the knowledge. Using these three knowledge activities as part of KM helped organize the knowledge perspective model for implementation.

Knowledge Sharing

The knowledge-sharing process occurs as either a codification strategy using data repositories or as a process that is a mix of repositories and face-to-face meetings for knowledge sharing with blogs, wikis, and Web 2.0 technologies (Paroutis & Saleh,

2009). Kitimbo and Dalkir's (2013) study of an organization identified project team members engaged in group KM activities such as brainstorming, job shadowing, and sharing stories and anecdotes to share tacit knowledge. Written contributions and organizational communication were used to share explicit knowledge. The knowledge shared involved procedures and guidelines recorded in documents, databases, and shared e-mails. Šárka (2014) examined face-to-face knowledge-sharing using tools such as video conferencing, telephone, and e-mail. This study concluded that face-to-face knowledge sharing by either formal meeting or informal meeting in the hall was the most efficient technique. Šárka also recognized the fact that most knowledge sharing cannot always take place in this manner and that other techniques are needed. The nonverbal elements seen in face-to-face meetings make that type of knowledge sharing the most efficient.

The importance of language was suggested by Berger and Luckman (1966) because language creates a world for the individual. Language and trust were issues for knowledge sharing for organizations that develop extensive knowledge maps to determine the best sources of knowledge. Although the knowledge map may indicate the source of high-quality information for a project, that source may not be used because of trust and language (von Krogh & Roos, 1995). Shared experiences of the individuals in a group provided a basis for a common language that was understood (Berger & Luckman, 1967, p. 68). Trust in knowledge sharing was the focus of a study by Whisnant, and Khasawneh (2014). They studied trust as an aspect of leadership and tacit knowledge sharing and found that as the leader demonstrated more dedication to service for the subordinate the sharing of tacit knowledge increased. The level of trust between the

leader and subordinate increased with the increase in dedication and this leads to an increase of tacit knowledge sharing. Trust is also a major component of social capital as discovered by Akhavan and Mahdi Hosseini (2015). Social capital focuses on social relations between individuals and knowledge networks. The research found trust to be the biggest determinant of knowledge sharing with (a) social network ties, (b) reciprocity, and (c) shared vision being behind trust.

Besides language and trust, Davenport and Prusak (1998) also suggested that the need for the right culture and having a common ground were important considerations for knowledge sharing. In a study in India with small manufacturing organizations, Uma Mageswari, Sivasubramanian, and Srikantha Dath (2015) found that culture has an impact on knowledge sharing and knowledge acquisition. The culture of the project team, the organization's management, and the other stakeholders in the project influenced knowledge sharing in the project. Zhang and Wang's (2013) found that process-oriented culture was more effective for knowledge sharing than results-oriented culture. Reciprocity for sharing knowledge is stronger in a process-oriented culture.

Cromity and de Stricker (2011) proposed that individual attitude and culture are the major factors for knowledge sharing. They suggested that generational, technical, and behavioral barriers are the reasons for blocked knowledge sharing. The organization needs to overcome these barriers for knowledge sharing in the organization. Schmitz, Rebelo, Gracia, and Tomás (2014) also studied culture for knowledge sharing. They examined culture as a factor that determines not just what knowledge should be shared, but also what knowledge should not be for the organization's competitive advantage.

Taylor (2013) suggested that to maintain a culture for organizational sharing, KM teams are needed in an organization. He developed a model for KM teams based upon the KM strategy for the organization. A shared management perspective is part of the model to encourage knowledge sharing in the organization.

Zarzu and Scarlat (2015) discussed KM in a multicultural organization. The analysis suggested that the leadership of the people involved in the project will impact the success of the project. Cultural diversity may be an advantage or an issue for the project. This will be different for each organization, and the procedures used in projects will be different.

Language, trust, and sharing knowledge have a significant effect on a project, and the PM process may not always proceed as indicated by theory. Sewchurran et al. (2010) discussed the difference between PM theory and practice. One area of concern for language, trust, and knowledge sharing is project involvement in different regions of a country or different countries of the world. Common work practices, communications, trust, and tools are not always the same (Schwalbe, 2010, p .65). Sewchurran et al. suggested that the theory should vary based upon the region where the project is being implemented.

Knowledge Sharing Techniques

To share knowledge in the PKM model, there were the KM software tools, such as mind maps, concept maps, wikis, discussion boards, and data repositories, to organize and communicate information. Individuals were an important part of the knowledge sharing process (Cross et al. 2004). As Berger and Luckman (1966) suggested,

knowledge is constructed by the social interactions of the individual. Two techniques that organizations use to understand the individual social interactions and the knowledge sharing process are knowledge mapping and social network analysis.

A knowledge map is the visual display of captured information and relationships for bridging the information gaps within the organization. Knowledge mapping is used to find knowledge experts based on the quality level of the knowledge and how the knowledge is to be applied. Eppler (2008) suggested that there may be different knowledge maps for different purposes in the organization. Because knowledge maps are used to locate experts, the process is referred to as an expertise location system or "yellow pages" by Yarosh, Matthews, and Zhou (2012). Eppler suggested that there may be different knowledge maps for different purposes in the organization. There would be a knowledge map for (a) knowledge creation, (b) knowledge audit, (c) knowledge identification, (d) knowledge sharing, (e) knowledge development, (f) application of knowledge, and (g) marketing of knowledge. In the process of creating a knowledge map for an organization, information about people in the organization is gathered to be used by other members to find expertise. Pietrzak, Jalosinski, Paliszkiewicz, and Brzozowski (2015) extended the concept of knowledge mapping to consider strategic group mapping of knowledge. Their research suggested that the ideas of a knowledge map can be used from a strategic perspective of the firm to identify competitive advantages that each organization has in a given industry. Yarosh et al. (2012) found that the more information about each member of the organization that is gathered, the greater is the speed in the selection of an expert when needed. They indicated that data about (a) time at current

position, (b) availability for meeting, (c) approachability, and (d) quality of answers were the most useful for selecting experts (Yarosh et al. 2012).

Social network analysis is an established graph theory approach to studying the relationships between people or groups of people. The focus is on the relationship between the people in the analysis, not just identifying the people transferring knowledge (Weng, 2014). Social network analysis is needed to understand where knowledge transfer is occurring, as well as the quality of the knowledge, by developing a network diagram identifying the people in the organization and the process of sharing knowledge. One of the measures of social network analysis is the number of connections for an individual and how frequently the individual has interactions with others (Weng, 2014). An organizational chart identifies the hierarchy of the people of the organization and the formal relationships, while a social network identifies the informal relationships between people (Dalkir, 2011, p .150). Sometimes, in the analysis of where knowledge was being transferred from, it can be discovered that one individual was the knowledge source for many people. That individual can be a bottleneck and slow down the knowledge transfer process (Cross et al., 2004).

Wang, Meister, and Gray (2013) studied the role of social influence on the use of KM systems in an organization. Previous research had indicated that management support is a major influence for the use of KM. They did not agree with that research and indicated that prior use is the major factor for the use of KM systems. Their focus was on different social influence factors and on the different many levels of employees. The authors showed that management should focus on encouraging the junior employees in

the use of KM systems. The junior employees seem to be a social influence on other employees.

Wang et al. (2013) found the importance of the individual in knowledge sharing. Yan and Davison (2013) also focused on the individual in their research on knowledge seeking in China found a connection between individuals who are seeking knowledge on a subject and the desire of those same individuals to contribute knowledge. Their suggestion from the research was the development of communities of practice for those individuals. Communities of practice provide a technique for employees to seek and contribute knowledge. The individual's personality characteristics were studied by Chu, KrishnaKumar, and Khosla (2014) to determine the relationship between different types of knowledge sharing. They found that individuals who are open to experience work well with innovation, and the personality trait of agreeableness increases core competency of the organization. The study also found that the personality trait of conscientiousness enhances work efficiency in knowledge sharing.

Knowledge sharing starts with the individual that share with a group. Xiang, Lu, and Gupta (2013) examined groups and knowledge sharing. They found that having a shared mental model for a group has a relationship with increased knowledge sharing. A shared mental model refers to group members having common expectations and understanding of the working processes, targets, and roles of other members. This study of IT development teams suggested that teams need to have a common view of tasks to increase knowledge sharing.

Tools are used to facilitate knowledge sharing in groups by individuals. Davison, Ou, and Martinsons (2013) studied IT tools for informal knowledge sharing such as blogs, online forums, and wikis at two public relations firms in China. Their research found that the frequent use of these informal knowledge sharing tools is connected to the culture of the firms. The research was performed in China, and the researchers were concerned that this may be unique to China.

Knowledge Sharing in IT Projects

The sharing of knowledge resolves differences in perspective, as discussed by Adolph and Kruchten (2011). In this study of differences in IT software development, it was discovered that the project group members must reach out and negotiate for consensus for the success of the software project. Not reaching out and negotiating creates a bunkering condition, with project group members avoiding others and not resolving perspective differences. Bunkering is an obstacle to the success of the project. The language used and the trust between the two individuals involved is a larger challenge for an individual external to the technical project team; the language used by the IT team may not be familiar, and misunderstandings may occur. For some projects, the technology development team is hired from outside of the organization. The language of this external group can be an issue for the stakeholders of the organization that is developing the IT project.

The impact of social interdependency on knowledge sharing in IT projects was the focus of a qualitative study by Pee, Kankanhalli, and Kim (2010). They examined whether goal, task, and reward interdependencies have an effect on knowledge sharing,

and it found that these social interdependencies do have a positive effect on knowledge sharing. The social interdependencies have a larger impact on knowledge sharing than does project complexity, project team size, or prior collaboration experience.

Individuals involved in the project to share knowledge need social interdependencies for knowledge sharing, but there are certain types of relationships that seem to be more effective. Cross et al. (2004) studied the criteria for effective relationships for sharing knowledge. They found that (a) knowing what another person knows and when to turn to him or her, (b) being able to gain timely information, (c) a willingness of the person engaged with to problem solve instead of just to provide information, and (d) the degree of safety in the relationship were the main criteria used to determine whom to turn to for acquiring information. The study went on to investigate what occurs if one important source of knowledge is removed from the project. This social network analysis indicated the significant impact that the one resource leaving would have on the project.

Incentives for knowledge sharing were the major criteria of the study performed by Ajmal, Helo, and Kekäle (2010). Their research examined critical factors for KM in a project. Having incentives was the most important factor for the success of KM. Incentives were more important than a coordinated approach, an appropriate process, or even the cultural support of the organization. As discussed in Chapter 1, programmers in the IT field are compensated based on their unique skills, but knowledge sharing in IT projects suggests that they transfer these skills to others, thereby potentially reducing their compensation. Offering a reward incentive for knowledge sharing that is critical for

the project success is a good policy to encourage programmers to exchange knowledge (Dalkir, 2005, p. 210). The lack of incentives was a major barrier for the research of Paroutis and Saleh (2009) on the use of wikis, blogs, and discussion boards. The author's research indicated that employees were seeking the rewards for using these tools and not using them without an incentive. The research of Frey et al. (2009) indicated not only those cultural factors are important, but also that reward incentives are not significant in the success of KM in a project. The concept of providing an incentive also was part of the research by Minbaeva et al. (2012). They also concluded that incentives were not an effective practice for knowledge transfer. Their research indicated that the relationship between the provider and the receiver was important for knowledge transfer. Procedures were needed to encourage the relationship between the provider and receiver by organization policies and practices. Their research also indicated that embedded knowledge that was part of the organization was more effective than offering rewards for knowledge transfer.

Instead of economic incentives for knowledge sharing, Ozer and Vogel (2015) studied formal and informal procedures for knowledge sharing for IT software developers. Their study showed that knowledge sharing can improve the performance of the receiver of the knowledge sharing, but one key to the process was the relationship between the developer and the supervisor. When there was a good relationship between the supervisor and the software developer, the knowledge sharing process was more successful. The relationship with the supervisor is not only important in the IT area of an organization, but in Kim's (2014) study of the human resources department, it was found

that a positive relationship with the supervisor had a positive impact on knowledge sharing. Trust was also an important part of the relationship with the supervisor. Their research also found that (a) compensation, (b) selection, (c) performance appraisal, and (d) training have an impact on knowledge sharing by the members of the organization.

Huang and Huang (2012) examined the involvement of IT members with users to improve knowledge sharing. They found that more involvement by systems analysts in the IT area increased the knowledge sharing of the user. Their research also found that an innovative culture increases knowledge sharing. This increase in knowledge sharing is not related to the involvement of the systems analyst. The research of Brown et al. (2013) not only examined when more knowledge sharing was needed, but the type of knowledge sharing that was required. They found that more complex tasks that were teachable usually used a face-to-face type of knowledge sharing. Their study also found that people that had been on the job for a longer period used face-to-face knowledge sharing more than the codified information in a database.

Research on knowledge sharing has shown the need for a shared mental model (Chu et al., 2014) and openness (Suorsa & Huotari, 2014), but Rosenkranz, Vranešić, and Holten (2014) viewed knowledge sharing between two groups that have different knowledge areas. For IT projects, the first process is the requirements process that involves the business user of the system sharing with the IT developers the requirements of the project. The two groups have different knowledge areas and can have challenges in sharing this information. While Rosenkran et al. (2014) proposed a boundary interaction framework, Zhao and Anand (2013) would suggest the collective knowledge bridge to

broker the issues between the knowledge areas of the two groups. Both of these techniques allow team members to describe, explain, and predict when and how project participants need to modify the knowledge sharing process.

Knowledge Sharing with Lessons Learned

One area of knowledge that is used to share knowledge from one project to the next is the lessons-learned process. At the closing of a project, whether it has been successful or not, the lessons-learned report from the project is created and contains knowledge for other projects. The process is that the lessons-learned knowledge is to be used by other projects, and their members acquire knowledge to avoid mistakes and problems. This process was not always successful because the team members involved in the project do not understand what has been learned. They only know their part in the project. Fuller, Dainty, and Thorpe (2011) have suggested a project learning cycle that encourages knowledge sharing by the project team members for a series of meetings during the project using a reflective action learning process. This process helps the project team understand the lessons that have been learned during the project. By understanding these lessons, the team members were able to use them in future projects. In a study by Reich (2007), cultural issues seemed to be a problem for the lessons-learned process. One project manager in the study commented that most project environments were not safe for a team member to say what went wrong on the project and that most organizations did not seem to be interested.

Knowledge Sharing with the PM Office

An organizing technique that firms are using to increase knowledge sharing between project managers is the creation of a PM office for all of the project managers of the organization. With all of the project managers in one office, they should share knowledge about managing projects with each other. The intent is to increase the institutional knowledge shared in projects in the organization. Institutional knowledge is one of the types of knowledge that Reich (2007) identified. The other three are domain, cultural, and process. Sharing the domain knowledge used in one IT project with other projects was discouraged. The organizational culture must encourage knowledge sharing, but that did not occur by placing all of the project managers in one office.

Müller, Glückler, Aubry, and Shao (2013) studied the PM office for organizations in the pharmaceutical industry. The results of this analysis indicated that although the PM office was important for knowledge exchange within an organization, knowledge exchange was dependent upon prior collaboration experiences. The social network analysis indicated that knowledge was commonly exchanged between project managers that were familiar with each other from previous work experiences. Project managers were not always involved in collaboration if they did not have an experience together.

Review of the PKM Literature

Historical Literature

Some studies have been performed on the use of KM in the development of an IT project. Becerra-Fernandez and Sabherwal (2001) studied the knowledge processes of socialization, internalization, combination, and externalization at NASA's Kennedy

Space Center, based upon the main tasks that were performed in an area of the organization. Tasks were divided into process tasks and content or objective tasks. The study also involved interviews and a questionnaire. It suggested that managing the knowledge process of an area is related to task orientation. For departments that are process focused, the area should use internalization and socialization for managing knowledge. For areas that are objective focused, they should use externalization and combination.

The research of Frey et al. (2009) on PKM included qualitative research and a quantitative approach. The qualitative research comprised 26 interviews conducted with individuals involved in either KM or PM. The quantitative research included an analysis of 496 questionnaires of project managers, leaders, and workers. This research indicated that organizations are aware of the benefits of PKM, but there are different ways to implement it in organizations. One of the most popular methods for knowledge sharing is the lessons-learned process that occurs at the end of a project. This process is not always successful, with the information from lessons learned not being dispersed throughout the organization. The research emphasized the organization culture for knowledge sharing. The success of PKM was identified in the use of project knowledge as determined by PKM efficiency, PKM usefulness, and the three cultural factors of (a) culture of freedom, (b) creativity, and (c) mistake tolerance in projects. PKM success also is determined by commitment and emphasis of top management, as well as informal networks.

Polyaninova (2010) performed a quantitative dissertation study on PKM in an Irish financial organization. The survey was completed by 24 people in the operations

and technology area of the financial organization. The survey focused on the tools and techniques being used for KM in a project. Although the survey provided valuable information on what tools were being used, it did not indicate whether the tools were being used properly and effectively. The survey also included some questions about some of the issues in managing knowledge in a project, but the results did not make it easy to determine a corrective course of action.

Current Literature

Karlsen, Hagman, and Pedersen's (2011) case study of an IT service provider discussed the difference in the object approach based upon the progression from data to information to knowledge for an information system. The study also included the people approach needed for knowledge sharing. The object approach included a lot of documentation for the tools and techniques in the project. The people approach relied on tacit knowledge exchange between people with less documentation. The difference discussed in the two approaches is similar to the differences between cognitivism and the autopoietic epistemology. The cognitivist approach would be the rational perspective of data to information to knowledge, and the autopoietic approach would be the personal perspective of the people involved in the sharing of knowledge.

Piorkowski, Gao, Evans, and Martin (2013) discussed the implementation of a dynamic KM system in the manufacturing environment, outside of the usual KM systems within an organization. The dynamic KM system involves interfacing with both machines and humans for the exchange of knowledge. The framework of the system includes motivation, people, interface, content, and infrastructure. These components are

connected in the manufacturing organization to dynamically manage knowledge and promote organizational learning. A customer KM provides an organization a way to find out about customers, share knowledge with them, and receive feedback from them. This KM system for electronic commerce was studied by Aghamirian, Dorri, and Aghamirian (2015). Their study developed a model for customer KM system. The customer KM system provides a way for customers to have input to the decisions of the organization. Mehta and Bharadwaj's (2015) research on knowledge integration from external sources examined the importance of a software project team's awareness of knowledge sharing with consulting firms and people outside of the organization. The analysis indicated that not enough attention was paid to this factor of a software project. Project team members were not obtaining enough knowledge from outside the organization or providing too much information to external organizations.

KM research in IT projects such as Stirbu's (2014) study showed that organizations are using IT for the development of KM systems. KM systems are accessing external knowledge and technical knowledge collection. Stirbu also found that organizations are using KM for quality assurance of their products. Lai and Tsen (2013) discussed the systems development life cycle for PM and knowledge accumulation in the IT industry in Taiwan. Their study found that knowledge accumulation by accumulating knowledge from both internal and external knowledge sources is helpful for the systems development life cycle. By the project team members accumulating knowledge, that knowledge can integrate with the systems development life cycle for the benefit of the project.

Remus's (2012) case study of KM in enterprise resource planning examined a particular type of IT software system that used the systems development life cycle for development. KM was analyzed by dividing it into the processes of knowledge acquisition and knowledge integration. The case study looked at the impact of KM process by external changes such as a competitor being purchased. Remus's findings indicated that the external changes impact major changes to the KM processes of an organization. Görög's (2011) qualitative study on transferring the knowledge from a single project to a group of projects examined the significance of the interrelationships between the projects. The scope and resources for the systems development process of the interrelated projects were studied. The research concluded that having an understanding of the connection about the scope of one project can determine decisions concerning scope and strategic decisions of other projects.

Critical success factors were the subject of research by Popovski and Nikoli (2015) and Akhavan and Zahedi (2014). The findings of Popovski and Nikoli were similar to those of Ozer and Vogel (2015), which indicated that managers are a critical factor in the success of KM. The managers need to help employees see the importance of gaining knowledge. The study also found that culture has a significant impact on KM. Having a culture that encourages the accumulation of knowledge and the willingness to share that knowledge is critical for KM. Akhavan and Zahedi focused on KM in project-based organizations. This study indicated the need for organizations to create knowledge structures based on the knowledge structure of the organization. The knowledge structure will be used to encourage knowledge accumulation and to share it with members of the

organization. Alrawi, Hamdan, Al-Taie, and Ibrahim (2013) studied knowledge sharing as a critical component for organizational knowledge dynamics. Their study indicated that employees had not shared knowledge at the needed level. Cromity and de Stricker (2011) found that the individual's attitude can hinder knowledge sharing, but Alrawi et al. (2015) found that management's attitude can have a negative impact on knowledge sharing. They also found that the firm's culture and the firm's vision can cause problems for knowledge sharing. A system was needed in the organization with management's support to transfer knowledge throughout the organization.

Research on knowledge sharing for innovation in an organization was the focus of studies by Shu, Page, Gao, and Jiang (2012), and Phipps and Prieto (2012). Shu et al. (2012) examined knowledge exchange and knowledge combination for product and process innovation. They surveyed 270 firms and determined that knowledge exchange and knowledge combining were necessary for innovation, with product innovation needing more than process innovation. Phipps and Prieto (2012) studied KM and innovation to determine if KM could improve the entrepreneurial mindset in the organization. Chien, Tsai-Fang, and Chin-Cheh (2013) suggested that innovation in an organization is enhanced by knowledge sharing. The study examined financial organizations, and found that organizations need to encourage knowledge sharing for innovation. Although not all IT projects have an objective for innovation, innovation can improve the IT PM process.

Some research on KM in IT projects has occurred in Europe and Asia. Durst and Wilhelm (2011) examined KM in a medium-sized German organization to determine the

awareness of managers of knowledge loss that may occur. They discovered that the managers were not concerned about the potential loss of knowledge when people would leave the firm. The organization had a priority taking care of the current business without regard for managing the knowledge and making it available for future activities. KM in Romanian organizations was researched by Pugnaa and Boldeanu (2014) and Stirbu (2014). Their analyses showed that KM for most organizations in Romania used explicit knowledge. .Managing the tacit knowledge in the organization was not as clearly defined. The studied also indicated the differences between KM in Romania and other countries. Not only is there a difference in KM between countries, but also between different organizations within the country.

Reich et al.'s (2008) knowledge perspective discussed the cultural differences between different organizations for KM. Andreeva and Ikhilchik (2011) considered the cultural difference between two countries, Japan and Russia, and examined the implementation of Nonaka and Takeuchi's (1995) SECI model. They identified some challenges for the model, including the fact that the culture in Russia does not encourage managers to share information, and the knowledge sharing occurs within groups. It does not cross group boundaries. A multinational organization working in Japan and Russia would have differences using the SECI model for KM. Kivrak, Arslan, Tuncan, and Birgonul (2014) studied the cultural differences between not only Japan and Russia, but a number of different nations. They used a case study methodology to examine cultural differences in construction projects involving multinational firms in Qatar, Libya, and Bulgaria. In a multicultural project team, it was found that language and communication

difficulties, trust, motivation, and personal relationships are the critical barriers to successful knowledge sharing.

In response to the increase in the number of IT projects that cross borders and become global, Hahn, Bredillett, Gyeung-Min, and Taloc (2012) examined these types of projects in Korea and France. They found that project success is based upon system knowledge, PM knowledge, cultural knowledge, and interpersonal knowledge of the project manager. Project managers need to learn how to manage this knowledge for the success of an IT project. KM is being studied in different countries, and there are differences between countries about how KM is used in organizations.

Other current studies in KM include Schmitz, Rebelo, Gracia, and Tomás's (2014) study of firms to determine the impact of KM on an organization. Their results indicated that organizations that develop KM processes improve the organization by encouraging employees to experiment and learn from errors. The organizations communicate openly and are supportive of employees. Shih-Hsiung, and Gwo-Guang, (2013) studied the importance of an ethical climate for KM. Their research found that the organization's rules and procedures were the most important ethical item for KM to be effective. Other important ethical elements were local laws and professional codes of conduct. For KM to help the organization attain organizational goals, there must be an ethical climate present. Rashid, Hassan, and Al-Oqaily (2015) studied the measurement of tacit knowledge. Tacit knowledge is an important part of the organization's performance. A model for measuring the tacit knowledge of the employees was created from the results of the study. This analysis called for the development of a model for

measuring tacit knowledge, possibly using employee variables such as (a) qualifications, (b) experience, (c) activities and (d) supervisor's observations.

Wu and Passerini (2011) studied project members of an IT team and their time management strategies for the project. They looked at how long the project took for an outcome and how that matched with the project team members. The analysis combined time management with PM and KM. In this analysis they divided team members into the four groups of (a) relator, (b) visioner, (c) crammer, and (d) organizer. Of the four groups, relators and visioners were not aware of time and deadlines, while crammers and organizers were very aware of time and paid attention to deadlines. By understanding the time strategies of the team members, a project manager can assign projects to the appropriate team members

Literature on the Research Method

When the focus of the research is on the how and why of contemporary events, with the researcher having little control over them, a qualitative case study strategy is appropriate. This research helps explain how and why an event is occurring (Yin, 2013a, p. 10). Simons (2015) suggested that studying a particular case in depth provides universal significance that can be used by others. In this study, I investigated the PKM model used in a financial insurance organization. The research studied how this model was used in PM for IT projects.

Algeo (2014) and Remus (2012) used case study methodologies in their research on PM in the IT area of organizations. Remus's (2012) research involved the enterprise resource planning process for an organization. Enterprise resource planning involves

information systems for the organization. Algeo (2014) studied project managers in Austria by interview and then observation of their actions in the PM process. The methodology of an interview and observation provide an opportunity to explore the differences between the data gathering processes and to understand how the subject performed the PM role. The case study methodology used for this research is similar to my research in IT.

The case study methodology was also used in KM research by Lopez and Esteves (2013) on the use of external knowledge in an organization. Their study in a banking organization in Spain found that external knowledge was used more frequently for new kinds of projects than previously performed projects. Muhammad, Rizwan, Sijun, and Libiao (2013) and Hallwood (2014) used a case study methodology for studying how IT firms used KM. Both studies examined knowledge sharing and culture in the firms involving the success of the project. Goepp, Caillaud, and Rose (2013) used a case study methodology in KM research on designing buildings for the environment using communities of practice. Their research with organizations in North America found that KM is a critical factor in designing for the environment.

Gap in the Literature

Winter et al.'s (2006) report on future research for PM requested the development of different models to understand the complex problems in PM and improve the number of IT projects. In response to this, Gasik's (2011) PKM model was developed to focus on the flows of knowledge in an IT project. The *PMBOK*® Knowledge Areas (PMI, 2013) and the knowledge perspective model of Reich et al. (2008) were created to focus on the

areas of knowledge and the different types of knowledge in an IT project. Knowledge sharing is how different types of knowledge flow in the project. The current research will evaluate how successful these different models for IT projects are in an insurance organization.

Hanisch and Wald (2011) suggested that IT projects are different due to the design of the project team, the complexity of the project, and the goal. Each project has differences about how the team is organized and its ability to develop the IT project. PM does not have a standard recommended process for each IT project. There is a need to study the PM process at this organization.

Previous research on PKM such as that of Becerra-Fernandez and Sabherwal (2001) study on KM as a task oriented approach at NASA needs to be explored in different organizations. They suggested that research is needed in a more knowledge-intensive organization than the engineering-oriented focus at NASA. With a different organization and project managers, the results may change. The gap in the literature as suggested by Fuller et al. (2011, p. 133) that needs to be researched is how PKM is implemented in different industries and organizations. There are a number of current studies of KM in IT in different countries, but there is a need to study KM in IT in the United States. By studying an insurance organization in Baltimore, Maryland, a better understanding of how PKM models are used in the development of successful IT projects .For a successful IT project, does the organization focus on the flow of knowledge or the knowledge areas? Does the PM office style of organization work better for the PKM

model in an insurance organization? Gasik (2011, p. 40) suggested that there is a need for a consistent model of PKM for all projects in an organization.

Polyaninova's (2010) research was performed in the financial industry without examining a framework for PKM. That study also suggested that more research is needed that examines frameworks of PKM for different projects. Frey et al. (2009) suggested the purpose of studying different industries may not be to find a framework that is usable by all organizations, but to determine the factors that call for different models for PKM. They examined the frameworks that included the KM tools and organizational structure for successful IT projects in an insurance organization.

Li-Su and Cheng-Po (2014) studied the critical success factors of KM implementation in life insurance organizations in Taiwan. This analysis indicated the importance of the individuals, the culture, and the IT in the implementation of KM systems. The organizational characteristics also have an impact on KM. This study showed how KM is different for each organization.

Morris (2013a, p. 239) suggested that there is not a unique theory of PM, and the use of the knowledge needed for a project differs for every organization. The current literature provided some different models for KM including customer KM and quality KM. The critical success factors also varied depending on the organization and where the system was developed. The gap in the literature was the use of different models of KM in PM in an insurance organization. There were some different research projects in different industries and organizations, but not an insurance organization. An insurance organization has business requirements and government regulations that are different

from previously studied engineering and financial organizations. This research study examined KM in IT projects and the use of different PKM models in an insurance organization in Baltimore, Maryland.

Summary and Conclusions

Knowledge in an IT project needs to be managed for the project to be successful. Managing the knowledge of an IT project involves acquiring, sharing, and transferring between (a) the project team, (b) the project manager, (c) the users of the project, (d) other project managers, (e) management of the organization, and (f) individuals interested in the project that are outside of the organization. Gasik (2011) has developed a PKM model to identify the knowledge acquisition, sharing, and transfer process in an IT project between the different individuals of the project. The *PMBOK*® (PMI, 2013) identified 10 knowledge areas in the PM processes of (a) initiating, (b) planning, (c) executing, (d) monitoring, and (e) closing. Another model of KM was presented by Reich et al. (2008), with knowledge as a resource involving domain, process, cultural, and institutional knowledge in an IT project.

The gap that this research studied was between the different models of KM in an IT project and how the knowledge in an IT project is actually being managed in an organization. With the models there were some different tools such as data repositories, Gantt charts, mind maps, discussion boards, wikis, decision trees, and flow charts. Techniques such as knowledge mapping and social network analysis helped manage it. Managing knowledge in a project involves people sharing it, and there are some issues that may be a problem. Language, trust, and the organizational culture are some of the

potential issues that must be addressed in an IT project. Morris (2013b) suggested that different organizations use KM differently in the PM process. The current research is needed to understand KM at the insurance organization and implementation at other organizations. In Chapter 3, the research method case study of the IT projects in an insurance organization is presented. This research is needed to identify the gap that may exist between the models for PKM and the actual PM process in the IT projects of an insurance organization. The case study research method provides the technique to examine one organization's approach to PKM in IT.

Chapter 3: Research Method

Introduction

The purpose of this qualitative case study was to explore the gap between the uses of PM and KM tools and techniques in IT projects. The purpose of this chapter was to propose the research methodology used to examine KM and PM in IT and to understand how KM is part of PM. To understand how KM is used in PM, there was an analysis of the tools and procedures of the PM process. This study documented and evaluated the use of KM in PM at an insurance company to determine where the tools and techniques of KM can be used to improve performance of IT projects. This research involved (a) technology, (b) the people involved with the technology, and (c) the organization that used the information systems project. According to Hevner, March, Park, and Ram (2004), these three factors are important for information systems research.

Research Design and Rationale

A case study methodology was used to explore the use of KM in the IT PM process. The research questions for the study were as follows:

RQ1: How is KM used in PM for IT projects?

RQ2: How are the tools and techniques for KM used in IT PM to improve the success of an IT project?

RQ3: How is the current PM process managing knowledge for an IT project?

RQ4: How does the PKM model for managing knowledge improve the success of an IT project?

Qualitative Research Design

There are many qualitative methods, such as ethnography, case study, and grounded theory. My qualitative research used a case study methodology because of its ability to connect theory with real life experiences. Gummesson (2014) suggested that the case study methodology focuses on the outcome instead of the details of the research process. Yin (2013a) commented that a case study approach is appropriate when (a) the research questions are either "how" or "why," (b) the research has no control over behavioral events, and (c) the research focuses on current events.

Qualitative Research in Information Systems

Myers (1997) suggested that positivist, interpretive, and critical are the three perspectives for qualitative research, with the positivist perspective being used in case study research. From a positivist perspective, my case study research was based on observing the data and objectively collecting it (Myers, 1997). Case study was the most popular qualitative method for information systems; it is appropriate for information systems because the research is about organizations and not the technical issues (Myers, 1997). Mishra and Mishra (2011) reported that case studies are still one of the most popular methodologies for information systems. This study of 186 research articles in 2011 found that 20% of the research used a case study methodology.

Social constructivism views the truth based on the perspectives of the individuals involved in the community (Patton, 2002, p. 96). The researcher observes the environment without judgment of the ideas of the individuals (Patton, 2002, p. 98). For

my research, I observed knowledge sharing in an IT project community. I studied the tools and the effectiveness of the process for the success of the project.

Information systems research must include business strategy, information systems strategy, organizational infrastructure, and information systems infrastructure (Hevner et al., 2004). Hevner et al. (2004) suggested seven guidelines for information systems research: (a) design an artifact, (b) develop technology solutions that are business oriented, (c) use adequate evaluation methods, (d) verify the artifact and its contribution, (e) use rigorous methods for the construction and evaluation of the artifact, (f) design the process as a search for an artifact that satisfies rules in the problem environment, and (g) present the artifact and findings effectively to management. The artifact developed for this research was a model of KM in the IT systems development process. The model was used in a business environment and was evaluated and verified for use in this context. The case study research method presented a model, but other research methods were considered to improve KM in the PM process.

Other Research Methods Considered

Ethnography involves the researcher observing people's action and interactions within the larger context in which they take place and then talking with people about them. Face-to-face interview studies are also a part of ethnography (Gans, 2010). In institutional ethnography, the social relations connecting people and activities are uncovered where knowledge of one group is favored over another (Bisaillon & Rankin, 2013). Institutional ethnography is a research approach that examines the socially coordinated character and organization of people's lives by the institutions with which

they are associated (Bisaillon & Rankin, 2013, p. 4). This research approach focused on the people and the organization. For my research project, the focus also included the technology and development of an information system.

Grounded theory is qualitative research based upon data that evolve into categories that are compared to develop a theory (Åge, 2011, p. 1600). For grounded theory, the research is not based upon an existing model, but the research is used to discover the new theory based upon the data. Data collection and analysis for grounded theory occur at the same time (Dunne, 2011). For my research, the emphasis was not on a new theory but on using the existing model to understand its use in the systems development process. To accomplish the goals of the research, the case study approach is appropriate.

Role of the Researcher

I was an external observer of the organization and had no involvement with the successful completion of any of the projects being studied. Researcher bias was managed by the verification process for all data by a member checking technique. The organization and the project team members reviewed all data from the research. In the process of accessing data for the study, I interviewed management and project managers who could influence the data received by the team members of the project. The information provided by the users of the project could also influence the data received from the developers of the project.

I had the perspective that the individuals involved in the project created their reality in the environment. How knowledge was shared in the IT project process was

determined by the individuals involved in the project. My role was to observe the process and understand it. I did not try to change the process, but only observe it. The perspective of the research was not based on the view of the project manager, project developers, users, or any specific stakeholders in the project.

Methodology: Qualitative Case Study

The case for the research was five projects in one organization. Semi structured interviews were conducted with project managers, customers, project developers, and senior managers in the organization. The research project included IT projects in one organization with the same organizational structure and culture. It focused on the people involved in the IT project and the management of the knowledge of the project, and it will not include an evaluation of the technology of the software or hardware used for the IT project. This case study was exploratory; using a purposeful sampling process and attempting to understand how IT projects used KM (Yin, 2013a).

Target Population

The target population for this research was the IT area of any insurance organization that used a PM process such as the predictive life cycle or the adaptive life cycle and that had project teams with more than two people. The research studied the addition of KM in the PM process using the PKM model. It also studied the financial insurance industry, but the PM process may be similar for other industries, and the research can be applied. The target population was any stakeholders in the PM process. This included project managers, project team members that develop the project, clients for whom the project is being developed, and the organization management that is

concerned with the costs of the project. The research included interviews with all of these stakeholders.

Sampling

The individuals in the organization being interviewed for the research included project managers, team members, users, and the organization's management. Part of the research was observing the IT project process and reviewing the reports. I studied knowledge sharing and the use of the different KM tools in the PM process. Interviews, observation, and document reviews were part of the validation process of the research. Information was grouped by the type of computer application that was being developed and those project team members who had had training in the use of KM and PM tools. For a case study approach, the study involved five computer application projects, working with different areas of the organization. Although Yin (2013a) suggested that two or three projects may be adequate for a straightforward analysis (p. 65), this research focused on one organization and five projects to provide the data needed for the research. The research involved five projects with each of the projects including project managers, team members, users of the product, and managers. In all, 24 individuals were interviewed for the research. By interviewing 24 individuals, the saturation level of the different ideas about KM in IT PM was attained. This purposeful selection of the sample was to gain representativeness of the use of these tools in PM in the organization and how knowledge flows for projects in this specific organization (Maxwell, 2005). The case study involved analyzing one organization and KM within the PM process. The projects selected for observation and analysis were selected based upon the variety of the number

of individuals involved in the project and how typical the project was for the organization.

The sample selected for the research was a single insurance organization. Within the financial organization, the projects had characteristics such as these:

- The project team involved more than three individuals;
- The project team used a knowledge-based system to share knowledge within the project or across projects;
- The project would benefit from applying knowledge shared by other projects;
- The cost is over $100,000;
- The lifespan is over 3 months.

The research was to understand how the PKM was used to enhance project quality, time, money, staff, and scope of the project. Success for the project was determined by the insurance organization being studied.

Unit of Analysis

For this research, there are three units of analysis. The first was the individuals in the organization and their KM processes. The second unit of analysis was the project team that was developing the project and their KM processes for the successful completion of the project. The third was the project teams of the organization and the KM processes for projects in the organization. The first two units of analysis had a people focus for the research, while the third has a structured focus on the organization (Patton, 2002, p. 231).

Data Collection

The case study focused on one organization with one corporate culture and structure. Within the organization, the research analyzed a variety of different IT projects. The sources of evidence for the case study were (a) documentation, (b) archival records, (c) interviews, (d) direct observation, (e) participant observations, and (f) physical artifacts (Yin, 2013a, p. 106).

The research involved an insurance organization and the individuals that were working on IT projects. Before any of the research for this project started, their agreement was needed. Their agreement was obtained by a letter of cooperation with the organization and a letter of consent for conducting interviews that included confidentiality for all information gained during the research.

Semi structured interviews were used from various levels including project team members, project managers, customers who used the software that was being developed, and senior management of the IT department. There were semi structured interviews involving different IT projects in the insurance firm. They lasted about 1 hour and were tape-recorded and transcribed. The interviewees discussed the use of KM and the tools used in their role on the project. The questions for the interviews related directly to the research questions for the project.

Knowledge sharing within a project and how project team members acquired knowledge was the focus of the research. Knowledge sharing between projects, with the lessons learned from one project being exchanged with other projects, also was studied. Trust and the language used in sharing knowledge were analyzed. Questions about the

amount of knowledge sharing outside of the organization and about how industry standards are included in projects were covered in the research project. Included in this research was not only sharing of knowledge, but also how knowledge was managed to limit knowledge shared with others. The first questions in the semi structured interviews focused on how knowledge was acquired and shared in an IT project. This includes the performance of knowledge sharing at different levels of the project and its effectiveness. The second set of questions pertained to the tools and techniques used for knowledge acquisition and sharing. From the interview questions, the PKM model was analyzed and a determination was made if the appropriate tools were being used with the mode. The interviews also examined if information was being shared across the project by all stakeholders.

Questions were open-ended to give the project managers, users, management, and project team members the opportunity to discuss different ways that knowledge was shared. The open-ended questions provided individuals the opportunity to discuss why knowledge was not shared using some of the tools and techniques. The interviews also covered the use of different software tools with (a) project managers, (b) users, (c) team members, and (d) management and how their awareness of the tools was used in the PM process.

Questions for the interviews were available to the interviewees before the interviews, which lasted approximately sixty minutes. In a case where an interviewee cannot meet for the interview, he or she could have responded to the interview questions in writing. All efforts were made to conduct the interview in person and only in unusual

circumstances were telephone interviews used. The interviewees were anonymous to protect the identity of the participants. All interviews were recorded using a Sony ICD-AX412 Stereo Digital Voice Recorder and transcribed by using TranscribeMe, into the computer software program, Nvivo 10.

The observation of the PM process studied how the KM and PM tools were used in the project development process and how they were used to share knowledge. The observation will study who was using the tools. Were the stakeholders, team members, and project manager using the tools? Information in the project used KM and PM tools for organizing it. How the information was organized was observed. The effectiveness of the process was studied along with what part of the effectiveness of the project process was associated with the PM and KM tools. What information was shared and when was it received determined the effectiveness of KM. By using both observation and interviews for data collection, observations validated what was said in interviews. All interview participants in the research received a copy of the transcript of the interview. They verified the information used for the research.

Besides the semi structured interviews and observations, different reports on costs, time, and status reports for the project will be used to understand the effectiveness of the project. The information generated during the project also was studied to determine whether it is effective. This also includes the process of knowledge flows, which was analyzed.

Data Analysis

Data collected from the semi structured interviews and observation for this research determined when KM and PM tools were part of the project development process and their effectiveness in managing the project. The research included when KM and PM tools were not part of a project and the reasoning about that decision. In the process of collecting data about why the tools were not part of the PM process, I analyzed the techniques used during the project to organize and structure the information of the project and how it was shared with the team members, organizational users, and individuals outside of the organization.

For a case study approach to the use of the KM and PM tools in the PM process, a deductive reasoning process was used. The research was used to study the data from the viewpoint that the use of KM tools and techniques being used to improve the IT PM process by increasing the success of projects. Based on the data from that perspective the importance of KM in the PM process was either be proven or disproved.

Data were analyzed, coded, and categorized using a pre-coding system to connect the data collected with the conceptual framework of the research. The information generated during the project also determined whether it was effective. The information shared and the timing of the information were included in the research. This included the process of knowledge flows. The effectiveness of the KM in the PM process was determined by (a) the success of the project from the perspective of the different stakeholders and (b) what information was shared and when it was shared.

The pre-coding system for the information on the individuals being interviewed consisted of the following: ID:Title, ID:ProjArea, and ID:Loc. The ID: Title was for the classification of manager, team member or client of the project. The ID:ProjArea was for the five different projects that were being studied. The ID:Loc was for the location of the individual being interviewed. The code KS was used for knowledge sharing for the different knowledge flows in the process: KS:Requirements, KS:Development, KS:OthPrjTeam, KS:Helpdesk, and KS:Test. The code EF:KS is used for the effectiveness of knowledge sharing in PM, and EF:KSnon is used when the information is private and is not shared. As Maxwell (2005) pointed out, before coding the researcher must read and listen to the data. In the process of thinking about the data for coding, the pre-coding system may change. It is more important to address the research questions than to adhere to the pre-coding system.

To help in analyzing the data for this research, the software product Nvivo was used to categorize data. Grouping the data detected patterns and themes about the case. The patterns and themes were used to make conclusions about the project and recommendations for improvements.

Issues of Trustworthiness

Although Yin (2013a) suggested that internal validity was part of the data analysis of an exploratory case study (p. 47), the proposed research included an effort to ensure that the information from the research was credible. Triangulation among the documents, observation, and interviews was used to validate the information about the projects that was gained from this research. Yin (2013b) discussed different types of triangulation

including using different methods for triangulation and different theories. He comments that the data source method used in this research will strengthen the validity of the case study. Maxwell (2005) pointed out that triangulation did not always increase credibility. All the sources of data could be biased and not be valid. Triangulation was used to prevent bias of the information collected and provide valid information for the research. By comparing different projects in the organization, the credibility of the research will improve. Another important concern for the credibility of the study was the amount of time in the field (Lincoln & Guba, 1985, p. 302). For this study, I spent three months working with the project team members. This was an adequate amount of time at the insurance company to provide credible data from the research.

Credibility was needed for validating the information within the organization, and transferability was needed to generalize the research and apply it to organizations outside of the one being studied. Transferability has limits in qualitative research. Lincoln and Guba (1985) commented that the researcher does not know the details about the project environment to which the research was being transferred. Not knowing the details about the project makes any claims about transferability or generalization to another project unreliable. To improve the transferability of the research, Lincoln and Guba (1985) recommended that the case study provide a methodological report (p. 360). The methodological report for this research included a complete description of the investigator, methods, and measures used in the research. The research needed to be "thick" (Lincoln & Guba, 1985) or "rich" (Maxwell, 2005) with enough details for use in other organizations.

For the dependability and reliability of the research, Lincoln and Guba (1985) recommended that the case study provide enough information on the process and the information found in the research for an inquiry audit. The audit was available to authenticate all of the findings of the research. As suggested by Yin (2013a) detailed field notes and good-quality tape recordings was used for interviews in the study. To add to the reliability of the study, each step of the research process included data on the process for the research that was performed (Yin, 2013a, p. 49).

The inquiry audit trail included six categories: (a) raw data, (b) data reduction and analysis, (c) data reconstruction and synthesis, (d) process notes, (e) materials relating to intentions and dispositions, and (f) instrument development information. A reflexive journal of the research was created with (a) a daily log, (b) a personal diary, and (c) a methodological log (Lincoln & Guba, 1985, p. 327). Maxwell (2005) suggested the use of respondent validation or member checking to confirm the information used in the research. This type of validation is used to confirm information from the research.

Ethical Procedures

The research involved an insurance organization and individuals that were working on computer projects for the organization. To assure the ethical treatment of the organization and the individuals a (a) letter of cooperation for working with the insurance organization, (b) letter of consent for conducting interviews and (c) letter of confidentiality for all information gained during the research. Copies of these documents were provided to the Walden University Institutional Review Board (IRB) for purposes

of seeking IRB approval for this study. Walden's IRB approval number for the study is 11-11-14-0068072.

A letter of cooperation was needed before any of the research was conducted with the project managers, project team members, the organization management and other stakeholders of the project their agreement is needed. The letter of cooperation for working with the insurance organization included the process for recruitment, data collection, and results dissemination activities that will occur at the site. A consent form for conducting interviews and research included the research procedure and some of the interview questions that were part of the research. Lincoln and Guba (1985) point out that although consent is provided, this does not mean that the interviewee has agreed to being directly quoted in the research. Patton (2002) discussed that during interviews information will be revealed by the interviewee that was not intended. There were ethical limits in the information that is used for the research and those concerns were part of the research. A letter of consent was used to ensure the information gathered from the research will not be disclosed to the public and to not disclose the participant's confidential information that was part of the research. The process to recruit individuals involved in the research was in cooperation with the insurance organization. The insurance organization selected project managers and project team members that were interviewed. The data collected from the research was confidential. The data will be held by me in encrypted files on a password protected computer. The data will be destroyed in 5 years. Information was provided to the insurance organization and other interested groups without revealing the individuals providing the information. There were not any

incentives for interviews for the research. The interviews were voluntary and confidential. The names of the individuals interviewed were eliminated. The population being studied was healthy adults over 18 years of age.

Summary

The research for this project was a case study of IT projects at an insurance organization. How knowledge was managed in the project is the focus of the research, with an analysis of the difference between the PKM models and what was occurring in IT projects. The project included interviews with (a) project managers, (b) project developers, (c) project team members that used the project, (d) project managers of other projects, and (e) IT management. Besides the interviews with individuals involved in IT projects, the research will include documents and observations of the project development process. Based upon the data gathered from the research, a coding system was developed to understand the research and make recommendations about managing knowledge in an IT project. The research included enough data for the project that was validated within the organization and transferred to other IT projects in similar organizations. A reflexive journal was maintained during the research to confirm the data and provide data for the transferring of the research to other organizations.

Chapter 4: Results

The purpose of this case study was to understand the role of KM in projects holistically. To accomplish this goal, I investigated and analyzed the use of KM tools and techniques in PM. The study documented the evolution of PM tools and techniques and compared them with KM tools and techniques to determine where they can be combined to improve the performance of IT projects. This study documented and evaluated the use of KM in IT PM in an insurance company. It was expected that the outcome of this analysis would have significant implications, from a strategic and organizational point of view, for future projects.

The central research question addressed how KM is used in the PM process of an IT department. KM is an important part of the PM process, and there are a number of theories about the use of KM in organizations. In this case study, I attempted to gather information about KM in the PM process for an insurance organization in Baltimore, Maryland.

Instead of studying the individual projects in the organization, I decided to study the five different business areas of the IT area and the IT projects that were being developed. Each business area contained projects, and no projects crossed business area boundaries. One of the business areas only used a predictive process for systems development, and three others used an adaptive approach. One IT area operated with correcting production issues with the current system.

Research Setting

The participants in this research were IT project stakeholders developing projects for an insurance organization. The stakeholders were involved in five different project areas of the organization. The stakeholders included (a) project managers, (b) project team members, and (c) project clients. A few of the participants were former students in courses I had taught at a local university in the past 20 years, but I had not spoken with them in a long time and did not ask them to be part of the research. The IT managers at the organization suggested the participants, but participation was voluntary. Participants received an introductory e-mail that arranged the interview.

Demographics

Participants in this research all worked for the insurance organization. This requirement was part of the agreement with the insurance organization for the research. Participants were the project clients, team members, or managers. Participants had been with the organization from 2 to 30 years. There were equal numbers of female and male participants in the research. Although the participants in the research frequently communicated with individuals outside of the United States, all of the participants worked in the United States.

Data Collection

The evaluation was carried out through a qualitative analysis. The subjects were the people involved in five different IT areas within the insurance company. Data were collected by interviews that lasted about 30 minutes. In the semi-structured interviews, I used a questionnaire as a guideline, with additional questions included as follow-up for

further discussion and detailed description. Although most of the information for this analysis came from the semi structured interviews, I took some field notes included in the analysis. The main areas of the questionnaire were (a) acquiring and sharing knowledge for an IT project, (b) the tools used for acquiring and sharing knowledge, and (c) using knowledge for the success of the project.

Based upon the agreement with the management of the IT area of the insurance organization, (a) team members, (b) managers, and (c) customers of the five project areas were contacted to participate in the research. The organization indicated that the project teams were working with projects that met the criteria of the research. Although the participation in this research was voluntary, the 20 people contacted based upon this process all agreed to participate.

Those 20 individuals agreed to face-to-face interviews and suggested another nine members of the IT area involved with IT projects. Three individuals declined to participate, and 26 individuals agreed to participate in the research. There were 24 face-to-face interviews conducted in person in Maryland and two telephone interviews with participants who were outside of Maryland. All of the interviews used the same questionnaire for collecting data. The interviews included (a) eight clients of the projects, (b) nine managers of the project areas, and (c) nine developers in the project area. By interviewing 26 individuals, the saturation level of the different ideas about KM in IT PM was attained. This determination was made by the similarities being found between the interviews. In addition to the interviews, five observations were made of the use of the major tools used for KM. Of the 26 interviews for the research, each project area

included at least four project stakeholders, and two groups had six people, which was the most among the five project group areas.

Data Analysis

All data from interviews and observations were added to NVivo 10. The interviews were recorded, and TranscribeMe was used to transcribe the recordings. Within NVivo 10, all interview transcripts were imported into sources and categorized by project manager, project team member, and client of the project. Nodes were generated based on the interview questions. Using the phases of the systems development life cycle for PM of (a) conceptual, (b) development, and (c) implementation, queries were developed to identify themes. A common term for the processing performed in the conceptual phase is the requirements gathering process (Schwalbe, 2010). The requirements theme was based upon the query for the keyword *requirements*. From the execution of this query, it was discovered that 24 of the 26 nodes of individuals interviewed referred to the requirements process. The code development theme was based upon the query using the keywords *IBM*, *review*, and *code*. This query was found in 25 of the 26 interviews. The testing theme was based upon the query for *testing*. This query was found in 25 of the 26 interviews and the helpdesk theme was based upon the query using the keyword *production* and *platform support*. This query was found in 20 of the 26 interviews. This process indicated the manner in which knowledge flowed in the IT area, and it determined the themes for the research. The themes found in this research differed from those discussed in Remus's (2012) enterprise resource planning case study. That

research for on the KM processes of knowledge acquisition and knowledge integration while this research focused on KM in the PM process.

Table 2

Responses from Interviews

Term	Client (8)	Management (9)	Team Member(9)	Total (26)	Percent
Requirements	7	9	8	24	92%
IBM, Review or Code	7	8	9	25	96%
Testing	7	9	9	25	96%
Production, Platform Support	7	6	7	20	77%

Evidence of Trustworthiness

Trustworthiness is the extent to which one has confidence in the findings of the research. To increase the confidence in the research findings, the answers to questions were determined to be credible by having more than one individual give the same answer. Other interviews verified the answers for each individual's interview. The participants validated the transcripts for their interview. The verification by others and the validation of the transcript provide evidence of the trustworthiness of the study.

Credibility

As part of the last 10 interviews, the findings of the previous interviews were confirmed with additional comments. This process added triangulation to the process. In the process of interviewing, the findings were consistent. The models were accurate views of the KM processing in the different phases of the IT project.

Transferability

Although this research was on the IT PM process in an insurance organization, the analysis provides a basis for more research in other organizations. The results of this research may be transferred to other organizations that include project teams with contexts similar to the insurance organization. Other organizations that have the same structure of project teams and clients that were involved with this research may be interested in receiving the results of this research. Many organizations are developing IT projects and are using the current PM model that does not focus on KM, and this research could be important. Morris (2013b) suggested that PM is a social construction and processes that were successful in one project may not work in another.

Dependability

For the dependability and reliability of the research, this case study provided enough information on the process and information found in the research for an inquiry audit. The audit with field notes and good-quality voice recordings of the interviews make the research dependable. TranscsribeMe transcribed all of the interviews, and the research participants verified all of the transcripts.

Conformability

Conformability is shown by the corroboration of the information by others. In the process of interviewing participants, prior data collected were validated. Through triangulation between participants, the information about KM and PM in the IT area was validated.

Study Results

The research identified tools associated with both face-to-face meetings and knowledge from a repository. The tools from the KM repositories changed during the different phases of the project. The project development process was divided into (a) requirements, (b) code development, and (c) testing. The three systems development processes of (a) requirements, (b) code development, and (c) testing provide the models for the research. These models are the themes for the research.

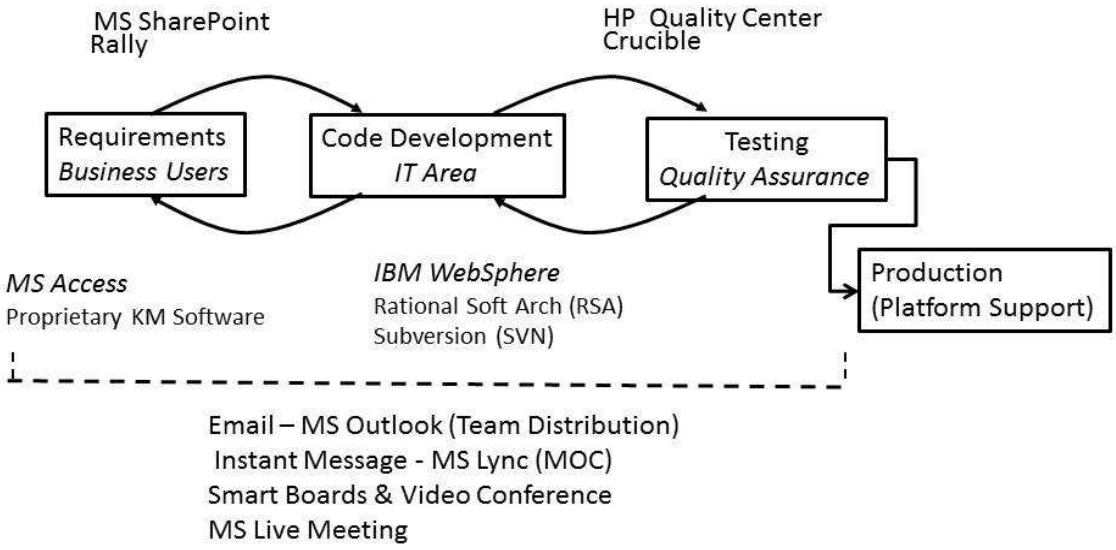

Figure 3. Knowledge flows in requirements, code development, and testing.

The platform support process involves production problems for the organization. This area added another KM repository for helpdesk processing to handle the production issues. The process for production problems used the same processing for code development and testing as did the project development process. The helpdesk process of the platform support is the fourth model and theme.

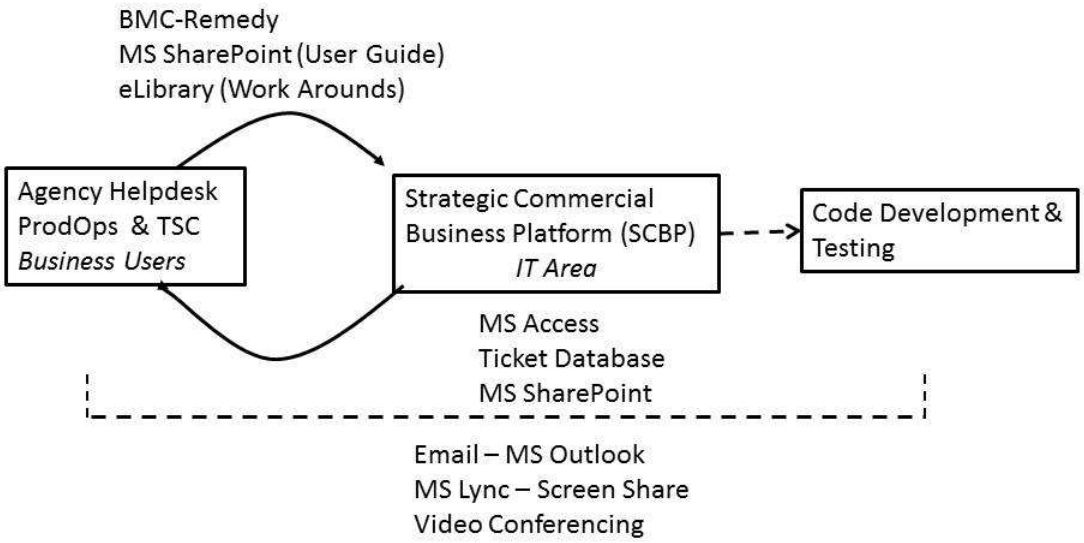

Figure 4. Knowledge flows in helpdesk.

Knowledge sharing between projects for quality standards and best practices used the KM repositories. The tools used with KM face-to-face in the different processing areas remained the same over the four processes that the KM repository tools changed.

Table 3

KM Repository Tools used in PM

Requirements	Code Development	Testing	Helpdesk
Rally	IBM WebSphere	HP Quality Center	Remedy
MS SharePoint	Subversion	Crucible	MS Access
MS Access	MS Access	Rally	MS SharePoint
	Rally	MS SharePoint	
	MS SharePoint		

The KM repository tools used in PM are described in this section.

MS SharePoint – The Microsoft product that helps an organization share, manage, and organize information.

Rally – The software package for agile software project development.

MS Access – The Microsoft Office product for databases.

IBM WebSphere – The IBM program development environment for IT projects.

HP Quality Center – HP tool for validating applications for IT projects.

Crucible – IT tool for program review.

Subversion (SVN) – IT tool for version control of applications.

Remedy – Helpdesk Tool to track problems with applications in the production environment.

The KM face-to-face tools used were (a) MS Outlook for e-mail, (b) MS Lync for instant messaging, (c) smart boards, (d) video conferencing, (e) MS Live Meeting, and (f) MS OneNote. With members of the business areas involved with IT projects being located throughout the United States, the face-to-face tools are frequently used. They are an important part of the knowledge sharing process for the organization.

An important aspect of KM is the security used to permit only the appropriate individuals to access different KM tools. For most of the KM repository tools, access is restricted by the project or the project area. The project manager determines who has access to project data. For the face-to-face tools, access is not limited by project boundaries. Team members need access to individuals throughout the organization. There

is a firewall to limit data being passed outside of the organization for the face-to-face tools, but team members can send messages outside of the organization.

Theme 1: Requirements Model

The KM processing for requirements of the project development process involved the (a) business analysts, (b) product owners, (c) IT developers, and (d) subject matter experts meeting to gather requirements for the IT project and analyze the processing for the application. The knowledge sharing in the model worked with MS SharePoint as a repository for the requirements and documentation for the project. Agile is the adaptive software development process that was used, and Rally was the tool used for the agile development with user stories. It was used as a tracking repository to keep track of the stage of development for the application. In projects using the predictive method, MS SharePoint was used to track the progress of the project. There was a MS Access database that documented the different business rules, standards, and data definitions that were needed for the project. The extensively used business rules stored in this database were referenced in the requirements documents for the project. The rules in this database were the governing items for project development and testing of the project.

For the face-to-face knowledge sharing in the requirements model, the agile process used a scrum in the morning to gather all of the project team members. A scrum is a 15- to 30-minute meeting to identify the tasks being worked on and present any issues that are occurring. Some project teams had scrums in the afternoon also, but there was at least one scrum each day for the project teams. The scrum involved every member

of the team, and the team could be at different locations. Tools such as video conferencing and smart boards were used to bring the team together.

Each project team had a conference room to discuss the project, and there was a conferencing system that permitted other team members in different locations to join the meeting by using the telephone. The e-mail processing for projects established the same e-mail message being received by all project team members.

Theme 2: Code Development Model

The code development KM processing focused on the project design and the development of the code for the application. Based upon the requirements in the repositories from the requirements model, the application was designed, and the code was created. This model included (a) the program development tool, IBM WebSphere, (b) Subversion (SVN), for version control of the code, (c) MS Access, which contains documentation for coding business rules, (d) MS SharePoint, and (e) Rally, for requirement information. A proprietary software tool was used in this process for applying screen rules and flows. In this model, the knowledge was managed for the best application for the project. Quality of the application was critical, and design reviews were performed in face-to-face meetings to ensure that the design of the project would be successful. Although most of the knowledge sharing in this process was within the IT groups, the design review process allowed other IT areas and users to review the design. Unified Modeling Language (UML), a visual information tool, was used as part of IBM Websphere to share knowledge for the design reviews. UML was used within the IT project teams for design reviews, but was not used outside of the IT area. After the design

review for the project, the coding of the project occurred, and programs were unit tested for the quality of the code without the other parts of the environment.

Theme 3: Testing Model

The testing KM process was for ensuring the quality of the project and the ability of the system to perform the required processes of the project. The model included the HP Quality Center to connect the requirements with the testing of the system. Based upon this testing, the requirements in MS SharePoint or the user stories in Rally could be updated. Code reviews were performed using Crucible. As was done with the design reviews, code reviews were available for all of the IT area for best practices and organizational standards. During this process, the platform support area became involved with the project to ensure that the design and processing of the system would not cause problems in the production environment. The testing process to implement a new project in production was a three-step process managed by the operations group. The process involved testing with a limited number of other applications running in the same environment and adding other applications and complexity as the software moved through the testing environments. Working with HP Quality Center has been a positive process, as one team member stated:

> I thought it [HP Quality Center] was going to be a pain, but it actually hasn't been bad. We're using Rally a lot, now that we're going Agile. What's been cool is this HP Quality Center links to Rally, so now [if] there's a defect open in there, I don't have to go to QC. I can just go to Rally and see what's going on.

After the software had passed through the three testing environments, it was implemented in production. This review by platform support focused on the quality of the systems because when the system moved to running in production, the platform support area handled keeping the system working.

Part of the testing model was the knowledge sharing that occurs with people outside of the United States. There was a 12-and-a-half-hour time difference between the IT teams in the United States and the members of the testing areas outside of the United States. It was difficult for telephone calls, text messages, and the use of MS Live Meeting to occur between these two groups. As a result, the groups communicated by e-mail or information on data repositories.

Theme 4: Helpdesk Model

The helpdesk KM processing focused on the platform support area for production issues that occur in the organization. The model used the Remedy repository tool for tracking issues in the system, and the knowledge base of the tool was used for resolving minor issues for the agents. Remedy is the KM tool used for ticket tracking, but there does not seem to be anything unique about the tool over other ticket tracking tools. As a client that uses Remedy commented:

> We've gone through a bunch of different tools, so every couple of years it's like, "Oh, we're going to do this tool." So we've gone from HPSM to Remedy, to — I forget what the other one was. So it's just a learning curve sometimes, but no, I think everybody can find what they're looking for fairly well.

The tracking process began with the identification of the issue and followed it through to resolution. The input to the model came from (a) the support center, (b) the insurance agent's helpdesk, or (c) the production team. The support center handled technical issues from employees in the organization; the insurance agent's helpdesk worked with agents outside of the organization; and the production team worked on issues that occurred during production processing for the organization. With all of the different issues, a workaround might first be needed while a permanent fix was determined. A decision was made of whether the issue was a defect in the system or something that could be corrected in a quicker manner. After the ticket had been entered in Remedy, a MS Access database application was used for reporting and to maintain a historical record of production issues. Remedy did not provide some of the desired reports needed, and the MS Access system, which was developed before the organization started using Remedy, was needed. If an issue was determined to be a defect, the correction was made with the same processing as the code development model and testing model. Remedy was used to track the issues from the beginning until after they were resolved. It was used to notify (a) the support center, (b) the insurance agent's helpdesk, or (c) the production area. When the testing process corrected an issue, a separate procedure was used to update Remedy and notify the appropriate area where the issue originated.

The helpdesk model also included MS SharePoint for errors that had special procedures, such as reprint documents for users at a specific location. There was also information for the helpdesk group, such as handling issues that should be sent to a

different group or determining whom to notify for queuing problems. These issues occurred, and MS SharePoint was used to keep individuals informed on the correct process for each issue.

For all the processes in IT project development, knowledge sharing across projects was needed for standards and best practices. Although requirements and documentation of projects were its primary use, MS SharePoint also included standards for all projects. MS SharePoint was organized by projects, but it also included areas for standards and best practices. All projects used these areas on MS Project. One of these areas was used for the technical walkthroughs of projects that were being implemented. This information was available to the different project teams that used the system. MS Access contained the information that was needed for all projects. These databases contained the standard manner in which coding and data access must be performed for applications in the organization.

Besides knowledge acquisition from a repository, there were also face-to-face meetings for learning. One of the face-to-face processes used in the IT area was the lunch and learn forum. This group was open to all IT members for the discussion of new skills that were needed. The forum was video recorded and was available for team members who needed this information. A current topic is XSLT, which is a skill needed for the IBM WebSphere environment in the development of code at the organization.

All four of the models for KM in this organization included the same face-to-face tools of e-mail, instant messaging, video conferencing, and smart boards. Knowledge sharing occurred in the face-to-face process, and after a discussion a repository stored the

knowledge. These tools helped the people in the face-to-face meetings to communicate their ideas better. The smart boards, as an example, provided a way for members of the meeting to draw their ideas on a board and for others to have the ability to add to the drawings, with a clear communication process. To help with the use of the face-to-face tools, the organization had some meeting rooms that connected with different locations. The organization had different locations that were not only in the United States but also in different countries around the world. The discussions in the meeting rooms were able to continue with input from different people until a conclusion was reached on the issue. The most used repository was MS SharePoint, but Rally, HP Quality Center, and Remedy were used as needed by the phase of project development.

This research examined the following questions:

RQ1: How is KM used in PM for IT projects?

This research question was answered by identifying how the knowledge flow divided into the four different phases of PM.

Findings RQ1

- The knowledge flows of the requirements phase required extensive knowledge sharing with the users and clients of the project. The knowledge repository, MS SharePoint, was used to collect and organize the requirement for the project. For the adaptive process that most of the project teams were using, Rally was the knowledge repository. A proprietary system using MS Access was used for rules and standard for the system. Tacit tools such as e-mail, MS Lync, and video conferencing were used extensively in this phase.

- The knowledge flows of the code development phase used the explicit tools of IBM WebSphere, Subversion and HP Quality Center to connect the requirements and analysis to the implemented code. There was also a design review process involving the review of the project design with standards and best practices of the organization. The review process added the organizational knowledge for the design of the project. Tacit tools such as e-mail, MS Lync, and video conferencing were used for design reviews and validated requirements from the earlier phase of the project.
- The knowledge flows of the testing process were used to ensure that the code performed the requirements of the project. The testing process used HP Quality Center and involved program review performed by the project team. The project was then passed on to the Quality Control area for further testing. This testing process required frequent knowledge sharing with the tacit tools and meetings to create testing plans and identify possible issues with the project.
- The knowledge flows of the helpdesk process were used to handle issues that occurred during the daily use of the IT systems. KM of the production issues involve discussion using tacit tools with users who were having the error and understanding the problem. The tacit knowledge was entered into the tracking system using the explicit tool, Remedy. The platform support area corrected the issue or sent to the project areas for code development and testing. The helpdesk performed requirements and analysis on the issues, and depending

on the size of the task, the issues were sent to the code development and testing models.

RQ2: How are the tools and techniques for KM used in IT PM to improve the success of an IT project?

Schwalbe (2010) identified some ways that an organization defines success such as meeting the objectives of the user, or reducing the costs for the organization. The DeLone and McLean IS Success Model (Petter & McLean, 2009) suggested that user satisfaction is the measure of success. At the insurance organization, project success was identified by the lack of defects of the software that was delivered.

Findings RQ2

- The PM process used explicit tools for success by frequently validating the outcome of the project with the standards from the proprietary KM system, MS SharePoint, and Rally.
- The PM process used tacit tools for success for timely access to the knowledge needed for the project. The face-to-face tools such as instant messaging and e-mail were used to gather the tacit knowledge for the project.

RQ3: How is the current PM process managing knowledge for an IT project?

Findings RQ3

- The current PM process is improving the quality by sharing knowledge about standards and best practices. In the past few years, there had been an effort to improve the quality of the projects by improving the knowledge of the team members about standards and best practices

- There has been a change in the process of creating the project teams by maintaining project teams instead of creating new teams for new projects. In the past, the teams were established for a project and after the project was completed team members would move on to another project.

RQ4: How does the PKM model for managing knowledge improve the success of an IT project?

Findings RQ4

- The PKM model identified the type of knowledge needed in the development of IT projects. That knowledge needs to be accessible and include tools to aid the development process. This can make the IT project more successful. By having well-organized knowledge quickly available, more successful projects with fewer problems that need to be corrected by the production support process can be created. Managing these types of complex projects is very difficult, and a number of people share the responsibility for different parts of the project. Sharing the KM of the project, such as the completion of tasks, keeps the project moving toward implementation.
- The model has created the ability for stakeholders to track knowledge in the project. The KM system using the MS Access database provided a process to track where standards and requests for processing in a new project were obtained. MS SharePoint and Rally also contained requirements for the project and could be tracked to improve the quality of the system.

- Another technique to share knowledge between projects was the lunch and learn meetings to share knowledge among the individuals of the IT area.
- Most of the IT project team members did not exchange IT knowledge with individuals outside of the organization. Some of the IT managers spoke of attending conferences outside of the organization, but that was not a large number of individuals. The strategy seems to be for a few people to go to the conference and have them share the knowledge with the other team members.

Issues with KM in PM

Issue 1: Duplicate Information

The major issue of the use of the knowledge repositories was the same information being stored in different repositories. Duplicate information was a major issue because when one repository changed with new information, the other repository did not receive the update, and there was a difference. This difference was a problem in the project development process when the project team did not use the most current information. Different information caused a problem in the processing of the application. Having two repositories with different information caused confusion for everyone working on the project. If the wrong information was used in the development of the project, the area affected by the wrong information needed to be corrected, this cost time and money. As one team member commented on duplicates:

> We got a problem. Well, this has this documented here, but this is here, so we would always have to go back to business to actually — is this really the actual value or is this — because this is what we've coded is this, so this doesn't match.

> Or it just hadn't been updated — in terms of, when you store things duplicate places, you don't know what's accurate and what's non-accurate.

The organization was working to have only one place be the exclusive repository for knowledge. That repository was used for all project development. How different requirements occur in different documents was the question. There appeared to be a number of possibilities, including confusion on the use of Rally and MS SharePoint and the codification of face-to-face tools.

The face-to-face tools added to this problem because the information in an e-mail or instant messaging was frequently changing. This information was more tacit and needed to become explicit by codifying it to a repository that was accessible by whoever needed the knowledge. Sometimes the information from the e-mails and face-to-face tools did not get transferred to the repository, as stated by this client of the IT organization:

> If they think, "I know we had a problem about this," and went into SharePoint and there's nothing documented. People are like, "Yeah, it was done through e-mails." Right, it sounds not good at all. I know for the problem we had before, the one I just told you about, the one that went from automated to semi-automated. That was a huge thing for business. The process of why and how wasn't necessarily documented, but the issue was put into a document. A final summary of what happened — like we couldn't fully get it fully automated so this is what we wound up with. But it wasn't about what happened and why. So those technical details are somewhere in someone's e-mail.

If the latest information from the face-to-face meeting was not used to update the repository, wrong information was being placed in it. With the repository being the source for project development, the wrong information was used. This had become such a concern that the organization was trying to stop the use of e-mail in this process and encouraged the use of the discussion boards feature of MS SharePoint to keep the most current information on it. The instant messaging process for face-to-face meetings was also a concern because there was not a process of storing information from instant messaging into the repositories.

Issue 2: E-mail

E-mail was presenting some challenges for the organization, and it is not a recommended manner for face-to-face knowledge sharing. From an information security perspective, there were concerns that e-mail was being used by individuals outside of the organization to access information that was private and not available to the public. Sending e-mails outside of the organization was also a concern. If files in an e-mail left the organization, there was no indication where the files would go. The large numbers of e-mails that were received were a problem also. As one manager stated:

> We're using e-mail too much. I would say that is probably still the main tool. For example, I was out for a week in October and I came back to 2,000 e-mails, and that doesn't include the stuff that automatically filters. Like, there's a lot in the [?] stuff I just automatically get rid of. Which is absurd to think about that, 2,000 in a week that you have to — so we get a huge number of e-mails. And we've talked about trying to get away from that, using the SharePoints more so that you could

> subscribe and get only the information you want. But it's still the main thing, and everybody gets hundreds of e-mails a day easily. So I would say that's not a great way, but we're still doing that a lot. We still rely a lot on e-mails. Some of the projects on platform and ultimately all of them are moving towards agile. So then, you get much more the face-to-face conversation and less of the e-mails. But we still have a huge numbers of e-mails.

The large numbers of e-mails were causing information overload for the managers, and trying to address all of the e-mails was distracting them from other responsibilities. As another manager of the organization stated:

> Yeah. What happens is, I think you're going to hear this [?], I sit in meetings for six hours a day, and 200 e-mails are piling up. I have to go home at night and catch up on my 200 e-mails from today, and so I'm not giving real-time responses. Luckily, we have MOC and instant messenger tool. It probably is officially Lync, L-Y-N-C, from Microsoft Lync. Luckily, if people need real-time information, they know either to just ask you that way or say, "Hey, received my e-mail?" I know that I better give it some attention. People are reading e-mails while they're supposed to be having meetings.

With this large number, it was very difficult to identify the particular e-mails to act upon and the ones that should be disregarded. The problem may be that e-mail was used to notify everyone. This made it difficult to identify the important information for your project. One example of this issue was commented on by a manager.

> To cover yourself, you send the things to everybody and anybody. Those people

> don't know how to weed through what they get, what's really important to me, and what's not. There is million distribution lists. I'll give you an example of one today. Something came down in our test region; I found out it was because some other infrastructural upgrade was upgrading Exadata node four, and someone said, "Did I get an e-mail at some point that said Exadata node four was going to be rebooted?" "Maybe." "Do I know if I want my databases on database Exadata node?" "No, I don't know. It may be there. I'm sure somebody covered themselves and sent it to the distribution list, but I don't know how that is meaningful to me." It's just yeah, bombardment of information.

At this point, with more emphasis being placed on other methods of knowledge sharing, IT members were not looking at e-mail on a frequent basis, and needed information for the project was being missed. There were a number of issues with the overuse of e-mail, and in some cases it had become an ineffective technique for sharing knowledge. There was a need for the organization to use other ways of knowledge sharing instead of e-mail.

Issue 3: Organization of Information

The other issue with the repositories besides duplicate information being stored in different locations was the ability to find needed information in a timely manner. Team members were using bookmarks to keep relevant information that they needed access to in MS SharePoint because of the challenges of finding information. One of the possible reasons for having the same information in different locations was not being able to find

the needed information on the repository. As one team member interviewee stated about MS SharePoint:

> I know that a lot of developers are told to search SharePoint and don't, and I'm guessing it's because it's hard to — not the easiest way to navigate around unless you know exactly what you're looking for. Developers have had direction: "Put stuff on this SharePoint. Put stuff on this SharePoint." And so they're using and putting their knowledge out there, but it's hard if you don't know what you're looking for to access it.

Another team member stated:

> Recently, I would say within about a year, we've been given a direction to try to put these things out there. We have a site, a SharePoint site, just a developer site where all this information goes, but to me, it's more confusing than — it's hard to find the information that you need. It's almost like — especially if you don't know what you're looking for. If you know what you're looking for, then you probably know the answer, but it makes it kind of easier to find it. But if you don't know what you're looking for and you have a bunch of questions, it's almost impossible to search that site that we have.

A client of the organization commented:

> I do find that sometimes looking for something in SharePoint is difficult because you think it should be under a project — I wish I had it up. I honestly might have to bring it up to refresh myself on some of it. But —

This can occur because the information was stored based on a project, or the terminology used in one project may be different in other areas of the department. As Dalkir (2011) pointed out about organizing information for a large number of people and departments in an organization, there is an importance of standards and having a consensus on how information is organized. At the insurance organization, the result of not having a consensus was that the information was stored in a location that could not be found by a user. This caused people to copy needed information to their own file process and maintain their own organization for it. This information on the personalized organization system was not updated, and incorrect information was used.

With the issue, there was also confusion over information that should be in Rally or MS SharePoint. For the project teams using the agile process, the requirements were being placed in Rally. For the project teams still using the waterfall process, the requirements were being placed in MS SharePoint. From a consistency perspective, there was a need for all requirements to be in one tool, and MS SharePoint seemed to be the common tool that all project teams should use. This was not the case for the agile teams because the requirements were needed in Rally and copying the requirements into MS SharePoint did not always occur. Sometimes there were differences between what was in Rally and what was in MS SharePoint. As one developer interviewee stated:

> There's a project SharePoint, and out there, you could see initiation documents, and scope documents, and requirements documents, and things of that nature. Since we have kind of gone away from pure requirement, documents are on SharePoint because a lot of the more detailed requirements are in Rally now. You

> might find some supporting artifacts in SharePoint, but the gist of the requirements would be in Rally. But the high-level initiations go — those types of cost benefit, those types of things you would find in the SharePoint repository. And then any kind of document that wouldn't fit into a Rally artifact, it would end up in the SharePoint now.

Another team member commented:

> In my opinion, we should delineate because SharePoint's more of a document sharing and Rally's more of work in progress and tracking. I push that we put the SharePoint version number in Rally to identify where the original requirements occur. I'm coding off this SharePoint version number so three months down the road someone says, "This isn't working for the document."

Over the past few years, the organization has made an effort to move needed knowledge from file sharing and e-library organizations to MS SharePoint. This effort was still continuing in the helpdesk model processing. Workarounds were needed when an issue could not be fixed promptly. This occurred on a regular basis, and users needed to have a way to keep working while the IT area updated the real issue. The issue was finding the workarounds in the system. The organization was confusing, and users were having difficulty adapting the workarounds because they could not find them. This issue was corrected by moving the workarounds to MS SharePoint with the User's Guide. The User's Guide contained the workarounds with all of the documentation about the system. Project requirements were organized in a file-sharing process similar to an e-library in the past, and the current use of MS SharePoint has improved the usability of the process.

Issue 4: MS Access

Although MS Access was used to share information throughout the IT area, there was a large concern that a better tool should be used. The major MS Access database was the proprietary KM software system that was used by 500 people in the IT development area. When multiple people attempted to update the same data at the same time, the database did not always work. This development environment did not have the support system that was needed. The database for user requirements had grown from a small group that originally used it to its current size, and a large number of records were stored on it. In the requirements KM process, the rules in the MS Access database were standards for the development of the system. If there was ever a question about the processing of the system during development or testing, the rules in this database were referenced. Thirteen of the 26 interviews for this study discussed the importance of this process in the project development process. The concerns about MS Access and its use in the project development process were stated this way:

> Look, because you're living within a shared infrastructure that could harm others, we need to review any changes being made to make sure we're comfortable with them. That your queries aren't resource hogs, or things like that. There are a lot of problems with it, performance-wise, security-wise. It's in a development environment, so it's not a major audit concern. It's more of a pain. Our business users have some consultants that they've hired who does all of the front-end Access work, even do the changes associated with modeling and the database. They come up with all of it. Then, they give it to us just for review, because

> basically we said a while back, "We won't support this." It's not an IT-supported tool. We were really trying to force them into moving it to that. I said, "Look, in order for me to support it, and give you the service levels that you want, you've got 500 users." I have to have it in prod. I can't guarantee you that service level in some dev unstable environment. In order for me to move it to prod, there has to be source control; there has to be reviews. All of the gates that we do for IT governance have to be adhered to, to move it to prod, where it could really impact a shared environment.

The organization was looking for a better system to maintain the information in this process, but they had not been successful, and they were not optimistic to find an alternative. This was a valuable KM repository that was used in the development area and not in production. There were procedures for maintaining production databases, but not for maintaining database systems in the project development area.

In the helpdesk model, there was another MS Access database used to keep track of issues being worked on in the IT area. This database was also used extensively by the platform support area. Remedy did not provide the reporting process that was needed to identify quality issues for the IT area. An extensive reporting system had been developed using a MS Access database environment for providing the needed quality reports from the system. If something happened to the database and it needed to be recovered, this would be done by restoring the data to the previous day. Any updates done on the day of the error would be lost. These MS Access databases provided a centralized, organized

location for needed knowledge for the IT area, but the organization needed to find a better way to store this needed information with a better recovery process.

Issue 5: KM Tools Lacking Use

Confusion on the use of MS SharePoint and Rally was identified in another issue, but there was also confusion on how the tools were to be used. Project managers and project teams determined the use of tools, but that differed from team to team. One team may set up a process to track tasks and connect to documents for a project, but another team may only use MS SharePoint as a document repository. Other teams in the adaptive process were not using MS SharePoint. This caused confusion for people moving from one project area to another.

During the interview process, some respondents indicated that they had never used the discussion board in MS SharePoint. Some thought that the discussion board was used by the younger members of the organization because of their use in school, but the older team members did not have the opportunity to use discussion boards in school. There was a group at the organization that attempted to help project teams use MS SharePoint more effectively. This group had members who reached out to project teams to address issues with MS SharePoint. MS SharePoint was not used as extensively as it could be. Project teams were finding other techniques for sharing knowledge, but MS SharePoint may have been a better option.

Another tool in which the organization had invested a substantial amount of money was the smart board for group collaboration. The smart boards permitted groups at different locations to work together on projects and share information. At meetings

involving the different project areas, a smart board was used to identify projects for the upcoming months and decide on the team members for the projects. By using the smart board, all members of the different teams were able to collaborate and determine projects for the IT area. The issue was that the smart boards were not used as much as they could have been used. Project team members were comfortable using the other tacit tools such as instant messaging, telephone calls, and e-mail to collaborate. These tools are not as effective as the smart boards. Only in the past year had the smart boards been installed, and team members were starting to learn how to use them. It was hoped that their use will increase in the future.

Issue 6: Offshore Development

One part of the IT development team was outside of the United States and the time difference between the different groups was 12 and a half hours. This caused some challenges for knowledge sharing for the organization because while one group was working in the United States, the other group was not working. This caused a delay in the sharing of knowledge, and the technologies such as instant messaging, scrums, smart boards, and telephone calls were not very effective. Sharing knowledge was limited to e-mail, file sharing, or data repositories. As one client stated in the interview:

> This is a real example — even though it takes 15 hours to change one rule, it's really 30 because we have to wait for all those hours in between. That is a long time. We should be able to change a rule — and that's working hours, not like one day, that's like — I don't know, four days. It should take two. It should take two.

> It takes four days for a rule and you have 280 to change. We're looking at years of a project just to do something like that.

Of the 26 interviews for this research, 14 discussed working with the group overseas. The discussions were about the time difference and the challenges that it presents and not the issues of culture or language difference. Sewchurran et al. (2010) discussed different countries for IT project development being a concern for language and trust. This does not seem to be the issue spoken about by the stakeholders who were interviewed. They commented on the scheduling challenges because of the time differences. There are benefits to the practice of working with overseas groups, but it has caused a time challenge for KM.

Summary

This case study examined KM in the systems development and platform support areas of an IT department. IT developers, users, and managers from five different IT areas were interviewed for the research. The knowledge sharing was divided into four themes—(a) requirements processing, (b) code development, (c) testing, and (d) helpdesk—for issues with the system. There were different repositories for the four different areas, but the same face-to-face tools were used for all areas. Although the organization used both a predictive and an adaptive development process, the four areas followed the IT project development process. The quality of the software developed by the group was a high priority, and knowledge sharing by the different KM tools was important. In studying KM in the PM process, a number of issues were discovered in the IT area, including duplication of information in different data repositories, the use of e-

mail, and the development of projects using workers outside of the United States. Although these issues caused challenges for the PM process, the IT area did develop successful projects for the organization.

The different models for managing the knowledge in the IT project development process were presented in Chapter 4. In Chapter 5, the research questions for the study will be answered for this organization. Interpretations will be presented on the flow of knowledge in the IT area and compared with the KM literature. Chapter 5 will also present recommendations for further study and the implications for positive social change from this research.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this case study was to understand the role of KM in projects holistically. To accomplish this goal, the research investigated and analyzed the use of KM tools and techniques in PM. The study documented the evolution of PM tools and techniques and compared them with KM tools and techniques to determine where they could be combined to improve the performance of IT projects. This study documented and evaluated the use of KM in PM in an insurance company. The outcome of this analysis will have significant implications, from a strategic and organizational point of view, for future projects. The evaluation was carried out through a qualitative analysis; the subjects were the people involved in different IT projects within the insurance company.

The results of the research divided KM into four parts of the IT department. Three were in the new systems development process of requirements, code development, and testing. The fourth part focused on platform support when issues with the operations system were occurring. These four parts of the IT area provided a significant amount of information on the knowledge sharing, acquisition, and utilization that were part of KM in PM.

Interpretation of Findings

Conceptual Framework and the Research Findings

The first part of the conceptual framework was an understanding of the use of traditional PM techniques in IT PM, both successes and failures. PM in the IT department of the insurance organization has evolved since the end of the 1990s. At that time, IT

projects had an engineering focus, with an emphasis on delivery of projects that performed the tasks as specified in the requirements. The failure rate of IT projects as reported by the Standish Group's *Chaos Report* was 31% of the IT projects (Eveleens & Verhoef, 2010). The project process involved a small group of people that were not part of a larger system of the organization. IT projects now involve many people who are working in different locations in the United States. There are also project team members who are not in the United States and who have a major role in the process. The IT project must be integrated into the complex existing IT environment that processes most of the insurance policies for the business. The IT members who will be maintaining the system after the project implementation must know the operations of the project. They are responsible for correcting problems that may occur when the project is part of the operating IT environment for the organization. In the effort to keep all of the stakeholders involved in the IT project, sharing knowledge is critical.

This research examined the following questions:

RQ1: How is KM used in PM for IT projects?

Literature Review of RQ1

The findings of the first research question discussed the phases of system development. The PM techniques used a project life-cycle approach of four phases: (a) concept, (b) planning, (c) execution, and (d) termination. The organization followed this approach to IT projects but was moving toward an adaptive approach. There was one group that still used a predictive approach. The adaptive approach still follows the four phases, but the planning and execution phases are performed in a shorter time span than

the traditional predictive approach (Schwalbe, 2010). The research found that different repository KM tools were being used in the life-cycle approach. The different tools aided the team members in the different phases for the success of the project. MS SharePoint and Rally were used in the requirements and analysis process to organize and understand the needs of the users. IBM WebSphere was used by the IT team to design and implement user requirements. During the design process for the project, a design review was used to ensure the inclusion of the quality and best-practices standards of the organization. After completing the design, the coding of the project was performed. HP Quality Center was used in the testing phase to ensure that user requirements were being taken care of in the process of the system.

Ziółkowski, Orłowski, and Wysocki's (2013) study on KM also broke the systems development process into phases, and their research focused on the requirements phase. Their study suggested that there was a need for clearer definition of the roles and processes of the project team members. Without the clear definition of the roles of team members, there was confusion about the ability of team members to perform tasks and apply knowledge to the project. With this insurance organization, the project team did not seem to have this issue. The team members seemed to have been able to work with each other to find the knowledge needed for the project.

The *PMBOK*® includes 10 knowledge areas: (a) integration management, (b) scope management, (c) time management, (d) cost management, (e) quality management, (f) human resources management, (g) communications management, (h) risk management, (i) procurement management, and (j) stakeholder management (PMI,

2013). These 10 knowledge areas were part of the PM process at the insurance organization. Scope management, time management, risk management, and procurement management used MS SharePoint or Rally in the different projects in the requirements process of the project. Quality management and integration management were part of the HP Quality Center and the testing process. Stakeholder management and communication management were done with the face-to-face tools and stored in MS SharePoint during the development of the project. By the process of the project areas and permitting the individuals of the IT area, the human resources management for the projects was performed. The management of the projects performed cost management throughout the PM process.

KM research is frequently focused on the KM processes of knowledge acquisition, knowledge sharing, and knowledge creation (Remus, 2012; Schmitz et al., 2014; Stirbu, 2014). In this research, the KM process was associated with the PM phases. In their research on business process and KM, Cao, Thompson, and Triche (2013) examined the task-technology fit in three global technology firms. The research found a relationship between the business process and the KM technology in a similar manner that the research on IT PM did. For this research on IT PM, the business processes were requirements gathering, code development, testing the system, and helpdesk processes. The research identified the technology involving KM tools and techniques for the different processes.

RQ2: How are the tools and techniques for KM used in IT PM to improve the success of an IT project?

Literature Review of RQ2

The findings of the second research question focused on the success of the IT project. The IT area of the organization placed a priority on the highest quality software that could be developed. The lack of defects that occurred with the software when placed in production was the indication of success. The lower the number of defects, the higher the rate of success would be for the project. The goal was for zero defects for a project, but that was not usually obtained. For high-quality systems, the organization had design and code reviews. The testing phase was a three-step process to discover all defects with the project and correct them before being placed in production.

Fewer defects in the software caused the user to have a higher level of satisfaction with the project. These criteria impacted the knowledge sharing that occurred in the project and after the project was implemented. Garstenauer, Blackburn, and Olson (2014) studied the use of KM in quality management for products. Their results indicated that the application of KM techniques for sharing tacit and explicit knowledge had a positive impact on the quality of products. Wang and Huynh (2014) also studied the connection between quality management and KM systems and found the same results as Garstenauer et al. Ghandvar and Sehhat (2015) studied KM and quality management in the insurance industry and also found a relationship between KM and quality management.

The findings of the second research question also include the different tools and techniques used for KM. MS SharePoint was used as a repository for the project. This repository contained the documents for the project, including scope, requirements, and

testing information. MS SharePoint was also used as a knowledge-sharing tool, with discussion boards for exchanging ideas about the project. Documents added to MS SharePoint also included information about the individual who added the document to the repository. This information created a knowledge map for the user of SharePoint to find an expert on the subject. For the business areas that used an adaptive approach, in addition to MS SharePoint, Rally was used to share user stories about the processes of the project. A KM system was developed using MS Access as the primary repository tool. The MS Access system contained user rules and procedures needed for the development of new applications. E-mail, video conferencing, and instant messaging were used to share face-to-face knowledge. These tools were different from the tools referred to by Patanakul et al. (2010), which include Gantt charts, work breakdown structure, and flow charts. They were also different from the mind maps and concept maps referred to by Wang and Jacobson (2011). Instead of using the specific tools as discussed by Patanakul et al. and Wang and Jacobson, the organization used Rally and MS SharePoint, which incorporated those tools. By incorporating the specific tools in other products, the team members were able to use one product and share knowledge for the project.

The organization used KM repository and face-to-face tools for timely access to the knowledge needed for the project. The face-to-face tools such as instant messaging and e-mail were used to gather the tacit knowledge for the project. As Boisot (1998) referred to in the process of codification, the data then needed to be converted to explicit knowledge and stored in a data repository such as MS SharePoint, Rally, or Remedy. In the PM process, without these KM tools, finding the right knowledge at the right time

was a challenge. The current tools were not always effective for the project, but they were better than the past process with file sharing, paper, and telephone calls. By identifying the processes for the knowledge and where the issues are, the organization could work to correct them for more successful projects.

Zhang and Wang's (2013) research suggested that a process-oriented culture improved knowledge sharing. This seemed to be the case for the project teams at the insurance team. There was a concern for sharing knowledge in each phase to improve the process. The focus was not always results-oriented, but the process of the different models being performed as well as possible. The project teams focused on the success of the project and the highest quality possible, but in each of the phases attention was paid to sharing knowledge for that process.

RQ3: How is the current PM process managing knowledge for an IT project?

Literature Review of RQ3

The findings of the research on the current PM process for managing knowledge answered the third research question. To improve the knowledge of standards some changes in the process such as senior IT people conducting code reviews and a separate group of the IT area reviewing the design of new systems have been implemented. These changes have improved the knowledge sharing for the projects. It has helped all team members understand design standards and the best practices for the organization. This knowledge had been missing in the past, and by improving the knowledge flow, the number of defects that the production area encountered has fallen.

The process of having IT team members of completed projects available for new projects accomplished the objective of having team members work with new teams and sharing their knowledge. The problem was the team members started realizing they wanted to stay with the same team members. They had developed a working relationship with these team members and did not want to disrupt this. The IT area moved to a structure with the project areas, and the team members did not move to new areas as they did in the past. This change helped the knowledge transfer because team members had worked with the others before. The relationships between team members were maintained and helped the team develop quality projects. As one manager described it,

> And what we found is, once you form a project team, and you build those and you build that cadence, and you build that, "Well, here's what I'm good at. Here's what you're good at," that if we keep that project team together longer, we begin to build velocity that we couldn't get in the other model that we had.

This process created an autopoietic system for the team members (von Krogh et al., 1998). By keeping the team together, the world created by the knowledge of the group was built on for the next IT project. This world used an understandable language for the team members, as suggested by Berger and Luckman (1966). With an understandable language and an increased level of trust, knowledge sharing for the team rose. This team structure increased the knowledge sharing because it followed the four criteria of: (a) knowing what another person knows, (b) access to that person in a timely way, (c) willingness of the other person to help, and (d) a degree of safety. Trust in the relationship as identified by Cross et al. (2004) for their study of knowledge sharing also

rose. Zhang, He, and Zhou (2013) suggested in their research that the strong tacit knowledge sharing that had occurred in the project team gave the project team a flexibility to work with different team members. This made it possible for the different members of the IT business area to work with different team members from the same business area for successful projects. This process also created *ba* as a place where knowledge was shared, created, and utilized, as discussed by Nonaka et al. (2000). In this process, the team members were moved closer together, and the ability to meet was enhanced. There were also conference rooms for each project to share project knowledge.

RQ4: How does the PKM model for managing knowledge improve the success of an IT project?

Literature Review of RQ4

The findings of the last research question examined PKM to improve the success of the project. The model was applied differently for the different processes of the project and used different repositories. The requirements process involved knowledge sharing between the business area and the IT groups with MS SharePoint and Rally. The design review that is part of the code development includes other projects. Depending on the size and scope of the project, it could also include other departments. For the testing process, the knowledge sharing was between the quality assurance area and the IT groups, with HP Quality Center as the repository. The code development process focused on the individuals of the IT area and their knowledge to develop the code for the project, with IBM WebSphere as the repository. The helpdesk processing involved knowledge

sharing between the users and the IT area, with Remedy as the repository. The users included both employees inside the organization and external clients who used the systems to perform business. Knowledge was also acquired from external sources, which included different courses that are available, outside consultants, the Internet, and user groups. The knowledge that was acquired using the different techniques based on the process that the knowledge needed.

Gasik's (2011) PKM models used Sveiby's (2001) five types of knowledge transfer of (a) between individuals, (b) between individuals and external structures, (c) between individuals and internal structures, (d) between internal and external structures, and (e) within the internal structure. The IT area had incorporated these five types of knowledge transfer. As the project teams moved to an adaptive process, there was more emphasis placed on the IT project teams and the users for the requirements processing. Team members needed to learn the adaptive process. A training course that occurred at another facility of the organization provided this. For external knowledge acquisition (Gasik, 2011), the organization also brought in external consultants to provide knowledge about the adaptive processing. IT team members were involved in external organizations and conferences to add knowledge. One of the important parts of the design and code reviews was the knowledge transfer between the individuals and the internal structures of the IT area. During these reviews, best practices and design standards for the organization were shared among project teams. The design and code reviews included the platform support area for involving the production area with the project teams in the IT area.

The insurance organization did not have many of opportunities for the team members to add external knowledge to the firm by attending external courses and conferences. The process for gathering knowledge was focused within the organization. This could be a concern as discussed by Foss, Lyngsie, and Zahra (2013) in a study on the importance of external sources of knowledge for use in the strategic decisions of the organization. Their analysis indicated that as an organization increased the use of external knowledge there was an increase in the ability of the organization to exploit new opportunities. This research showed the importance of external knowledge and the need for an organization to use it for a strategic advantage.

Literature Review of Issues with KM in PM

Jasimuddin et al. (2012) discussed knowledge sharing and the mechanism to convert the face-to-face knowledge to knowledge in a repository. This is the codification process of converting tacit knowledge into explicit knowledge. One of Jasimuddin et al.'s (2012) major issues was with the knowledge repositories not being up to date. The organization was also very concerned with this issue. Besides the information not being up to date, there was also concern about the same information being stored in different repositories. The research at the insurance organization was a good example of the problems that can occur with the issues that Jasimuddin et al. (2012) discussed. How to resolve this issue is an important task for the organization.

Another issue that Desouza and Evaristo (2004) discussed was a decrease in the level of understanding of knowledge in a repository. The knowledge was subject to the interpretation of the user and might not be the same as what the provider meant. This is a

possible problem, but there seemed to be a good working relationship with the organization. If there was a misunderstanding about knowledge in a repository, there seemed to be someone who could clarify the issue. The structure of the IT area and the knowledge-sharing environment for creating successful projects keep these misunderstandings to a minimum.

Cross et al. (2004) suggested that most people in an IT area would prefer information shared by a person instead of using a repository. At the insurance organization, that did not seem to be the case. On more than one occasion, individuals discussed the length of meetings and that there was too much information shared by people. Meetings that lasted an extensive amount of time became unproductive. There were other people who indicated that with the adaptive process they were constantly meeting to clarify the requirements and needs of the system. They did not think that achieving the needed clarity could have been done any other way than by sharing information with a person.

One of the issues in the research for the PM processing was how the KM tools such as MS SharePoint and smart boards were not being used by all of the project teams. There were some KM tools such as MS Project that were missing from the PM process. Gantt charts, and work breakdown structure that were discussed by Patanakul et al. (2010) were part of the MS Project tool. The task identification and scheduling process were performed by KM tools such as MS SharePoint and Rally instead of MS Project. As one team member described the scheduling task with Rally:

> And then we get into a planning session and then business said, "Hey, I want this 50 user stories to be done in the next sprint," or whatever it is. You assign points to it and then you look at it and say — you look at the team velocity but you look and say, "Gee, we can probably only do 35 of those stories, so 15 are going to have to be moved out." That's the playing that's going on. You're looking at those user stories, knowing we do some IT planning around what do we really think it's going to take us in terms of hours to do what they are going to do? Is it going to fit into a three-week increment? Is it not? Do we have to split it? And so on and so forth. That all happens in Rally now. We don't do it in MS Project.

There was some discussion about using MS Project, but other tools seemed to be better options because (a) members of the organization seemed to have limited access to MS Project; (b) more information was needed by MS Project than was used, and (c) the learning curve for MS Project was high compared with MS SharePoint.

In Mas-Machuca and Martínez Costa's (2012) study on critical success factors for KM, they identified the importance of adding new technology into the organization for knowledge sharing. Smart boards are a new technology for knowledge sharing that the organization has added. The tool may not be getting as much use as possible now, but by adding new technology, the organization has demonstrated its commitment to KM in the organization.

Buzan and Griffiths (2010) discussed the use of mind maps for a vision of new projects, and Wang and Jacobson (2011) discussed other visual tools for project development. Mind maps and concept maps were not used extensively in the project

development process. On occasion, they were used and stored with MS OneNote, but most of the projects that the organization developed were at a more detailed level. The organization used flow charts and other visual tools for project development. The visual tools of flow charts or mind maps were added to MS SharePoint for all of the project team. There seemed to be a change in the traditional PM tools and KM tools. The tools that were traditionally performed by one or the other have been moved together.

Discussion boards are a part of the combined tool, but there seemed to be a reluctance to use them. This led to a large amount of face-to-face contact via meetings, telephone conferences, or the other face-to-face tools, and the process of converting the tacit knowledge to explicit knowledge in a repository is a concern.

There seemed to be an appropriate amount of knowledge sharing in the researched IT projects. The organization did not provide any incentives for adding to MS SharePoint, Rally, or other KM tools, as was suggested by Paroutis and Saleh (2009). The culture of the organization seemed to encourage knowledge sharing. In the agile process, IT team members were frequently in contact with the business users, and this created an environment for sharing knowledge. There also seemed to be a culture of the stakeholders and IT team members having responsibility for the success of the project. Defining success for the project by the lack of defects and high-quality software created a culture in the IT organization of sharing knowledge. Design and code reviews, with knowledge sharing for IT project members to create high-quality software, have been the proper incentive for the team members. Lianying and Zhen (2014) studied the use of incentives for KM in China in new product development. Their research indicated that team and

non-financial incentives can be effective tools for KM. This group at the insurance organization seemed to provide the same results. The non-financial reward of the success of the project was a big incentive for the team. There was a strong team commitment, and each member seemed to be working for the success of the team. The design and program review process provided an opportunity for knowledge sharing within the IT area. These reviews were open to people outside of the project. This process of design and program reviews had a better effect than the process of lessons learned being discussed after the project was over. By having the design reviews, knowledge is shared as the project is being developed.

Dulipovici and Robey (2013) suggested that the social representation concerns are a part of the techniques used for sharing knowledge. What may work for one group of an organization may not work for another because of the social connections. With the groups involved in this study, there was a strong social connection within and between the different project areas. MS SharePoint was used more frequently in project areas that did not have Rally. This seemed to be a technical issue instead of a social concern. For the sharing of best practices and procedures between groups, MS SharePoint was the tool used because it was available to everyone.

One other technique discussed for knowledge sharing was for the organization to have an office of PM. At this insurance organization, the PM office was not in the same location as most of the IT developers. Although the PM office helped project managers share knowledge with each other, it did not seem to be an advantage to the knowledge sharing that was occurring with the IT teams. Becerra-Fernandez and Sabherwal's (2001)

study of the knowledge processes at NASA suggested that face-to-face knowledge-sharing techniques were needed for process tasks and repository use was needed for content tasks. In the IT area of the insurance organization, it was difficult to divide the tasks involved as process and content. The tasks involved both content development and the process for gathering the content. The insurance organization seemed to have a different organizational structure. Members of the IT area were involved in face-to-face knowledge sharing and using the knowledge repositories in each phase of the development process. Although the repository changed between phases, each phase used a repository.

Reich et al.'s (2008) knowledge perspective model discussed the changes in the knowledge during an IT project. At the insurance organization, the team members did not change very often by breaking projects into different departments of the IT area. This project studied five different areas of the IT department instead of five different projects. There were a large number of projects that were being developed in each area. Some of the projects were involved in resolving production issues for the group, and others were new projects needed by the organization. By using the departments, the employees maintained knowledge about the area, and when an employee changed projects, there were was less time needed to add the knowledge needed for the new project. The IT organization gave employees the ability to create self-directed project teams that helped team members to be motivated to stay with the group. The adaptive project development process that tried to create 10-day task cycles and short-term projects did not create the issue of team members leaving during the project.

Reich et al.'s (2012) discussion of (a) knowledge stock, (b) enabling environment, and (c) knowledge practices was clearly identified in the organization. By analyzing the four models of (a) requirements, (b) code development, (c) testing, and (d) helpdesk, each model included the three activities. Each model contained both explicit and tacit knowledge being shared for the success of the project.

McIver, Lengnick-Hall, Lengnick-Hall, and Ramachandran (2013) presented a model of four different types of organizations for the knowledge in practice perspective. Their research suggested that there are (a) enacted information, (b) accumulated information, (c) apprentice information, and (d) talent information perspectives. An insurance organization was an example of an enacted information perspective. This type of organization works with codified explicit knowledge that is used to answer clients' question and develop systems. This is very different from the talent information perspective, which does not rely on the codified information. It relies more on the talent information of the employees and their tacit knowledge. The other two perspectives used with organizations are more of a mix between the need for explicit and tacit knowledge than the enacted and talent information perspectives.

One of the issues with the current KM environment is the organization of information and being able to find the right information at the time it is needed. Yanchinda, Yodmongkon, Chakpitak, and Goldsmith (2011) studied this issue with a construction project in Thailand. Their approach involved using standard categories that were established by the government of Thailand. For the insurance organization, this may

be of some value, but Thailand is a different culture, and being able to be sure that all individuals in the IT area use these standards may be a challenge.

Within the requirements model, the proprietary software system was an MS Access database system that contained the system rules and standards for the organization. It was maintained by the user's area of the IT area and used extensively by the IT area for the development of requirements and coding for applications. This system had been in place for some years. As one manager put it in the original development of the system:

> Well, the interesting thing about [the proprietary KM software system] was when we originally built the [proprietary KM software system] what we were trying to do is get rid of the probes. We get requirements that were long sentences and paragraphs, and you have to pick out the salient points. We tried to do a [proprietary KM software system] because it became rows and columns, so you got rid of the probes. So it said, "For this state, or this time, or this whatever, here is the answer you were trying to give." That's what we were trying to do. Now, Access just happened to be the cheapest, easiest thing we can go find and do it whatever, but the real point of that was to try to make tape.

This MS Access database system was a major KM tool for the IT development area. It was the tool used by the business analysts and the user community to pass the rules and standards to the IT area. The business users hired consultants to develop the system, and they maintained it. This tool was used for creating new data elements and defining them for IT systems. A data rationalization team handled helping project teams

use the proper data for the project. The data rationalization team consisted of both users and IT employees. They met and determined the rules for the processes for coverages for the insurance items that were the product of the firm. If the needed data did not exist in the system, this group added the new data field and updated the documentation on the MS Access database. Frequently, in the requirements documents, there was a reference to the proprietary KM software system. This process has been used for a number of years, and before it was developed, a paper system had been used. This KM tool was how the organization handled the issue of miscommunications of requirements between the business analysts and the IT area. The proprietary KM software system's entries were the basis for application development. In the testing process, the application must operate as described in the proprietary KM software system.

One more item about the use of the proprietary KM software system in the organization was the comparison with the study by Frey et al. (2009) on PKM. This research examined the PKM success based on the knowledge being shared by the lessons-learned process in an organization. At this organization with the proprietary KM software system, the rules and standards were being shared during the requirements process and not during the lessons-learned process that frequently occurs after the project is completed. By sharing knowledge during the requirements process, the organization was trying to be successful by reducing the number of defects in the new systems. The study also suggested that commitment and emphasis of top management determined PKM success. In this case at the insurance organization, there was a commitment to sharing knowledge by the use of the proprietary KM software system. All of this research

about the proprietary KM software system corresponds with the research by Krishnaveni and Raja (2011) and their examination of KM tools such as search engines, knowledge portals, communities of practice, lessons learned, and best practices repositories. Their analysis found that the KM tools aided the IT area and were a success factor for the organization. This is also true with the insurance organization. The MS Access database software system was used as a data repository for not only best practices and lessons learned but also processing rules and the definition of data elements has been a success factor for the organization.

In this organization, knowledge that was needed for the operation of the department has increased. With the increase of knowledge used in the department, there has been an increase in the knowledge sharing to improve the performance. With the increased knowledge sharing, more decision making was occurring within the project teams instead of by the managers of the department. This has created self-directed teams for IT projects. One concern voiced by a manager of the self-directed team concept that was used to improve knowledge sharing was:

> Then I've got a self-directed team that, unless they really understand the whole of the context that they're building in, may start making some self-directed decisions that say, "Well, okay. My business partner wants me to do this — it's an extra month. What's an extra month, more or less? Or an extra week, more or less?" Sounds great when you're one [project] team? I've got 60 [project] teams probably coming out of this at the end of the day. If 60 of them make a one-week

decision, now I've got a one-year decision that got made. When you're at the top of that organization, you say, "My goodness, how do they get a year off?"

This is a difference with the manner in which IT projects were handled in a more planning–execution–controlling process of the past. There were some benefits to that style of PM, and those items need to be incorporated into current PM and KM processes.

An issue in the helpdesk model and the requirements model was the challenge of miscommunications with the user. The IT area is involved in the technical world of the computer system, and the users are outside of that world. As Polanyi (1962) suggested, the experiences created a framework for the knowledge being shared. This causes misunderstanding and a need to communicate in a manner that both areas understand. The IT area exchanged face-to-face messages with the helpdesk area for a clear understanding of the issue. Sometimes this involved the use of screen sharing with MS Lync to see the issue that was being presented. For the requirements model, the miscommunications that occurred were one reason for the frequent telephone calls, e-mails, instant messages, and other face-to-face methods that were used to understand the requirements of the user. As Berger and Luckman (1966) pointed out, language and trust are needed to improve knowledge transfer. With the IT area having a significant amount of face-to-face communication with the user, the miscommunications were minimized and quickly corrected.

Huang, Barbour, Su and Contractor (2013) suggest the development of transactive memory systems to help the organization share knowledge without using discussion boards or posting to other digital repositories. Transactive memory systems only indicate

the person that is the subject matter expert to contact for the answer to questions instead of the complete answer that is part of a discussion board. This process is helpful for individuals that are hesitant to post on digital repositories, but provide a manner for information sharing.

The issue of KM tools not always being used was discussed by Trusson, Doherty, and Hislop (2014). They warned about tools use being imposed by management and suggested that knowledge sharing tools need agreement by the users of them and cannot be dictated from management. If the tools are not supported by the individuals using them, they will not be used appropriately. That does not appear to be the case and IT team members did not seem to indicate that the use of the tools was being demanded by management. It appears that the tools are still new to the organization and time is needed for their adoption into the workplace. Haas et al. (2015) discussed the challenges of participation with online social platforms. In an online environment it is easier to withhold information because it is an indirect request for information instead of a face-to-face request. The suggestion was made that problems on an online environment need to be longer, broader and more novel to attract attention and answered.

Groupware could help the issue of e-mail for the organization in tacit knowledge sharing including security and too many messages. Evans et al. (2015) discussed the use of groupware with messaging, event planning, and alert services for updated project information could be an option for the organization. It could help with the project information being group together, but there still may be some issues with e-mails coming from external project sources.

The issue of offshore development is a challenge for many firms as they become global. For this organization, it was a cost concern that caused the firm to set up an offshore facility. It was less expensive to set up the facility although there was a 12-and-a-half-hour time zone difference. Consoli, Rocchi, and Spagnoletti (2014) discussed a software project involving teams from Italy and India. The project was not successful because of cultural differences between the two countries that created issues with the transfer of knowledge between the two teams. Kivrak, et al., (2014) discovered knowledge sharing challenges in their study of multinational project teams that could also contribute to issues for the success of the project. Kotlarsky, Scarbrough, and Oshri (2014) studied the issue of offshore expertise for an organization and suggested that a knowledge map with experts in both countries should be established to create more responsive answers to issues. Their research also suggested that knowledge of the knower is important for the best use of the knowledge. For an organization that may be a positive recommendation, but for knowledge sharing of the face-to-face process at the insurance organization that was a challenge.

The issues of the knowledge flows for the organization possibly derive from the project teams determining how knowledge is used only with their project. Knowledge is managed in each project team which is not always in agreement with the organization. There is a need for a knowledge management team with a chief knowledge officer that would align the knowledge activities of the organization with the business goals. They would be responsible for managing the knowledge of the organization (Dalkir, 2011). Tools such as the smart boards and SharePoint would be used as specified by

management. MS Access or another database environment would be viewed as containing important knowledge that was needed for IT projects.

Limitations of the Study

The limitation on credibility was that the insurance organization where the research was conducted provided guidance in the participant selection process. If the organization did not have a part in this selection, it is possible that different participants would have been part of the research. Another limitation is that the participants who did take part in the research were busy at their work and not always available. The participants provided time for the research while working on IT projects that were needed by the organization. The projects had deadlines that had to be observed for the organization. More time could have been spent on observations and interviewing different participants, but the participants who had the time available for the research had volunteered for it. Different participants in the research at the organization may have provided a different perspective on KM in the organization.

The limitation on transferability of the information of this research is that only one insurance firm was studied for its use of KM in IT projects. The process cannot easily be compared with another organization in a different industry. An insurance organization is regulated by the government, and there are restrictions on the processes that can be performed. This is different from a manufacturing environment, and this research may not easily transfer to that type of organization. This restriction on the operation because of the government may also limit the ability for the research to be transferred to another country.

The limitation on the dependability of the research was that the research involved 26 participants who volunteered for the research but were suggested by the organization. If 26 other people at the insurance organization were involved in the research, there might be some different results. With the participants in this research, the research developed the KM models for the IT projects at this organization. With other participants, the models might be different.

Conformability of the research was limited by the KM models for the different phases of the IT project development process that were shared with other participants in the research. Changes that were suggested were included in the research. The models were confirmed by managers and team members of the research. In this research, software tools were evaluated for their functionality in the organization. Since not all software was used by all participants, some were unable to provide a proper analysis of the software tools.

Recommendations

This research examined the IT department of an insurance organization. KM usage included the requirements processing, code development, and testing. The production processing added another area for KM. This may not be the same in other insurance organizations, and it may be different in the IT area of other organizations. The government highly regulates insurance organizations. IT project development must include these regulations, and this is not the case with other organizations. The IT area of other insurance organizations or other IT organizations should be studied to identify whether the KM processes can be divided in the same way as this research found them.

The first recommendation for the first research question on KM for an IT project is to study other project-oriented areas outside of IT. Crawford and Pollack (2007) suggested that IT projects are similar to construction projects. IT projects are also similar to engineering and business development projects. Research is needed to study KM in construction projects with success being managed for high quality. Does the use of a knowledge repository developed using MS Access have the same effectiveness as it did for this organization? Can the knowledge flow process be divided into the four phases of this organization?

For the second research question on the tools used for IT projects success, further research is needed for the use of MS Access as a knowledge repository for business rules and standards for the organization. This was not predicted. Although there are some concerns about the database being in the development area, the tool is highly used and seems to be effective for the organization. Research is needed to find out whether other organizations use this type of tool for KM to share business knowledge between users and the IT area. Is the tool used for business rules and standards? What is the user's role in maintaining this system? Is MS Access used or are there other tools used for this knowledge, and what are the issues with those tools? The sharing of the rules and standards of the organization is important for the quality of the IT projects. There was an issue with the repository being in the development area and not being maintained like databases in the production environment. How do other organizations resolve this problem? The research for this type of knowledge repository could be quantitative. The

research could study the number of organizations using MS Access or other database tools. What is the most frequently used tool for the knowledge repository?

Another recommendation based upon the second question on tools for the IT project success is the issues with e-mail identified in this research. E-mail is tacit knowledge and is converted to explicit knowledge by storing it in a data repository. For this insurance organization, that process of storing the e-mail information on a repository had a couple of issues, such as it not being added to the repository or the data being different when it was added to different repositories. When the data were different on the different repositories, it was very difficult to determine which data were correct. What have organizations done to control the issues of e-mail? Have other organizations been able to control the use of e-mail by the data repositories, or are the other face-to-face tools the best way to control the issue?

The third research question focused on the current PM process for managing knowledge. Further research is needed for this question based upon the research by Görög (2011) and comparing the PM process with the process of the insurance organization. This research was similar to Görög's study on knowledge sharing. The research showed a high quality of information being shared within the project and a high number of shared resources between projects. During the interviews, project team members of one group seemed to be very familiar with the other current projects. The reason for this seemed to be the design reviews and quality control processing within the IT area. Design reviews were open to any member of the IT area who wished to join the meeting. Besides making the design standards for the organization known, it also helped

keep all members of the IT area informed about the other projects in the organization. The other technique that helped was how all of the IT area had their offices in the same area. There is a need for another study to continue examining knowledge sharing in other organizations.

Implications

The implication for social change of this research is from understanding the importance of managing the knowledge flow in an IT project and the different processes that are needed. The IT area of organizations provides systems for businesses, medical facilities, and government for social change. IT projects are helping with the supply of medical care to individuals who have not had it in the past. Government projects are becoming available for more people than in the past. IT projects are helping to create social change. As these IT projects are helping with social change, they are increasing the number of people involved and the need to interface with other computer systems. These complications have caused an increase in the knowledge sharing needed for the success of the IT projects. Finding ways to improve the knowledge sharing of the IT development process is the objective of this research. Understanding KM in the PM process for IT will help improve the process. With an improved PM process, better systems can be developed that can improve the lives of people in society.

This research has implications for social change not only for society, but also for individual organizations. At the insurance organization, there was a lack of recognition of how important the knowledge repository process was for sharing knowledge. This process needs to be given the same procedures that other production systems receive with

routine backups and support. The IT team members developing projects need this information in a time-sensitive manner for the development of IT systems. The face-to-face tools of the organization were frequently being evaluated for effectiveness. There are a number of tools that are available for organizations for knowledge sharing. Evaluating these tools is needed for decision making for the best tools and process. This research helped identify the use of KM in the PM process, which is important for educating IT team members. The educational process of the PM process needs to include the different types of knowledge repositories and the knowledge sharing that is needed for developing IT projects. The issues being managed also need to be included. It is important to understand not only the tasks involved in the different phases but also the management of the knowledge in each phase of the IT project development process.

Conclusion

The IT department of an organization develops systems using PM tools, data repositories, and techniques for the organization to be able to perform business. Over the past few years, this process has become increasingly complicated, with larger project teams, team members in different locations and different countries, and being integrated into other systems. Managing the project has become more difficult. Part of managing the project is the management of the knowledge of the project that must be shared with the other areas of the organization to determine the computer needs and develop the best systems for the organization. Managing the knowledge for an IT project is a critical process. Understanding how an organization is managing the knowledge in the PM

process is needed to understand where improvements can be made for successful systems to help the organization.

In this research I examined four areas in the PM process of (a) requirements, (b) code development, (c) application testing, and (d) helpdesk services in an insurance organization. I studied how the organization managed the knowledge in the IT project development process. The different tools that were being used for KM and how the tools helped the success of projects were included in the analysis. The research also studied the issues with KM in the PM process at the organization and how to correct some of the problems.

In the research, it was found that the traditional PM and KM tools were being integrated together to combine the knowledge of the team members with project development. This helped with accessing knowledge for the project development. The integration of the tools did not eliminate some of the issues for the tools, such as lack of use, but it helped with accessing the knowledge during project development. With combining the knowledge in the process, maybe more knowledge was added to the system. The research also found the use of a database tool, MS Access, to be a very effective knowledge base for the organization. It was so effective that one of the big issues in the IT area was maintaining the system that existed in the development area and was not part of the production environment.

Morris (2013a) called for the reconstruction of PM from a knowledge perspective. He argued that PM is a social construct and knowledge is applied in context to the organization and project being developed. There is a large amount of knowledge about

the general practice of PM from the PMI and other resources. What is needed is a better understanding of the context of the project and its part for the success of the organization. Morris suggested that PM needs to include the cultural and institutional knowledge of the organization.

Organizations are becoming more knowledge aware (Zaharia, Tudorescu, Zaharia, & Zaharia, 2011). They recognize the importance of knowledge as a strategic asset. IT development needs to be viewed as a process of creation, innovation, knowledge sharing and learning (Rosenkranz et al., 2014). This research focused on one insurance organization and how that organization was using KM in the PM process. The knowledge perspective used by the PM process to achieve the objectives of the insurance organization was discovered. This perspective was not the same as other organizations and the tools such as MS Access, and Remedy that were being used might be different. The PM process was successful by keeping the number of defects to a minimum in the projects and helping the organization. By studying the issues of this organization, it is working to resolve them. Other organizations may be able to learn from this organization as a technique for analysis, but their issues will probably be different and require different solutions. As each organization studies its PM process with the KM, improvements can be made for that organization. The KM in the PM process may be a social construction for the organization, but as each organization studies KM in the PM process, it may lead to improved projects for many organizations. The improved projects can be used to solve many social issues.

References

Abu-Shanab, E., Knight, M. B., & Haddad, M. (2014). Knowledge sharing practices and the learning organization: A study. *IUP Journal of Knowledge Management, 12*(2), 38-50.

Adolph, S., & Kruchten, P. (2011). Reconciling perspectives: How people manage the process of software development. *Agile Conference (AGILE), 2011*, 48-56. doi:10.1109/AGILE.2011.43.

Åge, L. (2011). Grounded theory methodology: Positivism, hermeneutics, and pragmatism. *Qualitative Report*, *16*(6), 1599-1615. Retrieved from http://files.eric.ed.gov/fulltext/EJ956234.pdf

Aghamirian, B., Dorri, B., & Aghamirian, B. (2015). Customer knowledge management application in gaining organization's competitive advantage in electronic commerce. *Journal of Theoretical & Applied Electronic Commerce Research*, *10*(1), 63-78. doi:10.4067/S0718-18762015000100006

Ajmal, M., Helo, P., & Kekäle, T. (2010). Critical factors for knowledge management in project business. *Journal of Knowledge Management*, *14*(1), 156-168. doi:10.1108/13673271011015633

Akhavan, P., & Mahdi Hosseini, S. (2015). Determinants of knowledge sharing in knowledge networks: A social capital perspective. *IUP Journal of Knowledge Management, 13*(1), 7-24.

Akhavan, P., & Zahedi, M. R. (2014). Critical success factors in knowledge management among project-based organizations: A multi-case analysis. *IUP Journal of*

Knowledge Management, 12(1), 20-38.

Algeo, C. (2014). Exploring project knowledge acquisition and exchange through action research. *Project Management Journal, 45*(3), 46-56. doi:10.1002/pmj.21417.

Alrawi, K., Hamdan, Y., Al-Taie, W., & Ibrahim, M. (2013). Organizational culture and the creation of a dynamic environment for knowledge sharing. *International Journal of Management & Innovation, 5*(1), 1-11.

Andreeva, T., & Ikhilchik, I. (2011). Applicability of the SECI model of knowledge creation in Russian cultural context: Theoretical analysis. *Knowledge & Process Management, 18*(1), 56-66. doi:10.1002/kpm.351.

Anantatmula, V., & Kanungo, S. (2008). Role of IT and KM in improving project management performance. *VINE*, *38*(3), 357-369. doi:10.1108/03055720810904862

Ballejos, L., & Montagna, J. (2011). Modeling stakeholders for information systems design processes. *Requirements Engineering*, *16*(4), 281-296. doi:10.1007/s00766-011-0123-2

Becerra-Fernandez, I., & Sabherwal, R. (2001). Organizational knowledge management: A contingency perspective. *Journal of Management Information Systems*, *18*(1), 23-55. Retrieved from https://www.researchgate.net/profile/Rajiv_Sabherwal/publication/220591704_Organizational_Knowledge_Management_A_Contingency_Perspective/links/0c9605321c99993333000000.pdf

Berger, P. L., & Luckman, T. (1966). *The social construction of reality: A treatise in the*

sociology of knowledge. New York, NY: Random House, Inc.

Besner, C., & Hobbs, B. (2012). An empirical identification of project management toolsets and a comparison among project types. *Project Management Journal, 43*(5), 24-46. doi:10.1002/pmj.21292

Bisaillon, L., & Rankin, J. M. (2013). Navigating the politics of fieldwork using institutional ethnography: Strategies for practice. *Forum: Qualitative Social Research*, *14*(1), 1-27.

Boisot, M. H. (1998). *Knowledge assets: Securing competitive advantage in the information economy.* New York, NY: Oxford University Press.

Borgatti, S., & Halgin, D. (2011). On network theory. *Organization Science, Articles in Advance, 22*(5), 1165-1181.

Bredillet, C. N. (2010). Blowing hot and cold on project management. *Project Management Journal*, *41*(3), 4-20. doi:10.1002/pmj.20179

Brown, C. (2013). Critique and complexity: presenting a more effective way to conceptualise the knowledge adoption process. *London Review of Education, 11*(1), 32-45. doi:10.1080/14748460.2012.761818

Brown, S. A., Dennis, A. R., Burley, D., & Arling, P. (2013). Knowledge sharing and knowledge management system avoidance: The role of knowledge type and the social network in bypassing an organizational knowledge management system. *Journal of the American Society for Information Science & Technology, 64*(10), 2013-2023. doi:10.1002/asi.22892

Buzan, T., & Griffiths, C. (2010). *Mind maps for business: Revolutionize your business*

thinking and practices. Harlow, Great Britain: BBC Active.

Cao, Q., Thompson, M. A., & Triche, J. (2013). Investigating the role of business processes and knowledge management systems on performance: A multi-case study approach. *International Journal of Production Research, 51*(18), 5565-5575. doi:10.1080/00207543.2013.789145

Chien, Y., Tsai-Fang, Y., & Chin-Cheh, Y. (2013). Knowledge sharing, organizational climate, and innovative behavior: a cross-level analysis of effects. *Social Behavior & Personality: An International Journal, 41*(1), 143-156. doi:10.2224/sbp.2013.41.1.143

Chou, J., Irawan, N., & Pham, A. (2013). Project management knowledge of construction professionals: Cross-country study of effects on project success. *Journal of Construction Engineering & Management, 139*(11), 1. doi:10.1061/(ASCE)CO.1943-7862.0000766

Chu, M., KrishnaKumar, P., & Khosla, R. (2014). Mapping knowledge sharing traits to business strategy in knowledge based organisation. *Journal of Intelligent Manufacturing, 25*(1), 55-65. doi:10.1007/s10845-012-0674-1

Consoli, C., Rocchi, P., & Spagnoletti, P. (2014). An empirical study of offshore software development: The case of a ticketing application. *Journal of Computing & Information Technology, 22*(4), 267-275. doi:10.2498/cit.1002344.

Crawford, L., & Pollack, J. (2007). How generic are project management knowledge and practice? *Project Management Journal*, *38*(1), 87-96.

Cromity, J., & de Stricker, U. (2011). Silo persistence: It's not the technology, it's the

culture! *New Review of Information Networking*, *16*(2), 167-184. doi:10.1080/13614576.2011.619924.

Cross, R., Parker, A., Prusak, L., & Borgatti, S. P. (2004). Knowing what we know: Supporting knowledge creation and sharing in social networks. In E. Lesser & L. Prusak (Eds.), *Creating value with knowledge: Insights from the IBM Institute for Business Value* (pp. 61-81). New York, NY: Oxford University Press.

Dalkir, K. (2011). *Knowledge management in theory and practice* (2nd ed.). Cambridge, MA: The MIT Press.

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

Davison, R. M., Ou, C. J., & Martinsons, M. G. (2013). Information technology to support informal knowledge sharing. *Information Systems Journal, 23*(1), 89-109. doi:10.1111/j.1365-2575.2012.00400.x.

Desouza, K. C., & Evaristo, J. R. (2004). Managing knowledge in distributed projects. *Communications of the ACM*, *47*(4), 87-91. doi:10.1145/975817.975823.

Dulipovici, A., & Robey, D. (2013). Strategic alignment and misalignment of knowledge management systems: A social representation perspective. *Journal of Management Information Systems*, *29*(4), 103-126. doi:10.2753/MIS0742-1222290404.

Dunne, C. (2011). The place of the literature review in grounded theory research. *International Journal of Social Research Methodology*, *14*(2), 111-124. doi:10.1080/13645579.2010.494930.

Durst, S., & Wilhelm, S. (2011). Knowledge management in practice: Insights into a medium-sized enterprise's exposure to knowledge loss. *Prometheus, 29*(1), 23-38.

Dutt, M. (2014). Using mind maps to enhance creativity when managing projects. *Journal for Quality & Participation*, *37*(2), 1-10.

Eppler, M. J. (2008). A process-based classification of knowledge maps and application examples. *Knowledge & Process Management*, *15*(1), 59-71. doi:10.1002/kpm.299.

Eservel, U. Y. (2014). IT-enabled knowledge creation for open innovation. *Journal of the Association for Information Systems, 15*(11), 805-834.

Evans, R. D., Gao, J. X., Martin, N., & Simmonds, C. (2015). Integrating social knowledge and collaboration tools into dispersed product development. *International Journal of Advanced Corporate Learning, 8*(2), 20-27. doi:10.3991/ijac.v8i2.4548.

Eveleens, J. L., & Verhoef, C. (2010). The rise and fall of the Chaos Report figures. *IEEE Software*, *27*(1), 30-36.

Foss, N. J., Lyngsie, J., & Zahra, S. A. (2013). The role of external knowledge sources and organizational design in the process of opportunity exploitation. *Strategic Management Journal, 34*(12), 1453-1471. doi:10.1002/smj.2135.

Frey, P., Lindner, F., Müller, A., & Wald, A. (2009). Project knowledge management organizational design and success factors: An empirical study in Germany. In *Proceedings of the 42nd Hawaii International Conference on System Science – 2009* (pp. 1-14).

Fuller, P. A., Dainty, A. R. J., & Thorpe, T. (2011). Improving project learning: A new approach to lessons learnt. *International Journal of Managing Projects in Business*, *4*(1), 118-136. doi:10.1108/17538371111096926.

Gans, H. (2010). Public ethnography; ethnography as public sociology. *Qualitative Sociology*, *33*(1), 97-104. doi:10.1007/s11133-009-9145-1.

Garstenauer, A., Blackburn, T., & Olson, B. (2014). A knowledge management based approach to quality management for large manufacturing organizations. *Engineering Management Journal, 26*(4), 47-58.

Gasik, S. (2011). A model of project knowledge management. *Project Management Journal, 42*(3), 23-44. doi:10.1002/pmj.20239.

Ghandvar, P., & Sehhat, S. (2015). Relationship between knowledge management and quality management in insurance companies. *International Journal of Academic Research, 7*(1), 475-485. doi:10.7813/2075-4124.2015/7-1/B.81.

Ginevičius, T., Kaklauskas, A., & Kazokaitis, P. (2011). Knowledge model for integrated construction project management. *Business: Theory & Practice*, *12*(2), 162-174. doi:10.3846/btp.2011.17.

Goepp, V., Caillaud, E., & Rose, B. (2013). A framework for the design of knowledge management systems in eco-design. *International Journal of Production Research, 51*(19), 5803-5823. doi:10.1080/00207543.2013.795252.

Görög, M. (2011). Translating single project management knowledge to project programs. *Project Management Journal, 42*(2), 17-31. doi:10.1002/pmj.20222.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic*

Management Journal, *17*, 109-122.

Gummesson, E. (2014). Service research methodology: From case study research to case theory. *Revista Ibero - Americana De Estratégia, 13*(4), 8-17. Retrieved from http://search.proquest.com/docview/1667370731?accountid=14872.

Haas, M. R., Criscuolo, P., & George, G. (2015). Which problems to solve? Online knowledge sharing and attention allocation in organizations. *Academy of Management Journal, 58*(3), 680-711. doi:10.5465/amj.2013.0263.

Hahn, I., Bredillett, C., Gyeung-Min, K., & Taloc, M. (2012). Agility of project manager in a global IS project. *Journal of Computer Information Systems, 53*(2), 31-38.

Hallwood, C. P. (2014). Governing knowledge and the scope of the firm. *International Journal of Organizational Analysis, 22*(1), 2-13. doi:10.1108/IJOA-07-2010-0441.

Hanisch, B., & Wald, A. (2011). A project management research framework integrating multiple theoretical perspectives and influencing factors. *Project Management Journal*, *42*(3), 4-22. doi:10.1002/pmj.20241.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, *28*(1), 75-105. Retrieved from http://search.proquest.com/docview/218119584?accountid=14872.

Huang, M., Barbour, J., Su, C., & Contractor, N. (2013). Why do group members provide information to digital knowledge repositories? A multilevel application of transactive memory theory. *Journal of the American Society for Information Science & Technology, 64*(3), 540-557. doi:10.1002/asi.22805.

Huang, E. Y., & Huang, T. K. (2012). Investigating the antecedents of users' knowledge sharing intention. *Journal of Computer Information Systems, 53*(2), 93-102.

Islam, M. Z., Low, K. C. P., & Rahman, M. H. (2012). Towards understanding knowledge transfer: In search of a theoretical construct. *Franklin Business & Law Journal*, *2012*(1), 39-60.

Iuga, V., & Kifor, C. V. (2014). Information and knowledge management and their interrelationship within lean organizations. *Revista Academiei Fortelor Terestre, 19*(2), 31-38.

Jain, P. (2011). Personal knowledge management: The foundation of organisational knowledge management. *South African Journal of Libraries & Information Science, 77*(1), 1-14.

Jasimuddin, S., Connell, N., & Klein, J. (2012). Knowledge transfer frameworks: An extension incorporating knowledge repositories and knowledge administration. *Information Systems Journal*, *22*(3), 195-209. doi:10.1111/j.1365-2575.2011.00382.x.

Kane, G. C., & Borgatti, S. P. (2011). Centrality-IS proficiency alignment and workgroup performance. *MIS Quarterly, 35*(4), 1063-1078.

Karlsen, J. T., Hagman, L., & Pedersen, T. (2011). Intra-project transfer of knowledge in information systems development firms. *Journal of Systems and Information Technology*, *13*(1), 66-80. doi:10.1108/13287261111118359.

Karpicke, J., & Grimaldi, P. (2012). Retrieval-based learning: A perspective for enhancing meaningful learning. *Educational Psychology Review*, *24*(3), 401-418.

doi:10.1007/s10648-012-9202-2.

Kim, Y. W. (2014). HR practices and knowledge sharing behavior: Focusing on the moderating effect of trust in supervisor. *Public Personnel Management, 43*(4), 586-607. doi:10.1177/0091026014542342.

Kitimbo, I., & Dalkir, K. (2013). Characterization of knowledge sharing practices in a project based organization. In *Proceedings of the International Conference on Intellectual Capital, Knowledge Management & Organizational Learning* (pp. 561-567).

Kivrak, S., Arslan, G., Tuncan, M., & Birgonul, M. T. (2014). Impact of national culture on knowledge sharing in international construction projects. *Canadian Journal of Civil Engineering, 41*(7), 642-649. doi:10.1139/cjce-2013-0408.

Koskela, L. J., & Howell, G. (2002). *The underlying theory of project management is obsolete.* Presentation at the PMI Research Conference, Seattle, WA.

Kotlarsky, J., Scarbrough, H., & Oshri, I. (2014). Coordinating expertise across knowledge boundaries in offshore-outsourcing projects: The role of codification. *MIS Quarterly, 38*(2), 607-a5.

Krishnaveni, R. R., & Raja, C. (2011). Knowledge management and supporting tools in IT organizations. *BVIMR Management Edge*, *4*(1), 40-49.

Lai, W., & Tsen, H. (2013). Exploring the relationship between system development life cycle and knowledge accumulation in Taiwan's IT industry. *Expert Systems, 30*(2), 173-182. doi:10.1111/j.1468-0394.2012.00630.x

Lee, J. S., Keil, M., & Kasi, V. (2012). The effect of an initial budget and schedule goal

on software project escalation. *Journal of Management Information Systems, 29*(1), 53-78.

Lianying, Z., & Zhen, Z. (2014). The effects of incentive mechanism on knowledge management performance in China: The moderating role of knowledge attributes. *Project Management Journal, 45*(2), 34-47. doi:10.1002/pmj.21403

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. Newbury, CA: Sage Publications.

Li-Su, H., & Cheng-Po, L. (2014). Critical success factors for knowledge management implementation in life insurance enterprises. *International Journal of Management & Marketing Research, 7*(2), 79-89.

Lopez, V. W. B., & Esteves, J. (2013). Acquiring external knowledge to avoid wheel re-invention. *Journal of Knowledge Management, 17*(1), 87-105. doi:10.1108/13673271311300787

Manganello, F., Falsetti, C., Spalazzi, L., & Leo, T. (2013). PKS: An ontology-based learning construct for lifelong learners. *Journal of Educational Technology & Society, 16*(1), 104-117.

Mas-Machuca, M., & Martínez Costa, C. (2012). Exploring critical success factors of knowledge management projects in the consulting sector. *Total Quality Management & Business Excellence, 23*(11/12), 1297-1313. doi:10.1080/14783363.2011.637778.

Maxwell, J. A. (2005). *Applied social research methods series: Vol. 41. Qualitative research design: An interactive approach* (2nd ed.). Thousand Oaks, CA: Sage

Publications.

McIver, D., Lengnick-Hall, C. A., Lengnick-Hall, M. L., & Ramachandran, I. (2013). Understanding work and knowledge management from a knowledge-in-practice perspective. *Academy of Management Review, 38*(4), 597-620. Doi:10.5465/amr.2011.0266.

Mehta, N., & Bharadwaj, A. (2015). Knowledge integration in outsourced software development: The role of sentry and guard processes. *Journal of Management Information Systems, 32*(1), 82-115. doi:10.1080/07421222.2015.1029381.

Minbaeva, D.B., Mäkelä, K., & Rabbiosi, L. (2012). Linking HRM and knowledge transfer via individual-level mechanisms. *Human Resource Management*, *51*(3), 387-405. doi:10.1002/hrm.21478.

Mishra, D., & Mishra, A. (2011). Research trends in management issues of global software development: Evaluating the past to envision the future. *Journal of Global Information Technology Management, 14*(4), 48-69.

Morris, P. W. G. (2013a). *Reconstructing Project Management*. London, England: John Wiley & Sons, Ltd.

Morris, P. W. G. (2013b). Reconstructing project management reprised: A knowledge perspective. *Project Management Journal, 44*(5), 6-23. doi:10.1002/pmj.21369.

Muhammad, F., Rizwan, B., Sijun, B., & Libiao, B. (2013). Project management knowledge transfer upshots: Success story of Chinese project management firm. *International Journal of Multimedia & Ubiquitous Engineering, 8*(3), 225-238.

Müller, R., Glückler, J., Aubry, M., & Shao, J. (2013). Project management knowledge

flows in networks of project managers and project management offices: A case study in the pharmaceutical industry. *Project Management Journal, 44*(2), 4-19. doi:10.1002/pmj.21326.

Myers, M. D. (1997). Qualitative research in information systems. *MIS Quarterly*, *21*(2), 241-242. *MISQ Discovery*, archival version, June 1997, http://www.misq.org/supplements/. *Association for Information Systems (AISWorld) Section on Qualitative Research in Information Systems*, updated version, last modified: March 21, 2013, http://www.qual.auckland.ac.nz.

Nokes-Malach, T. J., & Mestre, J. P. (2013). Toward a model of transfer as sense-making. *Educational Psychologist, 48*(3), 184-207. doi:10.1080/00461520.2013.807556.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company.* New York, NY: Oxford University Press.

Nonaka, I., Toyama, R., & Nagata, A. (2000). A firm as a knowledge-creating entity: A new perspective on the theory of the firm. *Industrial & Corporate Change*, *9*(1), 1.

Ozer, M., & Vogel, D. (2015). Contextualized relationship between knowledge sharing and performance in software development. *Journal of Management Information Systems, 32*(2), 134-161. doi:10.1080/07421222.2015.1063287.

Paroutis, S., & Saleh, A. A., (2009) Determinants of knowledge sharing using Web 2.0 technologies. *Journal of Knowledge Management, 13*(4), 52 – 63, doi:10.1108/13673270910971824.

Patanakul, P., Iewwongcharoen, B., & Milosevic, D. (2010). An empirical study on the use of project management tools and techniques across project life-cycle and their impact on project success. *Journal of General Management*, *35*(3), 41-65.

Patton, M. Q. (2002). *Qualitative Research & Evaluation Methods* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Pee, L. G., Kankanhalli, A., & Kim, H.W. (2010). Knowledge sharing in information systems development: A social interdependence perspective. *Journal of the Association for Information Systems*, *11*(10), 550-575.

Petter, S., & McLean, E. R. (2009). A meta-analytic assessment of the DeLone and McLean IS success model: An examination of IS success at the individual level. *Information & Management*, *46*(3), 159-166. doi:10.1016/j.im.2008.12.006.

Phipps, S. A., & Prieto, L. C. (2012). Knowledge is power? An inquiry into knowledge management, its effects on individual creativity, and the moderating role of an entrepreneurial mindset. *Academy of Strategic Management Journal, 11*(1), 43-57.

Pietrzak, M., Jalosinski, K., Paliszkiewicz, J., & Brzozowski, A. (2015). A case study of strategic group map application used as a tool for knowledge management. *Journal of Computer Information Systems*, *55*(2), 68-77.

Piorkowski, B. A., Gao, J. X., Evans, R. D., & Martin, N. (2013). A dynamic knowledge management framework for the high value manufacturing industry. *International Journal of Production Research, 51*(7), 2176-2185. doi:10.1080/00207543.2012.709650

Polanyi, M. (1962). *Personal Knowledge.* Chicago, IL: University of Chicago Press.

Polyaninova, T. (2010). *Suitable knowledge management in project environment* (Masters thesis, Dublin Institute of Technology, Dublin, Ireland). Retrieved from http://arrow.dit.ie/cgi/viewcontent.cgi?article=1003&context=scschcomart

Popovski, V., & Nikolic, S. (2015). The crucial factors of the knowledge management implementation and effectiveness on the telecommunication market in the republic of Macedonia. *Economic Development / Ekonomiski Razvoj, 17*(1/2), 37-54.

Project Management Institute. (2013). *A guide to the Project Management Body of Knowledge (PMBOK guide)* (5th ed.). Newton Square, PA: Project Management Institute.

Pugnaa, I. B., & Boldeanu, D. (2014). Factors affecting establishment of an institutional knowledge management culture—a study of organizational vision. *Accounting & Management Information Systems / Contabilitate Si Informatica De Gestiune, 13*(3), 559-583.

Rashid, A. M., Hassan, Z. B., & Al-Oqaily, A. T. (2015). Investigation of tacit knowledge measurement methods. *Journal of Theoretical & Applied Information Technology, 76*(2), 170-177.

Reich, B. (2007). Managing knowledge and learning in IT projects: A conceptual framework and guidelines for practice. *Project Management Journal*, *38*(2), 5-17.

Reich, B. H., Gemino, A., & Sauer, C. (2008). Modeling the knowledge perspective of IT projects. *Project Management Journal*, *39*, S4-S14. doi:10.1002/pmj.20056.

Reich, B. H., Gemino, A., & Sauer, C. (2012). Knowledge management and project-based knowledge in IT projects: A model and preliminary empirical results. *International Journal of Project Management*. *30*(6), 663-674. doi:10.1016/j.ijproman.2011.12.003.

Remus, U. (2012). Exploring the dynamics behind knowledge management challenges—An enterprise resource planning case study. *Information Systems Management, 29*(3), 188-200. doi:10.1080/10580530.2012.687309

Rosenkranz, C., Vranešić, H., & Holten, R. (2014). Boundary interactions and motors of change in requirements elicitation: A dynamic perspective on knowledge sharing. *Journal of the Association for Information Systems, 15*(6), 306-345.

Šárka, H. (2014). Tools of internal communication from knowledge transfer perspective. *Journal of Competitiveness, 6*(4), 50-62. doi:10.7441/joc.2014.04.04.

Sauer, C., & Reich, B. H. (2009). Rethinking IT project management: Evidence of a new mindset and its implications. *International Journal of Project Management*, *27*, 182-193.

Schmitz, S., Rebelo, T., Gracia, F. J., & Tomás, I. (2014). Learning culture and knowledge management processes: To what extent are they effectively related? *Journal of Work and Organizational Psychology*, *30*(3), 113-121. doi:10.1016/j.rpto.2014.11.003.

Schwalbe, K. (2010). *Information Technology Project Management* (6th ed.). Boston, MA: Thomson Course Technology.

Sewchurran, K., Smith, D., & Roode, D. (2010). Toward a regional ontology for

information systems project management. *International Journal of Managing Projects in Business*, *3*(4), 681-692. doi:10.1108/17538371011076118.

Sharma, B. P., Singh, M. D., & Neha. (2012). Knowledge Sharing Barriers: An Approach of Interpretive Structural Modeling. *IUP Journal of Knowledge Management, 10*(3), 35-52.

Shih-Hsiung, L., & Gwo-Guang, L. (2013). Key factors for knowledge management implementation. *Social Behavior & Personality: An International Journal*, *41*(3), 463-475. doi:10.2224/sbp.2013.41.3.463.

Shu, C., Page, A. L., Gao, S., & Jiang, X. (2012). Managerial ties and firm innovation: Is knowledge creation a missing link? *Journal of Product Innovation Management, 29*(1), 125-143. doi:10.1111/j.1540-5885.2011.00883.x.

Simons, H. (2015). Interpret in context: Generalizing from the single case in evaluation. *Evaluation, 21*(2), 173-188. doi:10.1177/1356389015577512

Spalek, S. (2015). Establishing a conceptual model for assessing project management maturity in industrial companies. *International Journal of Industrial Engineering, 22*(2), 301-313.

Stirbu, O. M. (2014). Knowledge based management trends in IT companies. *Review of International Comparative Management / Revista De Management Comparat International, 15*(4), 514-526.

Suorsa, A., & Huotari, M. (2014). Knowledge creation and the concept of a human being: A phenomenological approach. *Journal of the Association for Information Science & Technology, 65*(5), 1042-1057. doi:10.1002/asi.2303.

Sveiby, K.-E. (2001). A knowledge-based theory of the firm to guide in strategy formulation. *Journal of Intellectual Capital*, *2*(4), 344-358. doi:10.1108/14691930110409651.

Swart, J., Kinnie, N., Rossenberg, Y., & Yalabik, Z. Y. (2014). Why should I share my knowledge? A multiple foci of commitment perspective. *Human Resource Management Journal, 24*(3), 269-289. doi:10.1111/1748-8583.12037

Taylor, G. (2013). Implementing and maintaining a knowledge sharing culture via knowledge management teams: A shared leadership approach. *Journal of Organizational Culture, Communications & Conflict, 17*(1), 69-91.

Tiwana, A. (2002). *The knowledge management toolkit: Orchestrating IT, strategy, and knowledge platforms* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Trusson, C. R., Doherty, N. F., & Hislop, D. (2014). Knowledge sharing using IT service management tools: Conflicting discourses and incompatible practices. *Information Systems Journal, 24*(4), 347-371. doi:10.1111/isj.12025.

Uma Mageswari, S. D., Sivasubramanian, C., & Srikantha Dath, T. N. (2015). Knowledge management enablers, processes and innovation in small manufacturing firms: A structural equation modeling approach. *IUP Journal of Knowledge Management*, *13*(1), 33-58.

Vissers, G., & Dankbaar, B. (2013). Knowledge and proximity. *European Planning Studies, 21*(5), 700-721. doi:10.1080/09654313.2013.734459.

von Krogh, G., & Roos, J. (1995). *Organizational epistemology*. New York, NY: St. Martin's Press.

von Krogh, G., Roos, J., & Kleine, D. (1998). *Knowing in firms: Understanding, managing and measuring knowledge.* London, England: Sage Publications.

Wang, D. H., & Huynh, Q. L. (2014). The Relationships among Quality Management System, Knowledge Management and Organizational Performance: An Application of the Heckman Two-step Method. *Journal of Applied Economics & Business Research, 4*(4), 235-245.

Wang, M.., & Jacobson, M. J. (2011). Guest editorial: Knowledge visualization for learning and knowledge management. *Journal of Educational Technology & Society*, *14*(3), 1-3.

Wang, Y., Meister, D. B., & Gray, P. H. (2013). Social influence and knowledge management systems use: Evidence from panel data. *MIS Quarterly, 37*(1), 299-313.

Weng, C. (2014). Technology management: The perspective of social network. *International Journal of Innovation & Technology Management, 11*(3), 1-7. doi:10.1142/S0219877014400112

Whisnant, B., & Khasawneh, O. (2014). The influence of leadership and trust on the sharing of tacit knowledge: Exploring a path model. *Journal of Business Studies Quarterly, 6*(2), 1-17.

Wiig, K. M. (1999). *Comprehensive knowledge management. Working paper KRI #1999-4, Revision 2.* Arlington, TX: Knowledge Research Institute, Inc. Retrieved on 6/18/2013 from http://www.knowledgeresearch.com/downloads/comprehensive_km.pdf.

Winter, M., Smith, G., Morris, P., & Cicmil, S. (2006). Directions for future research in project management: The main findings of a UK government-funded research network. *International Journal of Project Management*, *24*(8), 638-649. doi:10.1016/j.ijproman.2006.08.009.

Wu, D., & Passerini, K. (2011). Knowledge perspectives in projects: Understanding the role of time. In *Proceedings for the Northeast Region Decision Sciences Institute (NEDSI*) (pp. 878-887).

Xiang, C., Lu, Y., & Gupta, S. (2013). Knowledge sharing in information system development teams: Examining the impact of shared mental model from a social capital theory perspective. *Behaviour & Information Technology, 32*(10), 1024-1040. doi:10.1080/0144929X.2012.745901.

Yan, Y., & Davison, R. M. (2013). Exploring behavioral transfer from knowledge seeking to knowledge contributing: The mediating role of intrinsic motivation. *Journal of the American Society for Information Science & Technology, 64*(6), 1144-1157. doi:10.1002/asi.22820.

Yanchinda, J., Yodmongkon, P., Chakpitak, N., & Goldsmith, P. (2011). Using ontologies for knowledge management: The Chaipattana Aerator Project. In *Proceedings of the International Conference on Intellectual Capital, Knowledge Management & Organizational Learning* (pp. 806-817).

Yarosh, S., Matthews, T., & Zhou, M. (2012, May). Asking the right person: Supporting expertise selection in the enterprise. In *Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems* (pp. 2247-2256). Retrieved

from http://home.cc.gatech.edu/lana/uploads/yarosh-chi2012.pdf.

Yin, R. (2013a). *Case study research design and methods* (5th ed.). Thousand Oaks, CA: Sage Publications.

Yin, R. K. (2013b). Validity and generalization in future case study evaluations. *Evaluation, 19*(3), 321-332. doi:10.1177/1356389013497081.

Yi-Shun, W., Hsin-Hui, L., Ci-Rong, L., & Shin-Jeng, L. (2014). What drives students' knowledge-withholding intention in management education? An empirical study in Taiwan. *Academy of Management Learning & Education, 13*(4), 547-568.

Zaharia, C., Tudorescu, N., Zaharia, I., & Zaharia, G. C. (2011). The evolving process of the knowledge-oriented economy. *Economics, Management & Financial Markets, 6*(3), 160-165.

Zarzu, C., & Scarlat, C. (2015). Knowledge management for knowledge development: Lessons learnt while implementing international projects by multicultural teams. *International Journal of Management Cases, 17*(4), 221-231.

Zhang, C., & Wang, S. (2013). Process-orientation degree of organizational culture, knowledge sharing and knowledge management success. *Journal of Theoretical & Applied Information Technology, 50*(1), 104-115.

Zhang, L., He, J., & Zhou, S. (2013). Sharing tacit knowledge for integrated project team flexibility: Case study of integrated project delivery. *Journal of Construction Engineering & Management*, *139*(7), 795-804. doi:10.1061/(ASCE)CO.1943-7862.0000645.

Zhang, P., & Ng, F. F. (2013). Explaining knowledge-sharing intention in construction

teams in Hong Kong. *Journal of Construction Engineering & Management, 139*(3), 280-293. doi:10.1061/(ASCE)CO.1943-7862.0000607.

Zhao, Z. J., & Anand, J. (2013). Beyond boundary spanners: The 'collective bridge' as an efficient interunit structure for transferring collective knowledge. *Strategic Management Journal, 34*(13), 1513-1530. doi:10.1002/smj.2080.

Ziółkowski, A., Orłowski, C., & Wysocki, W. (2013). Knowledge management in the processes of project requirements analysis. *Studia I Materialy Polskiego Stowarzyszenia Zarzadzania Wiedza / Studies & Proceedings Polish Association for Knowledge Management*, *65*, 106-120.

Appendix A: Interview Questions

A. Knowledge Sharing in IT Projects

1. Describe the process to acquire needed knowledge from a knowledge base (databases and repositories).
    a. What types of knowledge are searched for ?
    b. What are the issues with process?
2. Describe the process to acquire knowledge from an individual.
    a. What types of knowledge are searched for?
    b. Who is providing the information?
    c. How is this information shared? (face to face meeting, email)
    d. What are the issues with process?
3. Describe the process to share knowledge with others using the knowledge base (database and repositories). Include sharing with others in the project and others that are not part of the project.
    a. What types of knowledge are shared and not shared?
    b. What are the issues with process?
4. Describe the process to share knowledge with an individual or group. Include sharing with others in the project and others that are not part of the project.
    a. What types of knowledge are shared and not shared?
    b. Is the information shared in group or individual meetings?
    c. How is this information shared? (face to face meeting, email)
    d. What are the issues with process?

B. Tools for Knowledge Management in Project

5. What tools are used in project development process?
    a. Who uses them and why do they use them?
    b. What determines which tools are used?
6. What are the issues, if any, with the tools?

C. Knowledge Sharing for Project success

7. How does sharing knowledge improve the system quality?
8. How does sharing knowledge improve the information quality?
9. How does sharing knowledge improve the user satisfaction?
10. How does sharing knowledge improve the use of the system created by the project?
11. How does sharing knowledge provide benefits to the individuals of the project and the organization?