Assessing the Relationship between Knowledge Management and Information Systems Project Success

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Abstract

Information systems (IS) project success is imperative for companies to remain competitive and relevant in the changing economy, however, IS projects continue to fail at high rates, which costs companies billions of dollars annually. Knowledge management has been identified as a potential failure factor for IS projects as many failed projects report failure in following standardized knowledge management process. The problem addressed in this study was that 66% of IS projects fail each year while reporting an 89.3% failure rate in following a standardized knowledge management process. Additionally, 64% of projects from low performance companies fail each year while reporting a 95% failure rate in knowledge management, which is costing companies to lose $109 million of every $1 billion, spent on projects. This quantitative correlational study utilized Internet survey results from members of a local Project Manager Institute (PMI) chapter to measure knowledge management factors and IS project success relationships. Data were measured with a 5-point Likert scale and was used for structural equation modeling with confirmatory factor analysis. The results indicate a monotonic relationship exists between IS project success and all four operationalized constructs of knowledge management. Future research to address the latent effects on the variables would also provide helpful information for reducing IS project failure rates.

Acknowledgements

If I had to sum up all the people in my life that have been instrumental in my educational journey, my acknowledgements section would be longer than the rest of my dissertation. Though many have contributed, my biggest fan and supporter was and always will be my husband. He has been with me for my entire college journey, every late night, every statistics class, everything. Without his love, moral support, and his willingness to takeover so many household activities (including taking our children to their activities), I could not have gotten where I am today. I will never be able to say thank you enough for his support and understanding. My two daughters have also been very supportive (and patient) in this journey and are happy it is finally drawing to a close. My father-in-law, who encouraged me to continue school and be everything I wanted to be, was more support than he ever knew. My extended family, parents, sisters, and friends that have all dealt with my occasional absence and have helped with my children when I needed quiet time to study (or just to breathe) have also been a great help. Finally, but not least, I would like to thank my chair, Dr. Oloyede, and my dissertation committee, Dr. Sines, and Dr. Smiley, for answering all my questions and helping me grow my dissertation into what it was today. I could not have completed this journey without you!

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Chapter 1: Introduction

Recent research continues to show a large number of information systems (IS) project failures, which is the inability to fulfill an IS project within schedule, budget, and functionality constraints (Gable et al., 2008). In a study published by the Standish Group in 2012 (as cited by Cleveland, 2013) 66% of IS projects fail annually. Of the failed projects, 89.3% also report failure in following a formal, standardized, and mature knowledge management process within their organization (Cleveland, 2013). A study conducted by the Project Management Institute (PMI) in 2014 stated $109 million of each $1 billion spent on IS projects was lost and not recoverable due to failure. Another study published in the Harvard Business Review stated one in six IS projects were considered failures as of 2010 (Flyvbjerg & Budzier, 2011). Data from the same period, as published in the Gallup Business Journal, stated an estimated $150 billion was lost explicitly from IS project failures (Hardy-Vallee, 2012). The PMI study also stated 89% of company projects complete successfully in high performance companies, but only 36% of projects complete successfully in low performance companies (Project Management Institute, 2014). As companies continue to amalgamate technology into their business in an attempt to gain efficiencies, projects that fail become a liability to the company, negatively influencing operating budgets and income.

Many variables, e.g. improper risk management (de Bakker, Boonstra, & Wortmann, 2011) and undeveloped project management methodologies (Berssaneti, & Carvalho, 2015), have been studied as failure factors, but improper knowledge management is beginning to take focus in many ways (Almeida & Soares, 2014; Reich, Gemino, & Sauer, 2014; Sedera & Gables, 2010). Knowledge management has been shown as effective in only 5% of low performance companies and 29% of high performance companies (Project Management Institute, 2014). With IS projects, knowledge management includes effective training of both business and technology staff in an effort to ensure system outcomes are properly understood and supported (Akhavan, P., & Zahedi, M. R., 2014; Reich, Gemino, & Sauer, 2014). This leads to business need fulfillment, since the business partners understand if the system was meeting their requirements, and positive business value, since both usage and support ensure the system was properly utilized and maintained (Reich, Gemino, & Sauer, 2014). Therefore, knowledge management has been named a potential factor for contributing to IS project success (Reich, Gemino, & Sauer, 2014).

Background

IS project failure theories have been studied by many scholars with emphasis on many different areas, depending on the type of project. Recent studies on IS project outcomes has supported the theory of knowledge management as a factor of IS project success or failure (Basten, Joosten, & Mellis, 2011; Reich, Gemino, & Sauer, 2014; Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). Even with a mature knowledge management processes in place, there are many factors for success in knowledge management (Almeida & Soares, 2014; Basten, Joosten, & Mellis, 2011; Flanagan & Kelly, 2015; Park & Lee, 2014; Reich, Gemino, & Sauer, 2014; Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). One success factor was employee trust in the organization and in other employees (Park & Lee, 2014; Yang, Huang, & Hsu, 2014; Hung, Durcikova, Lai, & Lin, 2011). Another success factor was leadership engagement (Yang, Huang, & Hsu, 2014). Adoption of knowledge management policies within an organization was another factor that was still being defined (Akhavan & Zahedi, 2014) and social capital was yet another newer success factor (Bartsch, Ebers, & Maurer, 2013). Knowledge management and IS project success was still a newer area of study with many opportunities for useful research.

Statement of the Problem

The problem addressed in this study was that 66% of IS projects fail each year while reporting an 89.3% failure rate in following a standardized knowledge management process (Cleveland, 2013). Additionally, 64% of projects from low performance companies fail each year while reporting a 95% failure rate in knowledge management, which was costing companies to lose $109 million of every $1 billion, spent on projects (Project Management Institute, 2014; Project Management Institute, 2015). While the PMI report does not specify how many projects are IS projects, the Gallup Business Journal, stated that an estimated $150 billion was lost during the same period specifically from IS project failures (Hardy-Vallee, 2012) while the Harvard Business Review stated that one in six IS projects were considered failures (Flyvbjerg & Budzier, 2011). Some researchers, such as Teo and Bhattacherjee (2014), argued that knowledge management was less likely in projects that have outsourced project teams than in organizations that have internal project teams to transfer knowledge to support. Reich, Gemino, and Sauer (2014) observed that an organization having a defined knowledge management process could ensure transition was proper regardless of the project team. Todorović, Petrović, Mihić, Obradović, and Bushuyev (2015) indicated that project success from a knowledge perspective was in the documentation of knowledge gained throughout the project and not necessarily in the transfer of knowledge itself. All the aforementioned agree that providing business value was essential to project success, potentially more so than meeting timelines and budget (Reich, Gemino, & Sauer, 2014; Teo & Bhattacherjee, 2014; Todorović et al., 2015).

Research was conducted on many areas of project success factors, but little research exists on the relationship between knowledge management characteristics and IS project success as predictors of success. Identifying characteristics of knowledge management as a predictor of success in projects could lead to better project outcomes and a reduction in money lost through failures. Reducing the number of failed IS projects and money lost as a result was imperative to both business and technology success for a company, hence the need for this study.

Purpose of the Study

The purpose of this quantitative correlational study was to examine the relationships between the presence and quality of knowledge management and IS project success in order to identify knowledge management characteristics that are predictors of IS project success. The aforementioned method was chosen to test the hypotheses related to knowledge management and IS project success to establish if knowledge management directly affects the outcome. The quantitative correlational method was effective in determining variable relationships when utilized with close-ended surveys as in this case (Zikmund, 2003). First, a correlational analysis of knowledge management (the independent variable) and IS project success (the dependent variable) was conducted to provide a baseline model for structural equation modeling (SEM). To capture quantitative data for the independent variable, knowledge management was operationalized with the following four variables: (a) knowledge creation, (b) knowledge transfer, (c) knowledge retention, and (d) knowledge application (Sedera & Gable, 2010).

A group of 255 project managers who are members of the PMI Central Illinois Chapter received Internet surveys that utilized a closed-ended Likert style questionnaire (Zikmund, 2003). A power analysis was run to determine the minimal sample size. The survey instruments for this study were Sedera and Gable's (2010) framework Knowledge Management Competency (KMC) and Gable et al.'s (2008) framework IS Impact Measurement Model (IMM), collectively KMC-IMM as utilized in Sedera and Grable's 2010 study. It was determined to collect quantitative data regarding the different elements of knowledge management (the independent variables) and IS project success (the dependent variable) in order to allow correlational analysis to identify the composite variables for SEM. SEM was used to examine hypothesized relationships between the variables outlined to assess the proposed model (Guarino, 2004).

Research Questions

To examine the relationship between knowledge management and IS project success, the research questions and their corresponding hypotheses ensure the process of validating (or disproving) the relationship between the variables was accomplished by using correlational analysis (Schumacker & Lomax, 2010). The research questions and hypotheses also ensure the composite variables are identified and useable as well. The primary research question and hypotheses is:

RQ. To what extent, if any, does knowledge management relate to IS project success?

Since knowledge management was operationalized with the four variables (knowledge creation, knowledge transfer, knowledge retention, and knowledge application (Sedera & Gable, 2010)), four initial questions were developed:

RQ1. To what extent, if any, does knowledge creation relate to IS project success?

RQ2. To what extent, if any, does knowledge transfer relate to IS project success?

RQ3. To what extent, if any, does knowledge retention relate to IS project success?

RQ4. To what extent, if any, does knowledge application relate to IS project success?

Hypotheses

Since knowledge management was operationalized with four variables, four pairs of corresponding hypotheses were developed for this study:

$H1_0$. There was not a significant relationship between knowledge creation and IS project success.

$H1_A$. There was a significant relationship between knowledge creation and IS project success.

$H2_0$. There was not a significant relationship between knowledge transfer and IS project success.

$H2_A$. There was a significant relationship between knowledge transfer and IS project success.

$H3_0$. There was not a significant relationship between knowledge retention and IS project success.

H3$_A$. There was a significant relationship between knowledge retention and IS project success.

H4$_0$. There was not a significant relationship between knowledge application and IS project success.

H4$_A$. There was a significant relationship between knowledge application and IS project success.

Nature of the Study

The purpose of this quantitative correlational study was to examine the relationships between the presence and quality of knowledge management and IS project success in order to identify knowledge management characteristics that are predictors of IS project success. The survey instruments for this study were a closed-ended Likert questionnaire combined with survey models from other researchers. The survey instruments for this study was Sedera and Gable's (2010) framework Knowledge Management Competency (KMC) and Gable et al.'s (2008) framework was Impact Measurement Model (IMM), collectively KMC-IMM as utilized in Sedera and Grable's 2010 study. The combined framework measured the independent and dependent variables. The local PMI Chapter President distributed the survey in an electronic form, which included the informed consent form, the questionnaire, and demographics questions. The respondents indicated their experienced perceptions of knowledge management characteristics in relation to IS project success.

The data collected was analyzed with QIMacros (2015) using descriptive statistics and Minitab (version 17) for correlation testing. SEM and correlational analysis was utilized to test the hypotheses and ultimately answer the research questions. To examine the variable relationships, correlational tests was used to identify composite variables for SEM. SEM was then utilized to analyze the hypothesized relationships between the variables to evaluate the fit of the proposed model (Guarino, 2004).

Significance of the Study

The examination of information systems project failures and contributing factors are necessary to ensure failures are eliminated. As discussed, failures cost companies millions of dollars annually and affect an organization's competitive advantage (Project Management Institute, 2014). Since knowledge management has been identified as a potential contributing factor to failure (Almeida, M. V., & Soares, A. L., 2014; Reich, Gemino, & Sauer, 2014; Sedera & Gable, 2010), continued studies to determine relationships and how to address knowledge management in projects to prevent failures was needed. In uncovering relationships, best practices can be formed and companies can adjust their policies to best practices to help ensure success. The knowledge gained because of this study will help team members determine proactive ways to identify and resolve knowledge management issues within active projects instead of dealing with the aftermath.

Definition of Key Terms

High performance company. A *high performance company* was a company that completes 80 percent or more of their projects on time, on budget, and within requirements (Project Management Institute, 2014).

Information system (IS). An *information system* was a collection of data, procedures, people, and information technology that interrelate to gather, store, process, and dispense needed information to sustain an organization (Whitten & Bentley, 2007).

Information system project success. *Information system project success* was delivering an IS project within budget, schedule, and functionality (Gable et al., 2008).

Internal-external. An *internal-external* relationship was the interaction between employees that are considered permanent employees for a company with employees that are not permanent employees for the same company (Park & Lee, 2014).

Internal-internal. An *internal-internal* relationship was the interaction between employees that are considered permanent employees for the same company (Park & Lee, 2014).

Knowledge application. *Knowledge application* was use of the knowledge that has been transferred (Sedera & Gable, 2010).

Knowledge creation. *Knowledge creation* was the accumulation of the identified knowledge that will need transferred from both the internal and external perspective (Sedera & Gable, 2010).

Knowledge management. *Knowledge management* was the creation, transfer, retention, and application of knowledge in an organization (Sedera & Gable, 2010).

Knowledge retention. *Knowledge retention* was the he storage of knowledge in a repository (Sedera & Gable, 2010).

Knowledge transfer. *Knowledge transfer* was establishing the knowledge sharing channels between internal and external resources and utilizing those channels (Sedera & Gable, 2010).

Low performance company. A *low performance company* was a company that completes 60 percent or fewer of their projects on time, on budget, and within requirements (Project Management Institute, 2014).

Summary

As companies continue to invest billions of dollars in IS projects annually, ensuring successful project outcomes becomes increasingly important (Project Management Institute, 2014). Since knowledge management has been identified as a potential contributing factor to failure (Almeida, M. V., & Soares, A. L., 2014; Reich, Gemino, & Sauer, 2014; Sedera & Gable, 2010), continued studies to determine relationships and how to address knowledge management in projects to prevent failures was needed. The purpose of this quantitative correlational study was to examine the relationships between the presence and quality of knowledge management and IS project success in order to identify knowledge management characteristics that are predictors of IS project success. This study used an online survey to gather information from project managers and utilized survey instruments on knowledge management and successful implementations in order to assess the data. SEM was used to identify which knowledge management characteristics are predictors of IS project success. This study was important to the body of knowledge because understanding the relationship between key factors and project outcomes can help affected team members proactively correct issues, as they become known.

Chapter 2: Literature Review

The purpose of this quantitative correlational study was to examine the relationships between the presence and quality of knowledge management and IS project success in order to establish knowledge management characteristics that are predictors of IS project success. This chapter contains an overview of studies conducted on IS project outcomes and knowledge management. There are three main sections for this chapter. The first section was IS project outcomes. The IS project outcomes section includes an overview, a discussion on IS project success definitions, and IS project outcomes theories found during research. The second section was knowledge management. The knowledge management section includes an overview of knowledge management, the knowledge management definition for this research, and knowledge management outcome theories found during research. The third section was IS project and knowledge management outcomes. The IS project and knowledge management outcomes section includes the overlap of the two areas and address the research gap. A final summary will conclude the chapter.

Documentation

The information on IS project outcomes and knowledge management was found by searching professional publications, scholarly journals, dissertations, and scholarly books. The initial focus for this literature review was IS project management. Theoretical frameworks on outcomes in IS projects were prevalent with recent studies focusing on knowledge management. At that point, focus on knowledge management and direct searching efforts to specific journals that cater to both topics became the focus. *Project Management Journal, Journal of Computer Information Systems, MIS Quarterly,* *Journal of Management Information Systems, and Information Systems Management* journals were key journals in the review process. A search for keywords conducted in the Northcentral University library and Google Scholar for scholarly references. Additionally, a search of the Project Management Institute knowledge base for similar content was also completed. Most information included was published within the past five years on the research topic.

Information Systems Project Outcomes

Overview. As IS projects continue to fail at the cost of $150 billion annually from a combination of complete losses and delays (Hardy-Vallee, 2012), studies continue in an effort to reduce failure rates. As research into IS project success and failure contributing factors continues, new definitions of success and failure have been studied. Several studies have shown variability in the definitions of success and failure as studies have evolved, which has also lead to the evolution of contributing factor studies (Basten, Joosten, & Mellis, 2011; Davis, 2014; Gingnell, Franke, Lagerström, Ericsson, & Lilliesköld, 2014; Lech, 2013; Reich, Gemino, & Sauer, 2014; Sedera & Gable, 2010). This section of the chapter will highlight IS project success definitions and IS project outcomes theories. The intent of this section was to inform on the variability of the definition of IS project success, provide the definition of IS project success for this study, and to address the current research on IS project outcome theories. An examination of knowledge management was in a separate section and omitted herein.

IS Project Success Definition. When addressing outcomes, it was important to first define what IS project success means. In short, the literature review shows there was not one single definition for IS project success. Traditionally, IS project success was completing an information systems project within the estimated time, budget, and scope (Basten, Joosten, & Mellis, 2011). The mentioned project success definition, commonly referred to as the iron triangle, has been widely accepted since the inception of project management (Basten, Joosten, & Mellis, 2011). Thus, failure was seen as an IS project falling outside of any point on the triangle, even to a minor extent (e.g. implementing one day late) (Basten, Joosten, & Mellis, 2011). Joslin and Müller (2015) accepted the basic iron triangle definition but believed contingencies and adjustments to the IS project's triangle through change management policies were not failures. However, if a project really delivered what it intended to, in the timeframe it intended to, and within the budget it intended to, was that truly success (Davis, 2014; Kuen & Zailani, 2012; Lech, 2013; Reich, Gemino, & Sauer, 2014; Serra & Kunc, 2014)? As IS project failure research expanded, so has the qualifications for IS project success.

IS project success was defined by Reich, Gemino, and Sauer (2014) as delivering an IS project within budget, scope, schedule, and business expectations. Business expectations add a new element that accounts for a couple of different factors. First, business expectations add customer feedback on the result as a success-determining factor (Reich, Gemino, & Sauer, 2014). The ability of the system to meet the customers stated requirements (e.g. the features needed to keep or gain end user functionality) was imperative to the organization (Reich, Gemino, & Sauer, 2014). Customer requirements should be gathered and quantified early in the project to ensure the customer needs are being met throughout the project as the build was completed (Reich, Gemino, & Sauer, 2014; Serra & Kunc, 2014). Second, business expectations add return on investment and the associated financial considerations (Reich, Gemino, & Sauer, 2014). Return on investment, however, takes time to discover and calculate, so using financial calculations for IS project failure definition was not useful (Reich, Gemino, & Sauer, 2014).

Basten, Joosten, and Mellis (2011) argued that scope should cover business expectations, but that may not be the case, depending on the scope detail. For instance, if the project scope definition stated that a new system in a system replacement project should pay an employee bi-weekly, then a system that performs that function fulfills the scope. However, if the end users for the existing payroll system had functionality that allowed for electronic W-2 forms and the new payroll system does not have that functionality, the business partners will not be satisfied with the resulting system since the business partners are losing significant functionality (Reich, Gemino, & Sauer, 2014). Therefore, the project would be a failure since a portion of the business value has been lost (Reich, Gemino, & Sauer, 2014). Project scope will not account for the detail gathered during the requirements gathering sessions for a project or address a project's contribution to company strategy (Serra & Kunc, 2014). The addition of business expectations does address the aforementioned key points.

To the contrary, Lech (2013) observed that adding business expectations as its own determining factor for success was really an add-on to the scope requirement and not a separate factor. A theoretical framework by Lech (2013) suggested changing the iron triangle's scope requirement to functionality. Changing scope to functionality would ensure the project met the customer's needs, essentially combining scope, and business expectations together (Lech, 2013). Lech (2013) observed that quantifying business expectations into a project plan ensured scope and expectations would cover functionality. Adding to the project plan would make functionality easier to track and subsequently easier to guarantee in the results, effectively quantifying customer needs and assessing them throughout the project with proper management techniques (Lech, 2013). Lech's (2013) definition was more of a technique for ensuring proper functionality with the combination of expectations and scope than a change to the triangle (Lech, 2013), as Reich, Gemino, and Sauer (2014) had suggested.

Gingnell, Franke, Lagerström, Ericsson, and Lilliesköld (2014) expanded on (Lech, 2013) functionality definition and suggested quality replace scope in the triangle as a combination of scope, business expectations, technical expectations, and functionality. The technical expectations component needs upfront consideration as well as the previously mentioned components, in an effort to ultimately ensure was teams can adequately support and maintain the system (e.g. 99.99% uptime, fits current infrastructure requirements) (Gingnell et al., 2014). Gable et al. (2008) combined scope, business, and technical expectations into functionality as the third point in the triangle (Gable et al., 2008). Gable et al. (2008) argued that functionality was not assured without the aforementioned variables.

Though Davis (2014) agreed with the overall components of business and technical expectations as factors defining IS project success, Davis cautioned that feedback was a difficult component to easily quantify due to customer subjectivity. Depending on the stakeholder, variability in what makes different customers happy with the result will differ (Davis, 2014). To overcome the issue of customer expectation variability, it was important to have consensus on the business and technical expectations before the project begins (Davis, 2014). One way to help define what the business and technical expectations are would be to relate the IS project to a strategic goal (Serra &

Kunc, 2014). When a strategic goal was well defined and an IS project was linked to a specific goal, defining the expectations of an IS project was demystified significantly (Serra & Kunc, 2014). However, linking an IS project to a strategic goal does not necessarily guarantee stakeholders or was teams was satisfied with the outcome (Davis, 2014; Serra & Kunc, 2014). Ensuring that requirements are thorough helps mitigate customer dissatisfaction (Davis, 2014). As shown, the definition of IS project success varies. For the purpose of this study, the definition of IS project success was the completion of a project within budget, schedule, and functionality guidelines (Gable et al., 2008). Gable et al.'s (2008) framework was Impact Measurement Model (IMM) was developed to address the aforementioned IS project success definition. Therefore, the IS project success definition proposed by Gable et al. (2008) and the measurement of the definition through Gable et al.'s (2008) IMM was the accepted direction for this study as indicated in *Figure 1*.

IS Project Outcome Theories. Many potential factors for IS project failures have been identified. According to Chua (2009), projects that fail have a significant deficiency in one of the following categories: people, process, or technology. For the purpose of this section, the author will use Chua's (2009) four points of failure for organizing outcome studies. Chua's (2009) categories are considered the iron triangle of IS project failure for the purpose of this study. It was important to note the significance of the triangle for this discussion. All three pieces affect and are dependent on one another. Therefore, the information in each category will overlap slightly in an effort to tie all three categories together adequately. *Figure 2* was a depiction of the failure model.

Figure 1. The IS project success triangle.

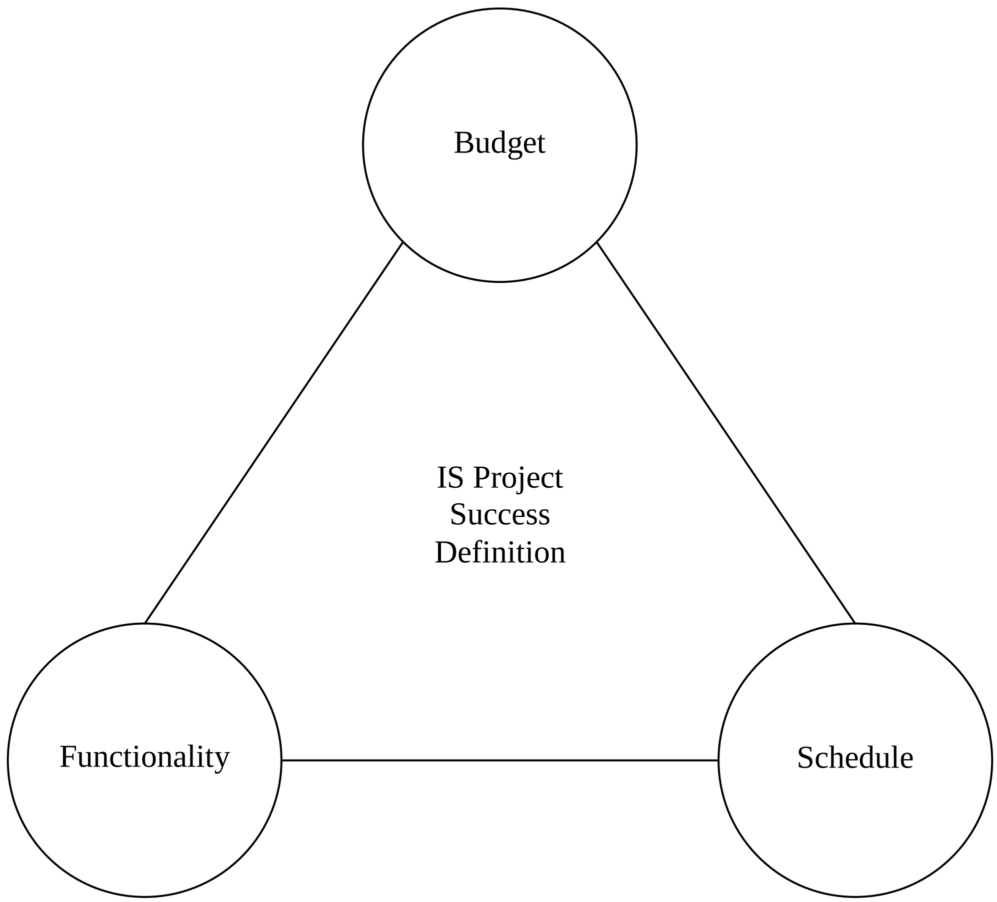

Figure 1. The IS project success triangle as defined by Gable et al. (2008).

Figure 2. IS project failure triangle.

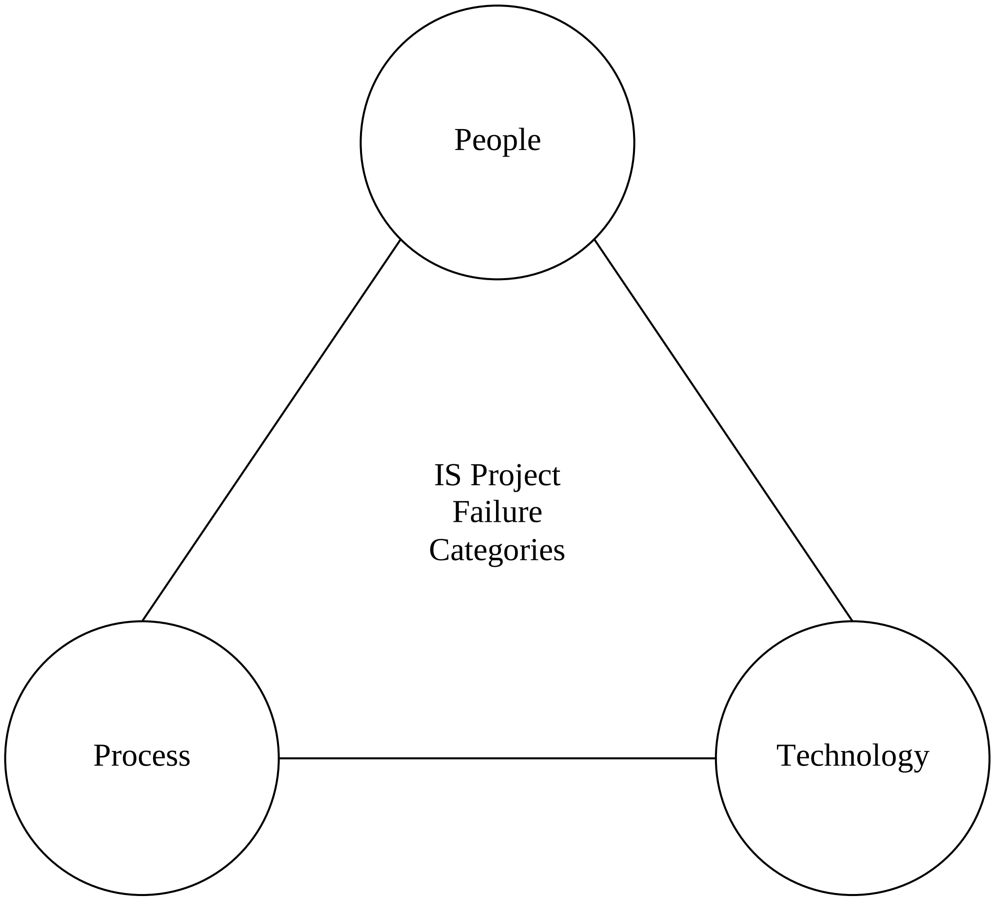

Figure 2. The IS project failure triangle as defined by Chua (2009).

People. The term people for the scope of this section can refer to any number of individuals. The people category includes project managers, end users, leadership, team members, vendors, and any person with a direct or indirect influence on the IS project that can determine its success or failure (Chua, 2009). The majority of the literature review on this section uncovered information on organizational leaders, project managers, and project team members.

Berssaneti and Carvalho (2015) observed that IS projects with a senior leader champion had a significant impact on IS project outcomes. Their study showed 94.43% of project team members that reported having a dedicated project manager, a mature project management office, and a senior leader champion reported successful project completion (Berssaneti & Carvalho, 2015). When considering the senior leader portion of their research, a senior leader champion lead to a 1.84 time increase in success (Berssaneti & Carvalho, 2015). In support of Berssaneti and Carvalho (2015), Yang, Huang, and Hsu (2014) found that senior leadership involvement led to a statistically significant better resource commitment and higher adoption rates for the final product. Haron, Gui, and Lenny (2014) found senior leader support led to a 34% increase in IS project success, due in part to the influence senior leaders have in other areas of the organization and over the resources directly, leading to better accountability (Berssaneti & Carvalho, 2015; Haron, Gui, & Lenny; 2014; Yang, Huang, & Hsu, 2014).

Berssaneti and Carvalho (2015) also observed that IS projects with a dedicated project manager had a significant impact on IS project outcomes. As previously mentioned, 94.43% of project team members who reported having a dedicated project manager, a mature project management office, and a senior leader champion reported successful IS project completion (Berssaneti & Carvalho, 2015). A dedicated project manager led to a 4.41 time increase in IS project success (Berssaneti & Carvalho, 2015). Haron, Gui, and Lenny (2014) had similar results from their study, which showed a

65.6% increase in successful IS project implementations attributed to a quality project manager. In support, Mir and Pinnington (2014) also found a 42.3% positive impact on project success when an experienced project manager was leading an IS project. Reich, Sauer, and Wee (2008) conducted an empirical review of project managers and IS project success and determined innovative project managers realize that the iron triangle was not their only responsibility as a project manager. Another empirical investigation by Sauer and Reich (2009) expanded on their previous review and indicated that effective project managers believe in being proactive in gathering and mitigating risk. In addition, proactive project managers divide work, build trust, and facilitating communication (Sauer & Reich, 2009). Mature project managers are preventing failures by mitigating other risks to the project that could ultimately affect the triangle, e.g. requirements adjustments, resource interactions (Reich, Sauer, & Wee, 2008). One risk mitigation technique found IS project team interactions and expectations (Reich, Sauer, & Wee, 2008).

Project team members, which include stakeholders and decision makers, are the backbone of a project. When project team members are not in harmony with one another, the outcome of the project was at risk (Bhoola, 2015; Di Vincenzo & Mascia, 2012; Dulipovici & Robey, 2013; Hung, Durcikova, Lai, & Lin, 2011; Lee, Park, & Lee, 2015; Reich, Sauer, & Wee, 2008; Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). The most prominent team factor for IS project success was keeping team members engaged in the project (Bhoola, 2015; Di Vincenzo & Mascia, 2012; Dulipovici & Robey, 2013; Hung, Durcikova, Lai, & Lin, 2011; Lee, Park, & Lee, 2015; Reich, Sauer, & Wee, 2008; Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). Bhoola's

(2015) study showed a statistical significance on the hypothesis that people are more engaged in projects when there are interpersonal relationships among the team members. In support of Bhoola's (2015) study findings, Di Vincenzo and Mascia (2012) determined statistical significance on the hypothesis that positive relationships between project team members lead to better social capital. Additionally, Di Vincenzo and Mascia (2012) found statistical significance on the hypothesis that better social capital lead to better IS project outcomes.

Building on the social capital theory, Lee, Park, and Lee (2015) determined that social ties and shared vision lead to a 61.7% increase in trust. With trust, team members had a better team mentality and better engagement (Lee, Park, & Lee, 2015). Reich, Sauer, and Wee (2008) determined from their empirical study that team members needed trusted and to have activities delegated to them to build confidence and reputation. Building reputation was the most significant extrinsic motivator for the teams, according to Hung, Durcikova, Lai, and Lin (2011). However, none of the aforementioned was possible without effective communication.

Lee, Park, and Lee (2015) found that effective communication lead to a 13% increase in social ties and a 41.5% increase in shared vision. All three factors have a statistically significant influence on IS project success (Lee, Park, & Lee, 2015). In support, Todorović, Petrović, Mihić, Obradović, and Bushuyev (2015) concluded that a proper communication plan that was closely followed by team members lead to a 68.8% increase in IS project success (Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). Though all the aforementioned authors stated the importance of social ties on engagement and thus IS project success, not all social ties were deemed helpful.

Dulipovici and Robey (2013) found in their case study that a project team's social ties could lead to misdirection and bias. As a result, misdirection and bias led to misalignment of information and loss of reputation (Dulipovici & Robey, 2013). As mentioned previously, reputation was an important extrinsic motivator for team members (Hung, Durcikova, Lai, & Lin, 2011), so social connections leading to loss of reputation (and subsequently trust) leads to a loss of motivation. A loss of motivation, leads to less engagement and, thus, social ties can negatively influence IS project success. In summary, positive interactions can lead to positive engagement and negative interactions can lead to a loss of engagement which can ultimately affect IS project success (Bhoola, 2015; Di Vincenzo & Mascia, 2012; Dulipovici & Robey, 2013; Hung, Durcikova, Lai, & Lin, 2011; Lee, Park, & Lee, 2015; Reich, Sauer, & Wee, 2008; Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). *Figure 3* depicts all the people factors.

Process. The term process for the scope of this section refers to project management methodologies (Chua, 2009). A mature project management methodology will include the necessary tools for structuring and maintaining a project, and will include the methods necessary to mitigate risk (de Bakker, Boonstra, & Wortmann, 2011). Additionally, a mature project management methodology will include appropriate use of governance and change management (Joslin & Müller, 2015). The aforementioned are presented below in the literature review herein.

Figure 3. IS project failure people factors.

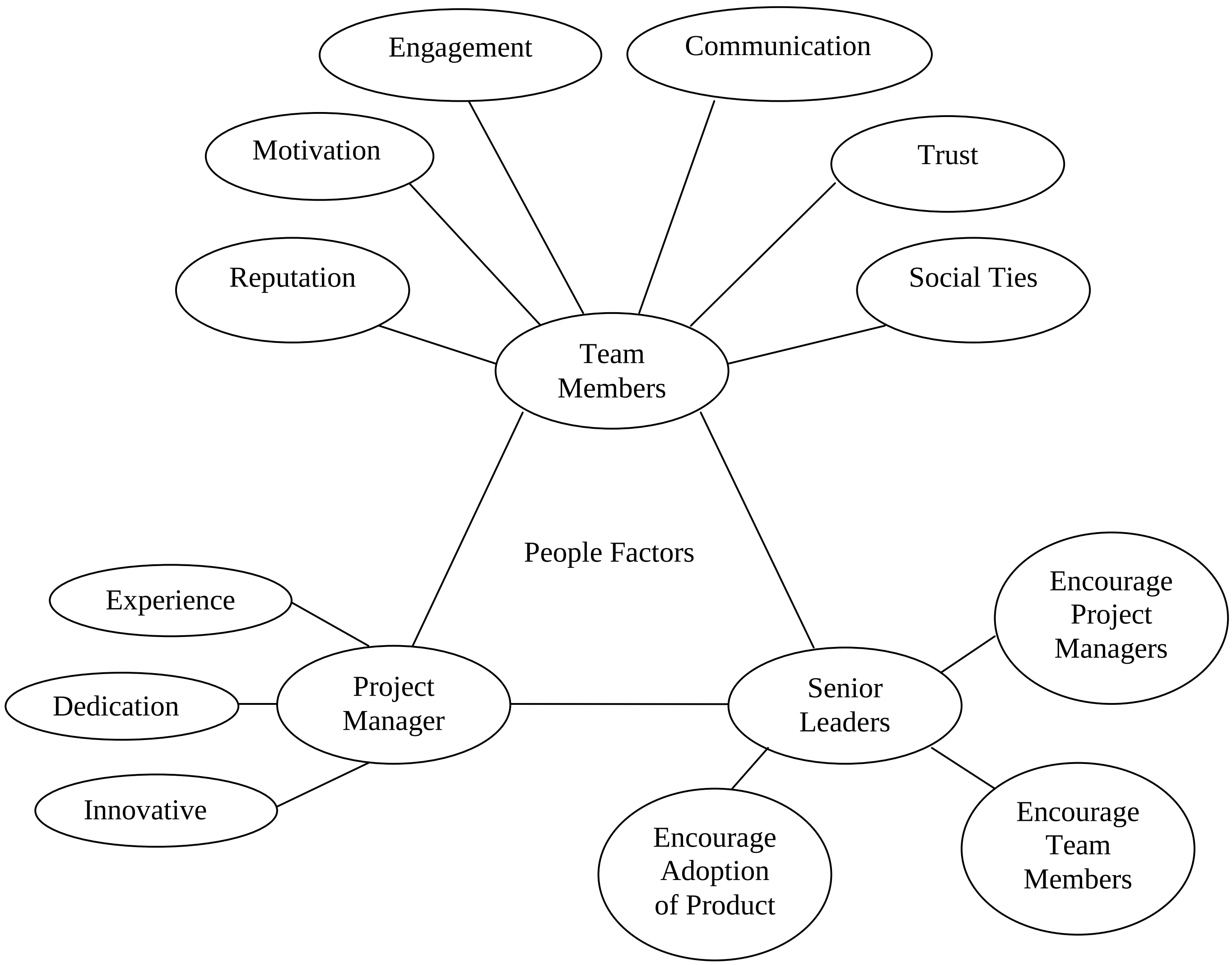

Figure 3. People factors graphical depiction created to represent all studies presented in the people section.

Allen, Alleyne, Farmer, McRae, and Turner's (2014) qualitative study suggested that monitoring techniques for scope, budget, timeline, and external influences had robust and matured by an organization to ensure effectiveness. To ensure the proper monitoring techniques were in place, an effective and efficient project management methodology was needed (Allen et al., 2014). Joslin and Müller (2015) conducted a study to determine if the use of a project management methodology increases the chance of IS project success. The results indicated that the appropriate use of a project management methodology lead to a 22.3% increase in the likelihood of IS project success (Joslin & Müller, 2015). In addition, Joslin and Müller (2015) reported governance as a quasi-moderator (Joslin & Müller, 2015).

IS project governance groups are responsible for determining project processes and rules (Allen et al., 2014; Joslin & Müller, 2015). Without a proper governance structure, there was no project selection process either (Joslin & Müller, 2015). Effectively, without governance, there cannot be consistent processes and procedures (Allen et al., 2014; Joslin & Müller, 2015). As such, an effective governance group leads to effective project management methodologies (Allen et al., 2014; Joslin & Müller, 2015). However, neither was possible without a mature project management office (Allen et al., 2014; Berssaneti & Carvalho, 2015).

Berssaneti and Carvalho (2015) concluded that project management office maturity contributes to IS project success using the iron triangle definition. As previously mentioned, their study showed 94.43% of project team members that reported having a dedicated project manager, a mature project management office, and a senior leader champion reported successful IS project completion (Berssaneti & Carvalho, 2015). Project management office maturity was shown to have a statistically significant affect on project manager success (Allen et al., 2014; Berssaneti & Carvalho, 2015; Mir & Pinnington, 2014). A mature project management office may lead to better procedures, but better procedures may not mitigate failure in all aspects of IS projects. As shown in the people section, a project manager that follows a mature project methodology led to a 4.41 increase in IS project success (Berssaneti & Carvalho, 2015). However, when IS project success was defined outside of the iron triangle, the maturity of all the aforementioned does not have the same affect (Allen et al., 2014; Berssaneti & Carvalho, 2015). When quality replaces scope, as was the definition for this research, maturity does not influence customer satisfaction (Berssaneti & Carvalho, 2015). To address the customer satisfaction factor, one factor to consider was risk mitigation.

An empirical study by de Bakker, Boonstra, and Wortmann (2011) determined managing risks in a cohesive format with proper communication lead to higher satisfaction rates for IS project stakeholders. Sauer and Reich (2009) indicated that being proactive in gathering and mitigating risk leads to building stakeholder trust. As shown previously, building trust within the project team (which includes stakeholders) leads to better IS project outcomes (Lee, Park, & Lee, 2015; Reich, Sauer, & Wee, 2008). Concerning customer satisfaction, when project stakeholders trust the project manger and other team members, there was a higher likelihood the outcome was satisfactory for a couple reasons. One, when the stakeholders trust the team, the stakeholders believes the team was doing their best (de Bakker, Boonstra, & Wortmann, 2011). Since the stakeholders believe the team did their best, the stakeholders believe the product was the best product possible. Second, if the stakeholders feel communication of risks was proper, then the stakeholders were aware of the risks to the outcome throughout the project (de Bakker, Boonstra, & Wortmann, 2011; Lee, Park, & Lee, 2015). Therefore, again, stakeholders are happier with the outcome considering all the known risks. When a project management methodology contains proper risk management requirements, customer satisfaction increases (de Bakker, Boonstra, & Wortmann, 2011; Lee, Park, & Lee, 2015; Reich, Sauer, & Wee, 2008; Sauer & Reich, 2009). However, the risk management plan still needs part of a cohesive communication strategy (de Bakker, Boonstra, & Wortmann, 2011; Lee, Park, & Lee, 2015; Reich, Sauer, & Wee, 2008; Sauer & Reich, 2009; Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015).

As mentioned previously, Lee, Park, and Lee (2015) found that effective communication leads to a 13% increase in social ties and a 41.5% increase in shared vision, which lead to an increase in trust. All three factors have a statistically significant influence on IS project success (Lee, Park, & Lee, 2015). Reich, Sauer, and Wee (2008) determined that risk management planning was most effective with a comprehensive communication and follow up plan. In support of Reich, Sauer, and Wee (2008), Todorović, Petrović, Mihić, Obradović, and Bushuyev (2015) concluded that a proper communication plan that was closely followed by team members lead to a 68.8% increase in IS project success (Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). Therefore, a thorough project management methodology that contains proper standards for all the aforementioned leads to higher IS project success on all defined success factors. A model of the process factors was in *Figure 4*.

Technology. The term technology for the scope of this section refers to the actual output of the project and any technology that contributes to the outcome of an IS project (Chua, 2009). Technology includes the final technical product and the infrastructure utilized by the product (Chua, 2009). Failures in technology are generally failures in one of the other categories as well because people as instructed by the process category develop technology. Provided herein was an examination of the relationship between the three factors as well.

Figure 4. IS project failure process factors.

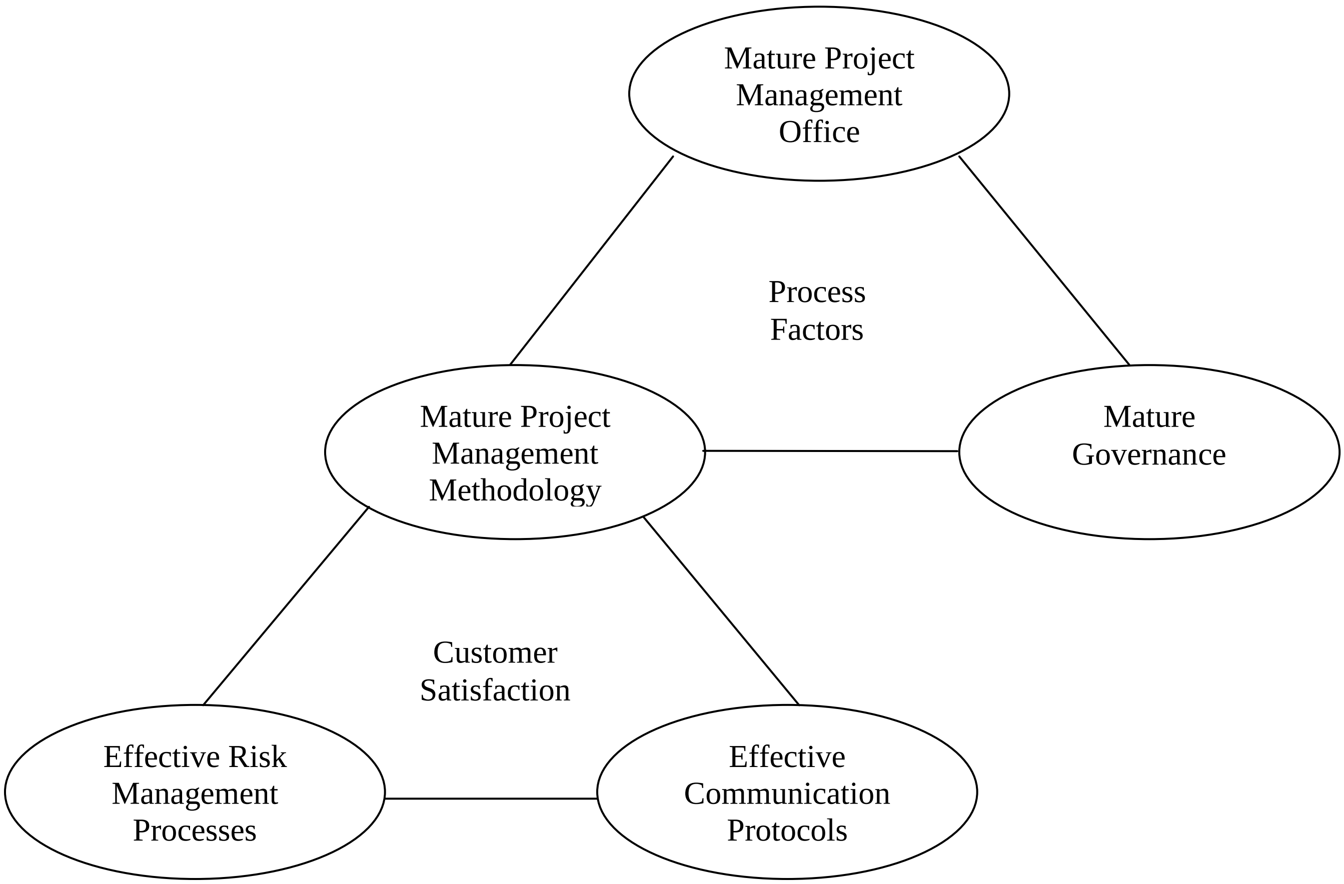

Figure 4. Process factors graphical depiction created to represent all studies presented in the process section.

Bhoola's (2015) research determined, among other things, that inadequate hardware infrastructure was a critical factor for IS project success. Infrastructure was the backbone of was and IS projects. When considering an was system such as a web-based system, a company could have three servers in a basic setup: a database server, web server, and application server (Al-Ahmad, Al-Fagid, Khanfar, Alsamara, Abuleil, & Abu-Salem, 2010). Proper speed and interconnectivity from robust hardware and network connectivity ensure the servers connect properly without issue (Al-Ahmad et al., 2010; Bhoola, 2015). If setup was inadequate, unscheduled downtimes or interruption of service can occur (Al-Ahmad et al., 2010). Thus, even if the system developed or selected as part of the project was exactly what the business partners want and need, the system may not perform well and may cause issues for them (Al-Ahmad et al., 2010; Bhoola, 2015). A malfunctioning system negatively impacts the quality IS project success factor as the customers will not be satisfied with the end product (Gingnell et al., 2014) A malfunctioning system can also be contributed to a people factor as the infrastructure may be inadequate due to vendor concerns or due to the project team not understanding what was needed (Chua, 2009).

Regardless of the system type, technology failures are perhaps the biggest critical factor for many IS projects. Al-Ahmad et al.'s (2010) empirical literature review determined that regardless of the was domain, technology failures were common in infrastructure, lack of expertise, and conflicting interests. Though technology fails due to the aforementioned factors, the failures are also people factor failures (Chua, 2009). Without adequate project resources with the correct skill sets, technology failures are all but certain (Al-Ahmad, et al., 2010). Another people factor that influences the technology factor was group social ties. As mentioned previously, Dulipovici and Robey (2013) determined that a group's social interactions (misdirection and bias) could lead to project misalignment. In addition, Dulipovici and Robey (2013) also discovered that misalignment of data and an issue with the quality of the technical output could occur due to the same misalignment. Misalignment can cause incorrect build work and a subsequent failure in the technology factor (Dulipovici & Robey, 2013). *Figure 5* shows the model of the technology factors.

Figure 5. IS project failure technology factors.

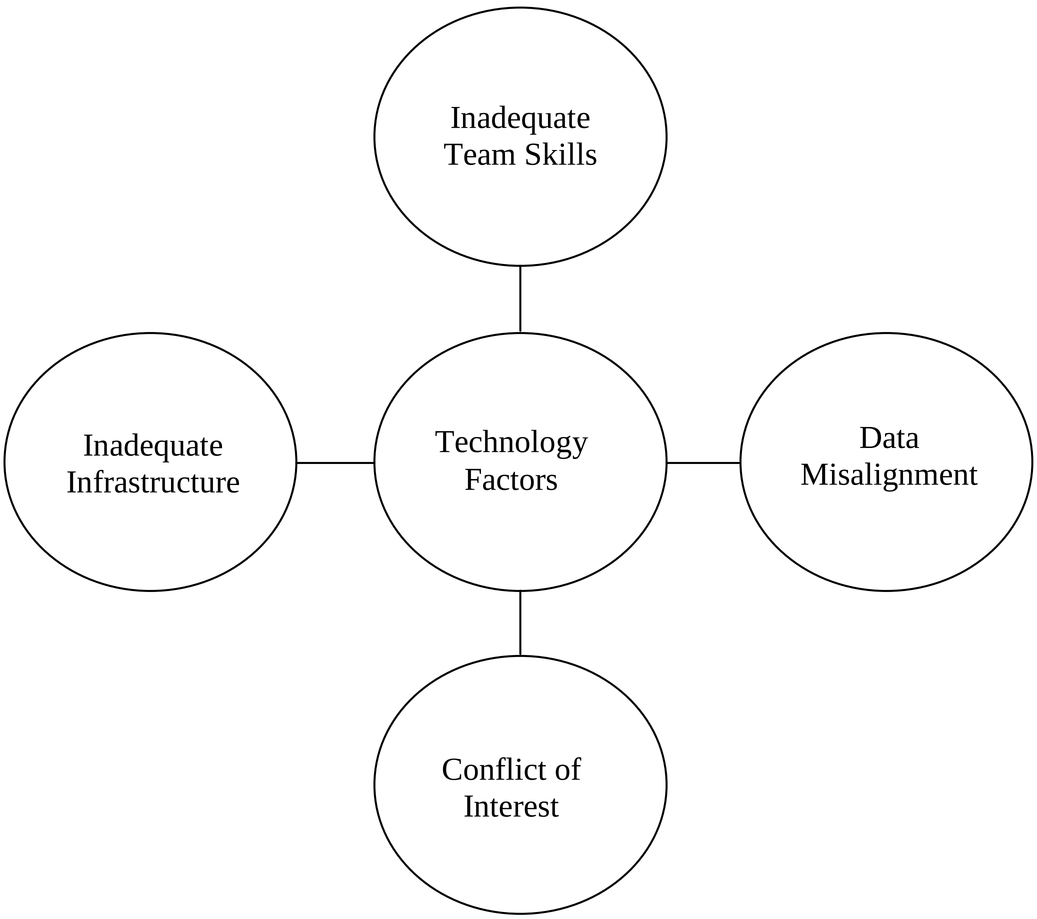

Figure 5. Technology factors graphical depiction created to represent all studies presented in the technology section.

Knowledge Management Outcomes

Overview. Knowledge management became a prime subject in the early 2000s due to the rapid increase in business technology (Akhavan, Jafari, & Fathian, 2005). The commercialization and growth of the Internet lead to the increase use of technology for business functions (Akhavan, Jafari, & Fathian, 2005). Knowledge management was the process of creating, transferring, retaining, and applying knowledge (Sedera & Gable, 2010). In regard to IS projects, knowledge management was the process of the aforementioned within the context of a project or post implementation knowledge gathering (Sedera & Gable, 2010). The purpose of this section was to build the definition of knowledge management for this study. Additionally, this section will identify current theories on knowledge management outcomes. The intention of this section was to provide the basis for the knowledge management portion of the study. The final section of this chapter will synthesize this section with IS project outcomes section.

Knowledge Management Definition. The definition of knowledge management was consistent within in the literature on the actions needed, but the grouping of the actions was different. For the purpose of this research, there are four categories for knowledge management: knowledge creation, knowledge retention, knowledge transfer, and knowledge application (Sedera & Gable, 2010). This section will contain the definition of the categories as supported by the literature, avoiding influences on the categories in direct relation to knowledge management success or IS project success. Both topics are elsewhere.

Knowledge Creation. The first step in knowledge management was to identify and accumulate the knowledge that will need transferred from both the internal and external perspective (Sedera & Gable, 2010). Ideally, a discovery process can identify the majority of knowledge but emergent knowledge that was uncovered needs acknowledged (Flanagan & Kelly, 2015). Throughout the lifecycle of an IS project, knowledge emerges with the majority manifesting in the execution phase (Almeida & Soares, 2014). It was important for IS project teams to identify what knowledge t needs documented for sharing beyond the project (Park & Lee, 2014). If identification and documentation of the knowledge for the IS project was not done correctly, knowledge was lost after the team disbands (Park & Lee, 2014). At that point, the knowledge gained becomes organizational memory for the project team and was inaccessible for future projects unless the initial members are reengaged (Almeida & Soares, 2014; Park & Lee, 2014). Beyond the implementation, knowledge needs identified on lessons learned during project closure (Rhodes & Dawson, 2013). Identifying knowledge post mortem can help elevate issues with future projects of a similar nature (Rhodes & Dawson, 2013).

Knowledge Retention. Knowledge retention was the act of actually documenting and storing knowledge in a sharable form (Sedera & Gable, 2010). In addition to the creation of useful documentation, storage of the knowledge in a useful way was also important (Almeida & Soares, 2014). Electronic storage was the most convenient way to store documentation. For versioning control and greater security control, a storage system such as SharePoint can be helpful for storing documentation (Almeida & Soares, 2014; Rhodes & Dawson, 2013). Electronic storage in a searchable format allows for keyword searching (Almeida & Soares, 2014; Rhodes & Dawson, 2013). When utilizing knowledge repositories, keyword definitions and system structure are important (Almeida & Soares, 2014; Rhodes & Dawson, 2013). The more organized the site is, the easier it was for end users to find what they are looking for (Almeida & Soares, 2014; Rhodes & Dawson, 2013). Meaningful capturing (and storage) of knowledge makes it useful to the parties for whom the information was meant shared with (Almeida & Soares, 2014; Park & Lee, 2014; Rhodes & Dawson, 2013).

Knowledge Transfer. Knowledge transfer refers to establishing the knowledge sharing channels between internal and external resources and utilizing those channels (Sedera & Gable, 2010). Knowledge retention and knowledge transfer are closely related (Akhavan & Zahedi, 2014; Rhodes & Dawson, 2013; Teo & Bhattacherjee, 2014). The difference between the transferring and retaining was that knowledge transfer was the method of getting knowledge to and from the necessary parties (Teo & Bhattacherjee, 2014). This was beyond retention, where identified knowledge was documented, but it was also in line with knowledge creation in the aspect of getting knowledge from one source to another (Akhavan & Zahedi, 2014). Mainly, retention focuses on documentation where sharing focuses on the people. Sharing knowledge between the groups should happen as resources work together and should be communicated to others with a need to know through communication methods that were agreed upon in a communication plan (Bakker, Cambré, Korlaar, & Raab, 2011; Savolainen & Ahonen, 2015). In addition, captured information also needs shared appropriately by communicating the document availability to others (Bakker, Cambré, Korlaar, & Raab, 2011). Once the knowledge has been disseminated, the applying the knowledge becomes the focus.

Knowledge Application. Knowledge application was the utilization of knowledge that was transferred (Sedera & Gable, 2010). After knowledge retention and transfer, it has applied (Park & Lee, 2014). When knowledge was available but not applied, resources are gathering information again and again, causing rework (Park & Lee, 2014). Rework causes a loss of productivity and creates gaps in system support (Bartsch, Ebers, & Maurer, 2013; Savolainen & Ahonen, 2015). In addition, if the knowledge was not useful, it was worthless to the parties it should be helping (Savolainen & Ahonen, 2015). So ensuring application of knowledge in a useful manner was important. Gauging knowledge usefulness requires an assessment process.

Knowledge assessment, the review of knowledge to ensure the usefulness of knowledge to the intended parties, was a part of knowledge application (Flanagan & Kelly, 2015; Sedera & Gable, 2010). Assessment starts during identification (Rhodes & Dawson, 2013). Assessment of the quality of the knowledge and the applicability of that knowledge begins when knowledge was identified (Reich, Gemino, & Sauer, 2014; Rhodes & Dawson, 2013). Without the constant process of reevaluating the knowledge, collected knowledge becomes less useful and out of date. No knowledge was better than inaccurate knowledge. *Figure 6* shows the model of knowledge management.

Knowledge Management Outcome Theories. As knowledge management has grown in popularity, so has the research on knowledge management outcomes. As such, theories have emerged on failure factors for knowledge management for organizations, in daily business and in projects. The categories presented group the failure factors by key issue areas: people, process, and technology. The direct tie to IS project success was omitted from this section, as it was covered elsewhere. A model of the knowledge management failure factors was shown in *Figure 7*. A final model of the researched people, process, and technology factors for knowledge management was shown in *Figure 8.*

Figure 6. IS project knowledge management categories.

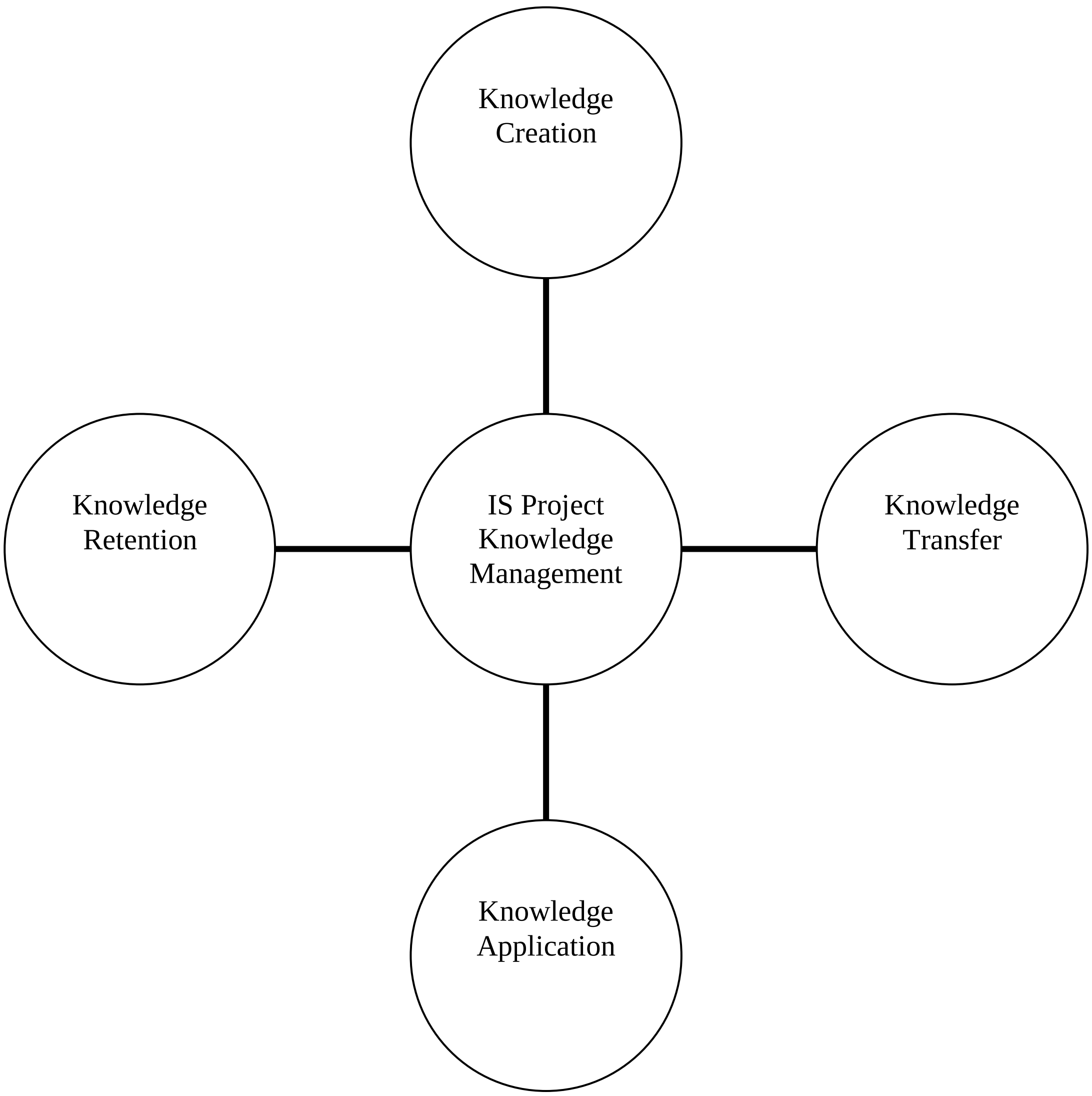

Figure 6. IS project knowledge management categories as defined by Seder & Gable (2010). These categories are also the operational variables of the independent variable, knowledge management.

Figure 7. Knowledge management failure categories.

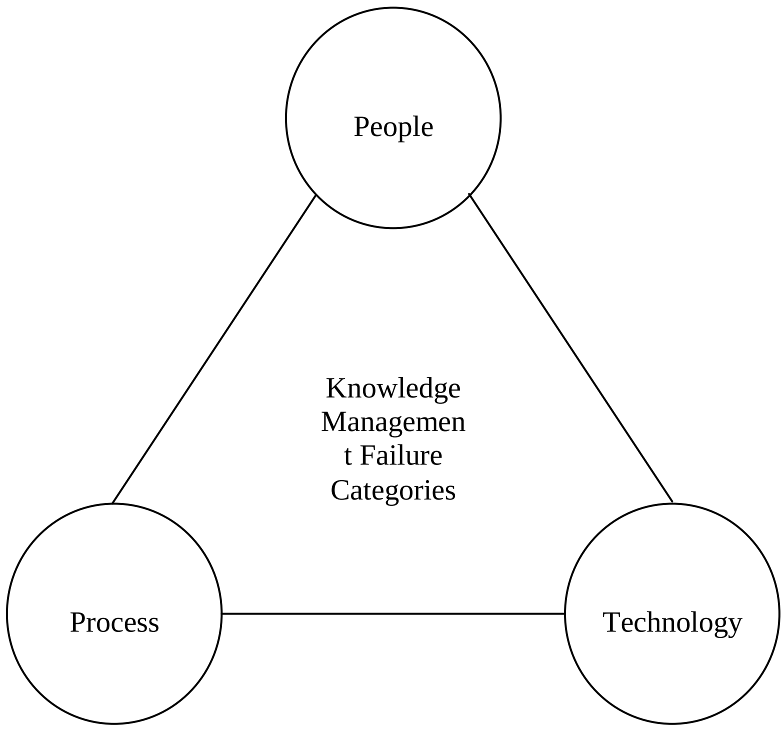

Figure 7. Knowledge management failure grouping used for this paper as defined by the section studies.

People. From a people perspective, the main success factor studied for knowledge management was leadership commitment to defined practices. If leaders do not commit to the enforcement of polices or procedures outlined then there was a lack of accountability (Park & Lee, 2014; Yang, Huang, & Hsu, 2014). When there was a lack of accountability, it was less likely that a process was followed correctly (Yang, Huang, & Hsu, 2014). A study by Yang, Huang, and Hsu (2014) found a statistical significance on adoption of knowledge management practices when senior leadership was committed and expressive of their commitment. As with many other things in an organization, leaders need to lead by example for a practice to take hold in an organization. Leading by example builds employee confidence in the process, in addition to the aforementioned accountability (Park & Lee, 2014). Additionally, knowledge leadership must be a main concern for an organization (Yang, Huang, & Hsu, 2014). Knowledge leadership includes the dissemination of knowledge to support personnel in an easily referenced format, like in a knowledgebase (Park & Lee, 2014).

Another people factor was the actual employees of the organization and their adoption of the knowledge management strategy. The adoption of knowledge management strategies within an organization can also be a knowledge management success factor. Though companies may see the value in knowledge management, the adoption (or refusal) of knowledge management procedures can be crucial to the continued success of knowledge management in an organization (Akhavan & Zahedi, 2014). A study by Akhavan and Zahedi (2014) researched the effects of adoption strategies on continued business knowledge management success. Their study found statistical significance between the adoption rate of knowledge strategies and the success of knowledge management in the organization (Akhavan & Zahedi, 2014). Yang, Huang, and Hsu (2014) attributed adoption success to leadership support, which lead to knowledge management success. In partial support, a study by Choi, Lee, and Yoo

(2010) studied the effects of was teams support of knowledge management procedures as a success factor for knowledge adoption. As such, Choi, Lee, and Yoo (2010) found a statistical significance with was support, meaning was support of knowledge management led to great adoption rates with technical knowledge (Choi, Lee, & Yoo, 2010). To the contrary, a study by Reich, Gemino, and Sauer (2014) showed no significance in adoption rates with was involvement from a business perspective. The contradictory outcomes between the studies can be partly contributed to the difference between business knowledge and technical knowledge factors.

Regardless of the group leading the adoption efforts, a company must have a knowledge management standard and expectations for their employee to ensure strong adoption rates (Akhavan & Zahedi, 2014). A proper documentation strategy standard, sharing practices, and usage are all important for adoption of knowledge management strategies for a company (Akhavan & Zahedi, 2014; Choi, Lee, & Yoo, 2010). Inconsistency in usage can lead to frustration among the employees in the organization (Akhavan & Zahedi, 2014; Choi, Lee, & Yoo, 2010; Reich, Gemino, & Sauer, 2014). Adoption was an area that has not been expanded upon greatly at this point and will need future research on adoption methods that are most effective with proper support from all the members of the organization (Akhavan & Zahedi, 2014; Choi, Lee, & Yoo, 2010; Reich, Gemino, & Sauer, 2014).

Process. The process of knowledge alignment within an organization was another area with little research. The concept of knowledge management success and alignment lies in having knowledge captured and shared in a way that was useful to the audience for a specific cause instead of capturing and sharing knowledge that was not useful to the organization (Dulipovici & Robey, 2013; Reich, Gemino, & Sauer, 2014). For instance, if the company was a hospital, the hospital may collect descriptive information on a patient (i.e. eye color, hair color), but may not translate that data to a knowledge document for storage in a knowledge management system. If that data were relevant for diagnosis, then the data could be included in a knowledge article. Alignment with the purpose of the knowledge was important to ensure there was not a large amount of useless knowledge in repository. When there is, it becomes difficult to find meaningful knowledge. When meaningful knowledge was harder to find, employees are less likely to use the knowledge process (Dulipovici & Robey, 2013; Reich, Gemino, & Sauer, 2014). Aligning of knowledge with company strategies helps ensure greater business value as well (Reich, Gemino, & Sauer, 2014). More research was needed in knowledge alignment to help define the importance of alignment.

Technology. Technology was an area with minimal information. According to a study by Akhavan and Zahedi (2014), information technology accounted for 33% of the failures in knowledge management. In Akhavan and Zahedi's 2014 study, the failures occurred when knowledge bases were not adequate to support the knowledge structure (e.g. not robust enough). Failures with knowledge bases would fall into the capturing knowledge category and the applying knowledge categories. Without branching into IS project success, the technology category can expand with further best practices for was systems that support the specific types of knowledge storage, such as PDFs.

Figure 8. Knowledge management failure factors.

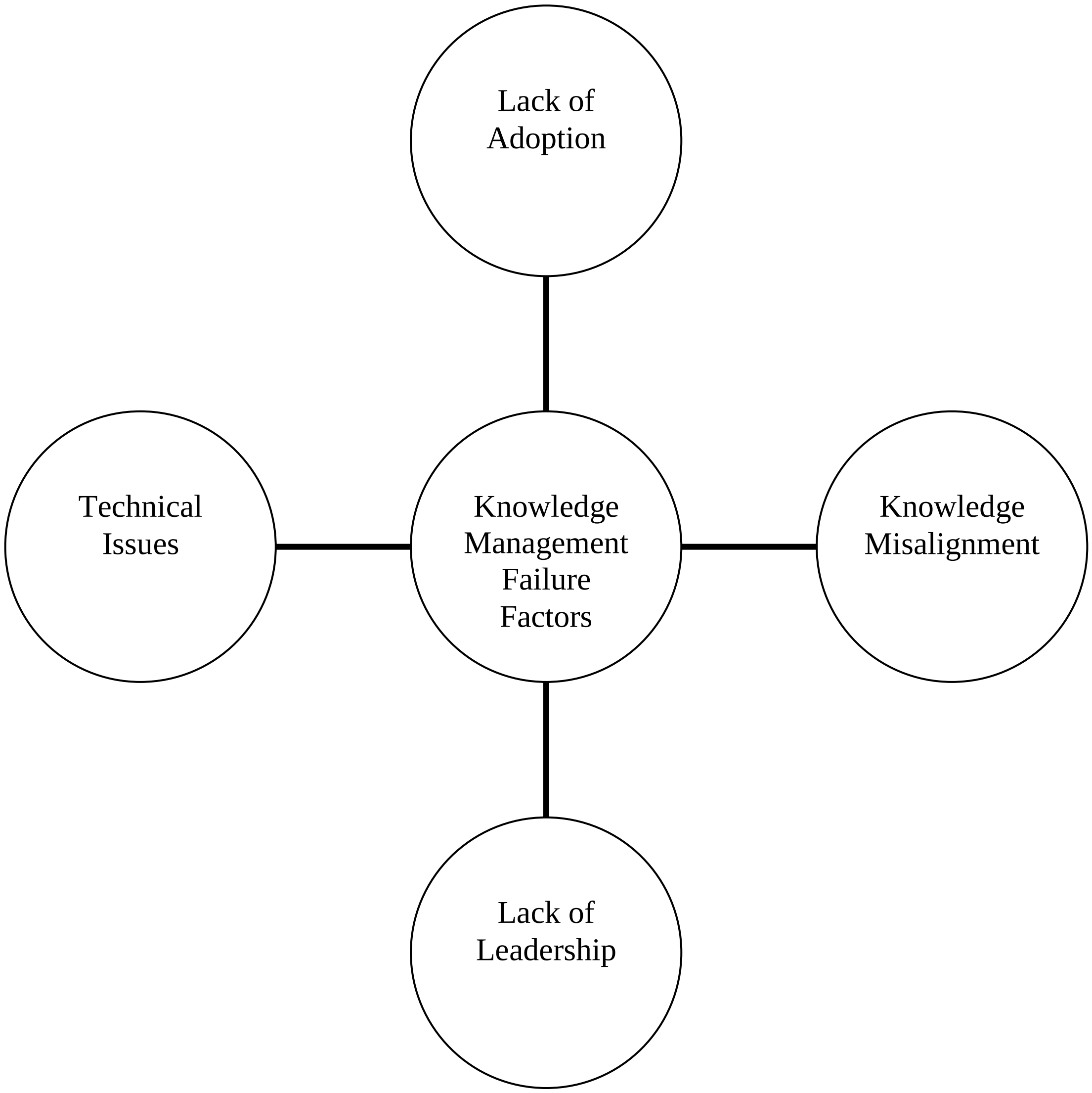

Figure 8. Knowledge management failure factors as defined by the section studies.

IS Project and Knowledge Management Outcomes

Overview. This final section of the literature review will combine knowledge management and IS project success together to form the IS project success and knowledge management outcomes theories. This section will show what information was available on the individual key pieces of knowledge management and how failures in that area affect IS project success.

Knowledge Creation and IS project Success. The first step in knowledge management was to identify the knowledge that needs gathered (Flanagan & Kelly, 2015; Sedera & Gable, 2010). In relation to an IS project, it was identifying the knowledge needed for running the project, identifying key resources to contribute to was knowledge and business knowledge relevant to the project, and identifying the knowledge needed for post implementation support and system usage (Akhavan & Zahedi, 2014; Gemino, Reich, & Sauer, 2015). In order for IS projects successful and for the resulting system useful, all the aforementioned must be identified early in the project and continually throughout the project as new information arises (Akhavan & Zahedi, 2014; Gemino, Reich, & Sauer, 2015). According to a study by Gemino, Reich, and Sauer (2015), higher project performance was statistically linked to better knowledge identification and documentation. Their study showed the importance of identifying knowledge as the backbone of knowledge management success within an IS project.

Akhavan and Zahedi (2014) had similar results in their study. Their study found that of the IS projects that were reported as failures, 50% did not properly recognize knowledge (Akhavan & Zahedi, 2014). Additionally, only 17% reported transparency and 83% reported knowledge strategies insufficient (Akhavan & Zahedi, 2014). Both studies report the importance of knowledge transparency and a knowledge strategy for identification to ensure all resources are collecting data consistently (Akhavan & Zahedi, 2014; Gemino, Reich, & Sauer, 2015). No studies were found to the contrary. The knowledge strategy, which was noted as a defining factor for success does not stop at identification. The knowledge strategy encompasses all phases of IS project knowledge management, including knowledge capture.

Knowledge Retention and IS project Success. Knowledge retention was the act of actually documenting and storing knowledge in a sharable form (Flanagan & Kelly, 2015, Sedera & Gable, 2010). When considering knowledge retention within an IS project, one of the biggest challenges for IS projects was synchronizing knowledge across the business, technical, and leadership teams (Gemino, Reich, & Sauer, 2015). As knowledge was continually identified throughout the duration of the project and post implementation, retaining the knowledge in a meaningful way becomes important (Almeida & Soares, 2014). Not only was it important for the current project, but it was also important for future projects (Rhodes & Dawson, 2013). Therefore, the retention of knowledge needs in a cohesive and relatable way for future examination, not just in a meaningful way for the current project team (Almeida & Soares, 2014; Park & Lee, 2014; Rhodes & Dawson, 2013). For instance, when implementing a new system, a system diagram would be a great way to capture the connectivity of the application server to the database server and to every other server that may be needed for the application to function properly, in addition to any other systems it may interface with (Park & Lee, 2014; Rhodes & Dawson, 2013).

A study by Akhavan and Zahedi (2014) identified that 33% of failed IS projects reported issues with the technology storing knowledge and 83% reported issues actually storing and recalling knowledge from the technology. Essentially, the knowledge repository was not adequate to handle the type of knowledge that was in by not being robust enough or by not being well designed for easy recall (Akhavan & Zahedi, 2014). Gemino, Reich, and Sauer (2015) found that IS projects reported higher success rates when higher levels of project documentation were reported. Additionally, IS projects with higher documentation alignment had higher levels of project documentation (Gemino, Reich, & Sauer, 2015). So, if the appropriate knowledge was captured within an IS project, project documentation was completed properly, documents align with the knowledge strategy, and the supporting technology was adequate for storage and retrieval then IS projects are more successful (Akhavan & Zahedi, 2014; Gemino, Reich, & Sauer, 2015). Knowledge capture does not stop at implementation for an IS project however. Post mortem knowledge capture in the form of lessons learned can also provide significant knowledge for future IS projects (Alkhuraiji et al., 2014; Rhodes & Dawson, 2013; Yang, Chen, & Wang, 2012).

In a qualitative study by Alkhuraiji et al. (2014), lack of quality lessons learned documentation attributed to unnecessary future IS project failures. Letting others learn from your mistakes was noted as a future IS project success factor. Yang, Chen, and Wang's (2012) study, which found that quality lessons learned documentation on technical aspects of the project lead to better technical outcomes for system support and future upgrades to the system, supported this. According to Rhodes and Dawson's (2013) qualitative study, quality issues with post-mortem learning sessions from projects are prevalent. The biggest challenges with using lessons learned information was inconsistent documenting of sessions, inconsistent definitions of lessons learned, and barriers of time gaps (Rhodes & Dawson, 2013). Therefore, lessons learned documentation has a positive impact on future IS project success and on system support when the sessions are structured, the purpose was well defined, the knowledge was properly captured, and the session was held in a timely manner (Alkhuraiji et al., 2014; Rhodes & Dawson, 2013; Yang, Chen, & Wang, 2012). After the knowledge capture has occurred, knowledge needs shared.

Knowledge Transfer and IS project Success. Knowledge transfer and IS project success has the most information available of all of the knowledge management variables. The effort of transferring knowledge between resources on the IS project team (both internal and external resources), transferring knowledge between the IS project team and future support via training, and presenting IS project information to those with a need to know (e.g. stakeholders, sponsors) was defined as knowledge transfer (Flanagan & Kelly, 2015; Sedera & Gable, 2010). Effective knowledge sharing was essential to knowledge management. When considering IS projects, sharing occurs between team members that are internal to a project with members that are external to the project and between internal team members (Bakker, Cambré, Korlaar, & Raab, 2011). Team members can be internal to the company, contracted help, or vendor resources (Bakker, Cambré, Korlaar, & Raab, 2011; Savolainen & Ahonen, 2015).

Knowledge transfer has been shown to have an impact on IS project success. A study by Akhavan and Zahedi (2014) showed that 83% of failed IS projects reported knowledge sharing deficiencies. Knowledge transfer was pivotal to project success as part of communication between project team members (Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). One gap addressed in the literature was the sharing of knowledge between internal and external team members. A study by Teo and Bhattacherjee (2014) addressed knowledge transfer from outsourced companies to internal resources from an IS project perspective. The results indicated that characteristics of outsourcing clients played an important role in facilitating knowledge transfer (readiness and attitudes) (Teo & Bhattacherjee, 2014). Additionally, the transferred knowledge and the knowledge integration mechanisms affected utilization by the client, which generated significant operational and strategic performance improvements in was operations afterward (Teo & Bhattacherjee, 2014).

Ensuring knowledge transfer occurs takes more than just a good strategy. Bakker, Cambré, Korlaar, and Raab's (2011) qualitative study evaluated appropriate project knowledge transfer protocols to the permanent organization. The factors of research were motivation (to share and build knowledge), the embedding of knowledge, and the capacity to absorb knowledge by the parent organization (Bakker, Cambré, Korlaar, & Raab, 2011). The resulting combination of data resulted in the conclusion that project owner's willingness and ability to absorb the knowledge from the project was a main contributing success factor for successful knowledge transfer (Bakker, Cambré, Korlaar, & Raab, 2011). Mehta, Hall, and Byrd (2014) found similar results in their study between internal team members. These studies report that IS projects are more successful because knowledge sharing lead to better team performance (Bakker, Cambré, Korlaar, & Raab, 2011; Mehta, Hall, & Byrd, 2014). To the contrary, Choi, Lee, and Yoo (2010) determined from their study that knowledge sharing had a significant impact on IS project success, but team performance in projects was not impacted by knowledge sharing. Regardless of whether or not team performance was affected by knowledge sharing, knowledge sharing was shown affected by other factors about the project team.

One factor that influences knowledge sharing and IS project success was the perceived benefit of participation to the individual team member. Building reputation was found the most significant extrinsic motivator for the teams, according to Hung, Durcikova, Lai, and Lin (2011). In support of their study, Akhavan and Zahedi (2014) determined that 33% of project resources stated personal outcome as a key factor for sharing knowledge within a project. In the same study, 50% reported rewards and incentives for the same reason (Akhavan & Zahedi, 2014). Therefore, team resources felt that gaining reputation, gaining a reward, or other personal reward was their driving force for sharing knowledge within a project. Elevating social capital was also shown as a success factor for sharing knowledge among team members in IS projects (Bartsch, Ebers, & Maurer, 2013).

Bartsch, Ebers, and Maurer (2013) determined that the social ties between the project team in the organization lead to higher motivation in project teams to share knowledge (Bartsch, Ebers, & Maurer, 2013). A study by Gemino, Reich, and Sauer (2015) showed that the more social alignments there were with project team members, the better the outcome of the IS project. Rroject team members with better social ties are better coordinated with one another (Di Vincenzo & Mascia, 2012). When project team members are not coordinated with one another, it poses risks to the outcome of an IS project (Bhoola, 2015; Di Vincenzo & Mascia, 2012; Dulipovici & Robey, 2013; Hung, Durcikova, Lai, & Lin, 2011; Lee, Park, & Lee, 2015; Reich, Sauer, & Wee, 2008; Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). Therefore, from the listed studies, there appears a link between social capital and knowledge sharing success, which was shown to lead to IS project success.

One aspect of social capital ties back to the factor of trust was the interactions between internal-internal employees and internal-external employees (Lin, Wu, & Lu, 2012; Park & Lee, 2014). According to a study by Akhavan and Zahedi (2014), 50% of IS project team members stated trust as a defining factor in whether or not the team members attempted to build social capital with one another or share knowledge. If employees have rapport and trust, knowledge sharing comes naturally (Bartsch, Ebers, & Maurer, 2013). Therefore, if the internal-internal social relationships are built and trust was developed, employees are more likely than not to share knowledge naturally (Lin, Wu, & Lu, 2012). A study by Lin, Wu, and Lu (2012) reported that employees did not like knowledge sharing because they felt sharing key knowledge would negatively impact their career (e.g. replaced by younger employee). This lead to fear for the employees when discussing electronic knowledge management options (Lin, Wu, & Lu, 2012). To the contrary, Hung, Durcikova, Lai, & Lin (2011) found that employees liked to share knowledge because of the notoriety of sharing. Essentially, the first study suggests fear while the latter suggests an ego boost when sharing knowledge. Another trust factor occurs between internal employees and external employees when contracted companies are selected to manage projects or if employees have had poor experiences with team members previously (Park & Lee, 2014). Building trust between individuals in this instance can occur with positive interactions and demonstrated reliability (Park & Lee, 2014). Trust and social capital appear to work in tandem. The same thing occurs with internal-external communication (Park & Lee, 2014).

A study by Zhao, Zuo, and Deng (2015) indicated that cross-project knowledge transfer was affected by the governance structure of a company and by the capabilities of the company to communicate. So, when the IS project team members have a governance standard for communication, there was greater knowledge sharing and greater IS project success. Knowledge transfer was considered pivotal to project success as part of communication between project team members (Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). Without proper communication of knowledge inside of a project, timelines can slip, which overruns budgets (Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). The comprehensive theme of gathering and disseminating the right information to the right people was one key to success (Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015). Ensuring all project partners are satisfied with the final product and are informed of any issues upfront can lead to better success rates.

Knowledge Application and IS project Success. Knowledge application and IS project success has many areas of opportunity for research and does not have a large number of study data available. In the instance of an IS project, the knowledge has applicable for the project (Park & Lee, 2014). Applying the knowledge that was gained throughout a project requires trust within the project team (Bartsch, Ebers, & Maurer, 2013), as does knowledge sharing. Applying knowledge after a project requires ease of use and applicability (Savolainen & Ahonen, 2015). Ease of use and applicability are both tied to knowledge capture and knowledge identification (Savolainen & Ahonen, 2015). According to a study by Choi, Lee, and Yoo (2010) effective knowledge application within an organization leads to better future system outcomes, but the effects of knowledge application on IS project success was relatively unknown.

Knowledge assessment, which was part of knowledge application, has very little information on its contribution to IS project success. Knowledge assessment within an IS project consists of an ongoing evaluation of knowledge gathered throughout the project and as part of the lessons learned project closure documentation (Flanagan & Kelly, 2015; Park & Lee, 2014). Throughout an IS project, as configuration occurs and as customizations are completed, captured documentation needs reassessed and updated (Savolainen & Ahonen, 2015). As requirements or scope changes throughout an IS project, shared and captured knowledge needs reassessed as well. Further evaluation on knowledge assessment in IS projects was necessary to determine what (if any) affect knowledge assessment has on IS project outcomes.

Research Gap

When considering knowledge management factors and IS project outcomes, there are numerous gaps addressed. For the purposes of this study, the gap addressed was the individual variables of knowledge management as indicators of IS project success. As shown above, knowledge sharing has many areas that have been addressed independently, but the other variables have not and knowledge transfer has not been examined while considering the other variables. Thus, this research aims to address all the individual variables and their link to one another for knowledge success and IS project success. Furthermore, the definition of IS project success has been expanded to include other quality factors in addition to scope. No research exists to tie the knowledge management variables to the proposed definition of IS project success. This research was important to the body of knowledge because better understanding of the knowledge management variables and their role in IS project success can lead practitioners to develop better practices to ensure IS project success. Since quality was factored into the IS project success definition, the research will address quality factors as well. This was important to the body of knowledge because it addresses functionality and customer feedback, which are starting to take more precedent in IS project success theories and more important to business value (Seder & Gable, 2010).

Summary

As IS projects continue to fail at the cost of $150 billion annually (Hardy-Vallee, 2012), studies continue on this topic in an effort to reduce failure rates. As knowledge management has grown in popularity, so has the research on knowledge management outcomes. As such, theories have emerged on failure factors for knowledge management for organizations, concerning daily business and in regard to IS projects. Individual studies on knowledge creation have suggested identifying as a factor for success, within no studies showing otherwise (Akhavan & Zahedi, 2014; Gemino, Reich, & Sauer, 2015). In regard to knowledge retention, a study by Akhavan and Zahedi (2014) identified that 33% of failed IS projects reported issues with the technology storing knowledge and 83% reported issues actually storing and recalling knowledge from the technology, with no contradicting studies. Neither variable was heavily studied. Knowledge transfer had the most relevant information with areas such as social capital, trust, and communication listed as contributing factors (Akhavan & Zahedi , 2014; Bakker, Cambré, Korlaar, & Raab, 2011; Choi, Lee, & Yoo, 2010; Savolainen & Ahonen, 2015; Teo & Bhattacherjee, 2014). This area has the most information but has not been studied in relation to the other knowledge management factors. Knowledge application has very little information and no real direct tie to IS project outcomes. As such, the study of knowledge management factors and their link to knowledge management success and IS project success fills an important gap in the literature, helping to bridge a gap in knowledge management theories and prevent IS project failures in the future.

Chapter 3: Research Method

The purpose of this quantitative correlational study was to examine the relationships between the presence and quality of knowledge management and IS project success in order to identify knowledge management characteristics that are predictors of IS project success. There has been research conducted on many areas of project success factors, but little research exists on the relationship between knowledge management characteristics and IS project success as predictors of success. This study addressed this gap by assessing the relationship between knowledge management and information systems project success using a quantitative correlational method in order to collect and analyze the data. This chapter presents the research questions and hypotheses for this study. Additionally, this chapter contains the research method and design. Presentation of the following key factors for this study was also contained herein: the participants and their selection process, the process used for conducting the study, and the analysis methods utilized. Finally, this chapter addresses the assumptions, limitations, and ethical considerations for this study.

To examine the relationship between knowledge management and IS project success, the research questions and corresponding hypotheses ensured the process of validating (or disproving) the relationship between the variables was accomplished by using correlational analysis (Schumacker & Lomax, 2010). The research questions and hypotheses also ensured the composite variables were identified and useable as well. The primary research question and hypotheses was:

RQ. To what extent, if any, does knowledge management relate to IS project success?

Since knowledge management was operationalized with the four variables: knowledge creation, knowledge transfer, knowledge retention, and knowledge application (Sedera & Gable, 2010), four initial questions were developed:

RQ1. To what extent, if any, does knowledge creation relate to IS project success?

RQ2. To what extent, if any, does knowledge transfer relate to IS project success?

RQ3. To what extent, if any, does knowledge retention relate to IS project success?

RQ4. To what extent, if any, does knowledge application relate to IS project success?

Because knowledge management was operationalized with four variables, the following corresponding four pairs of hypotheses were developed for this study:

$H1_0$. There was not a significant relationship between knowledge creation and IS project success.

$H1_A$. There was a significant relationship between knowledge creation and IS project success.

$H2_0$. There was not a significant relationship between knowledge transfer and IS project success.

$H2_A$. There was a significant relationship between knowledge transfer and IS project success.

$H3_0$. There was not a significant relationship between knowledge retention and IS project success.

$H3_A$. There was a significant relationship between knowledge retention and IS project success.

$H4_0$. There was not a significant relationship between knowledge application and IS project success.

$H4_A$. There was a significant relationship between knowledge application and IS project success.

Research Methods and Design(s)

All three scientific research methodologies were considered for this study. Considering the research aims to examine variable relationships, qualitative and mixed methods were not appropriate (Trochim & Donnelly, 2008). Numeric data are needed for analyzing relationships, which means a quantitative method was required (Trochim & Donnelly, 2008). The quantitative method was also selected so generalizations could be made about the population (Trochim & Donnelly, 2008). Of the quantitative methods, a correlational design was most appropriate as it allows for relationship investigation (Zikmund, 2003). This also allows for the usage of structural equation modeling (SEM) for examining variable relationships. An experiment was not practical and unnecessary as a cause-effect relationship was not the purpose of this study (Zikmund, 2003).

The correlational design was selected because of its alignment with the study purpose, which was to determine if individual knowledge management characteristics have a correlational relationship with IS project success. The correlational method has two limitations for this study. One limitation to the correlational method was the inability to measure variable errors (Guarino, 2004; Schumacker & Lomax, 2010). The second limitation was the inability to model each variable as the correlational method can only explain variable relationships (Guarino, 2004). To overcome these limitations, structural equation modeling was included (Guarino, 2004; Schumacker & Lomax, 2010).

Structural equation modeling (SEM), which was a statistical technique used to test models, was used to test the hypothesized relationships among the latent and measured variables (Guarino, 2004; Schumacker & Lomax, 2010). SEM was used for this study due to the inevitable errors in measurement from the use of latent variables (Hox & Bechger, 1998). Using SEM for this study increased the validity of the results and offset the measurement errors (Hox & Bechger, 1998). After the generation of the SEM model, added indicators were used to show which knowledge management characteristics are predictors of was success, which was the purpose of this study. A self-reporting survey research design was the best approach for this study as it enables consistent, timely collection of numerical data for analysis (Vogt, 2007). One limitation to the self-reporting survey was respondent bias or mistakes in their responses (Vogt, 2007). To ensure validity and reliability of the collected data, confirmatory factor analysis (CFA) and Cronbach's alpha were calculated for each construct (Hox & Bechger, 1998).

Population

The target population was IS project managers with a Project Management Institute (PMI) certification who are members of the Project Management Institute Central Illinois Chapter (PMI-CIC). The Project Management Institute (PMI) is a world-renown project management certification organization with over 480,000 members that specialize in project management areas. This target population was selected due to their knowledge of the subject matter, all of which are required to maintain a project management PMI certification. The PMI-CIC division has over 2,000 members and was selected because of availability. The target population was appropriate for this study because obtaining and maintaining a project management certification requires a continuing demonstration of project management experience, which was validation of experience in the project management field. Therefore, the target population was considered verified experts in project management and, thus, project outcomes. A prequalifying question asking the respondent if they are current members of the PMI-CIC narrowed the respondents to the required demographic.

Sample

The sample of this population was calculated using G*Power's a priori power analysis conducted using a significance level of 0.05, effect size of 0.02, and 0.90 statistical power. The sample size recommended was 255 at minimum. Utilizing the calculation listed helped ensure reliability and validity while producing a manageable dataset for timely analysis (Freeze, Alshare, Lane, & Wen, 2010). The survey was distributed to the entire PMI-CIC group. All questions were required before submission once the respondent had qualified, which limited the responses to only full responses. Once 255 full responses were received, the survey shut down automatically. This ensured the dataset was not too large for timely analysis but was large enough to hit the requirements for validity and reliability.

Materials/Instruments

The survey instruments for this study was Sedera and Gable's (2010) framework Knowledge Management Competency (KMC) and Gable et al.'s (2008) framework was Impact Measurement Model (IMM), collectively KMC-IMM as utilized in Sedera and

Grable's 2010 study (Appendix A). The KMC framework was designed to test the independent variable (knowledge management) via ten measures, broken into categories that correspond with the operationalized variables (Sedera & Gable, 2010). IMM was designed to test the dependent variable (IS project success) via 27 measures (Gable et al., 2008). Sedera and Gable (2010) combined the frameworks into KMC-IMM to conduct a correlational analysis of the two variables. For this study, the KMC-IMM framework had slight modifications. First, the framework was applied to a 5-point Likert scale instead of a 7-point scale for ease of generalizing (Guarino, 2004; Schumacker & Lomax, 2010). Both a 5-point and 7-point scale was acceptable for quantitative correlational analysis (Guarino, 2004; Schumacker & Lomax, 2010). Second, the framework was generalized to all IS systems to gather more data. Beforehand, the questions focused on enterprise systems for a specific vendor, which was only a subset of all information systems.

The authors tested KMC-IMM validity with a Multiple Indicator Multiple Case (MIMIC) model (Sedera & Gable, 2010). The KMC-IMM produced a goodness of fit indicator of 0.88 and absolute fit indicator of 0.077, both of which represent a good fit (Sedera & Gable, 2010). The model was then tested with Partial Least Squares (PLS) at a significance level of .05, of which all operationalized variables presented at 0.6 or higher, ensuring construct validity (Sedera & Gable, 2010). Cronbach's alpha was utilized for construct reliability, which was determined 0.702, which was greater than the 0.70 minimum requirements (Sedera & Gable, 2010).

Operational Definition of Variables

For this study, previous studies on knowledge management were reviewed to identify and define the variables, as evidenced in the literature review. The independent variable, knowledge management, was operationalized to knowledge creation, knowledge transfer, knowledge retention, and knowledge application (Sedera & Gable, 2010). *Figure 9* shows the conceptual model.

Figure 9. Knowledge management and IS project success conceptual model.

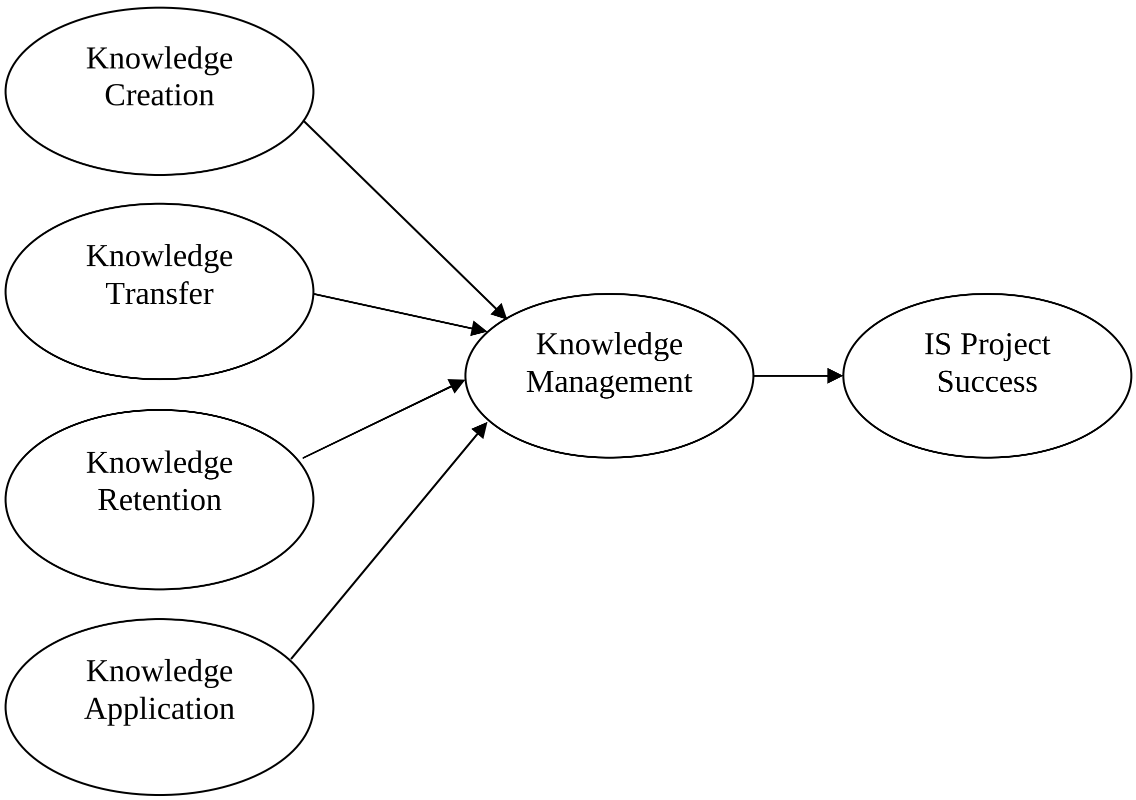

Figure 9. Knowledge management and IS project success conceptual model used for the purpose of this study as defined by Sedera and Gable (2010).

The independent variables and dependent variable were measured on a 5-point Likert scale as: 1 = Strongly Disagree, 2 = Disagree, 3 = No Opinion/Neutral, 4 = Agree, 5 = Strongly Agree. The participants answered questions about the level of use of knowledge management in each instance and then the level of IS project success experienced. The results for each category was added and averaged to determine the composite score for that knowledge management category, as was the IS project success section (Schumacker & Lomax, 2010). Knowledge management categories with composite averages of four indicated best practices for knowledge management, while composite score approaching five indicated advanced best practices (Sedera & Gable, 2010). IS project success scores approaching a composite average of three indicated an average amount of success whereas a four indicated a highly successful IS project (Sedera & Gable, 2010). Therefore, the independent variables and the dependent variable had interval values to enable the measurement of knowledge management and IS project success relationships.

The operational definitions of the variables for this study were:

Knowledge creation. The independent variable *knowledge creation* refers to accumulating the identified knowledge that will need transferred from both the internal and external perspective (Sedera & Gable, 2010). Knowledge creation was a subscale of knowledge management. Knowledge creation was measured by six items in the KMC-IMM, which represent best practices for the category. The scores for the six knowledge creation questions was combined and then divided by six to establish the composite score (Schumacker & Lomax, 2010). Therefore, knowledge creation was an interval variable.

Knowledge transfer. The independent variable *knowledge transfer* refers to establishing the knowledge sharing channels between internal and external resources and utilizing those channels (Sedera & Gable, 2010). Knowledge transfer was a subscale of knowledge management. Knowledge transfer was measured by one item in the KMC-IMM, which represents best practices for the category. The scores for the one knowledge transfer question were considered the composite score (Schumacker & Lomax, 2010). Therefore, knowledge transfer was an interval variable.

Knowledge retention. The independent variable *knowledge retention* refers to the storage of knowledge in a repository (Sedera & Gable, 2010). Knowledge retention was a subscale of knowledge management. Knowledge retention was measured by two items in the KMC-IMM, which represent best practices for the category. The scores for the two knowledge retention questions was combined and then divided by two to establish the composite score (Schumacker & Lomax, 2010). Therefore, knowledge retention was an interval variable.

Knowledge application. The independent variable *knowledge application* refers to using the knowledge that was transferred (Sedera & Gable, 2010). Knowledge application was a subscale of knowledge management. Knowledge application was measured by one item in the KMC-IMM, which represents best practices for the category. The scores for the one knowledge application question were considered the composite score (Schumacker & Lomax, 2010). Therefore, knowledge application was an interval variable.

IS project success. The dependent variable IS project *success* refers to delivering an IS project within budget, schedule, and functionality (Gable et al., 2008). IS project success was measured by 27 items in the KMC-IMM, which represent best practices for the category. The scores for the 27 IS project success questions was combined and then divided by 27 to establish the composite score (Schumacker & Lomax, 2010). Therefore, IS project success was an interval variable. Table 1 shows a summary of the variable types and measures.

Table 1
Summary of Variable Types and Measures

Variable	Type	Measure
Knowledge creation	Independent	Interval
Knowledge transfer	Independent	Interval
Knowledge retention	Independent	Interval
Knowledge application	Independent	Interval
IS project success	Dependent	Interval

Data Collection, Processing, and Analysis

The survey instrument was administered via www.surveymonkey.com to allow for easy sharing and a cost-effective distribution method. The PMI-CIC was contacted and asked to share the survey with all participating members. An informed consent form (Appendix B) was distributed to the participants with the survey link. The participants were informed of the study purpose, their right to not participate, and the confidentiality of the survey. Before entering the survey, the participants acknowledge they have read and understood the informed consent form and they agree. The survey instrument also contained demographic information regarding education level, years of experience, and gender (Appendix C). SurveyMonkey auto-assigned reference numbers to the respondents which were used to ensure data were synchronized at export. The answers were exported from SurveyMonkey for analysis upon closure of the survey.

The interval values collected were used for structural equation modeling with confirmatory factor analysis and then analyzed concerning the hypothesized relationships. To ensure validity and data reliability, the data collected was validated using Cronbach's alpha and confirmatory factor analysis (CFA) for each construct (Schumacker & Lomax, 2010; Trochim & Donnelly, 2008). Spearman's correlation was used for hypothesis analysis (Trochim & Donnelly, 2008). The combination of the aforementioned methods helped ensure the reliability and validity of the results, confirming or denying the existence of the hypothesized relationships (Trochim & Donnelly, 2008).

The SurveyMonkey web survey service collected the data for this study. After all data were collected, the data were exported and analyzed with Minitab and QIMacros. In QIMacros, an analysis of variable relationships was conducted which produced descriptive statistics about the variables, e.g. standard deviation and mean (Zikmund, 2003). Equal weights were given to question so responses could be used for calculating frequency distributions and the mean scores (Zikmund, 2003). The standard deviation, mean and normal curve plot provided for each variable to calculate Cronbach's alpha. Since this study used SEM for data analysis, internal consistency and validity was tested with CFA for the constructs (Hox & Bechger, 1998). Therefore, internal consistency was tested and validity ensured via CFA and Cronbach's alpha calculations (Hox & Bechger, 1998).

Data analysis. Data analysis falls into one of two categories: parametric and nonparametric (Zikmund, 2003). To determine which method was necessary for this study, a few key factors were reviewed. First, parametric methods require either ratio or interval data whereas nonparametric requires either ordinal or nominal measures (Zikmund, 2003). Nonparametric can also be used for non-normal, interval data (Zikmund, 2003). This study used interval data, but normalcy testing indicated a non-normal districution. Second, parametric methods are utilized for correlational analysis generally, assuming normal data (Zikmund, 2003). This study was a correlational analysis with non-normal data. Third, nonparametric methods need larger sample sizes than parametric in order to show statistical power (Zikmund, 2003). This study required 255 responses based on the power analysis, which was adequate for either method. Therefore, since this study was a correlational analysis with interval data with non-normal data, nonparametric data analysis methods were most appropriate (Zikmund, 2003).

Nonparametric test methods. Since the nonparametric data analysis methods were most appropriate, the data were analyzed with a correlational analysis (Zikmund, 2003). Correlational analysis was used for measuring relationships among the dependent and independent variables and provides a baseline for SEM (Schumacker & Lomax, 2010; Zikmund, 2003). Since the purpose of this study was to show variable relationships and the data are not normal, the correlational analysis nonparametric method was most appropriate. Additionally, since this study utilized interval values, Spearman's correlation measured the independent and dependent variable relationships. Spearman's correlation was appropriate for interval values with non-normal data distribution (Onwuegbuzie & Daniel, 1999). Since the correlational coefficient *r* has a range of +1.0 to -1.0, a perfect linear relationship was at either +1.0 or -1.0 (Zikmund, 2003). The correlation results established a baseline model for SEM and provided composite variables. In addition to correlational analysis, the dependent and independent variables were tested for relationship statistical significance along with the Spearman test in Minitab for each hypothesis.

Rules for rejecting or accepting the hypotheses. For hypothesis testing, one consideration was the alpha (significance) level, which was the probability of accidentally rejecting a null hypothesis when it should be accepted, which was called a type I error (Trochim & Donnelly, 2008; Zikmund, 2003). Alpha levels can be set to anything a researcher wants, but adjusting the alpha levels too high can result in a type I error (Zikmund, 2003). Typically, alpha levels are set at 0.01 or 0.05 (Zikmund, 2003). This means there was a 1% likelihood of rejecting a null hypothesis (at alpha =0.01) or a 5% chance of rejecting a null hypothesis (at alpha=0.05) (Trochim & Donnelly, 2008; Zikmund, 2003). Since the KMC-IMM framework utilized an alpha level of 0.05, this study did as well (Seder & Gable, 2010). Therefore, the *p*-value calculated by the Spearman correlation test in Minitab for each hypothesis in this study was compared to the alpha level as *p*<=0.05, leading to the rejection of the null hypothesis when p<=0.05 (Trochim & Donnelly, 2008; Zikmund, 2003). If *p*>0.05, the null hypothesis cannot be rejected for this study (Trochim & Donnelly, 2008; Zikmund, 2003).

Hypothesized model validation using SEM. To validate the hypothesized model with SEM, the hypothesized model must be broken down into a structural and measurement model (Guarino, 2004; Schumacker & Lomax, 2010). Afterward, the hypothesized model was assessed with Non-Normed Fit Index (NNFI), Comparative Fit Indices (CFI), and Root Mean Square Error of Approximation (RMSEA) for goodness of fit (Schumacker & Lomax, 2010). When utilizing SEM analysis, generally RMSEA values equate to the following categories: below 0.05 means a good fit, 0.05 to 0.08 means a reasonable fit, 0.08 to 0.10 means a mediocre fit and greater than 0.10 means a poor fit (Schumacker & Lomax, 2010). For NNFI and CFI, 0.95 and greater means a good fit (Hu & Bentler, 1999). Root Mean Square Residue (RMR) will also show a value of less than 0.08 if the model was a good model fit (Hu & Bentler, 1999). Chi-square will present very low also if the model was a good fit (Hu & Bentler, 1999). For this study, the goal was for RMSEA between 0.05 and 0.07 for the hypothesized relationships while NNFI and CFI were at or above 0.95, and RMR was below 0.8 (Hu & Bentler, 1999; Schumacker & Lomax, 2010). The listed calculations are the first step in SEM analysis, but not the only step. The measurement model also needs assessed.

To assess the measurement model for latent variable relationship for validity, LISREL 9.2 was used (Diamantopoulos & Siguaw, 2010). Indicator loadings were significant if $p<=0.05$ (Diamantopoulos & Siguaw, 2010). To assess the measurement model for latent variable relationship reliability, squared multiple correlation (R^2) was used (Diamantopoulos & Siguaw, 2010). A high R^2 will signify indicator reliability for the tested indicator (Joreskog, 2000). These calculations assessed the measurement model. Afterwards, the structural model will need assessed to determine if the collected data supports the theoretical relationships from this study (Diamantopoulos & Siguaw, 2010). For this study, LISREL output was used for analyzing latent variable theoretical relationships (Diamantopoulos & Siguaw, 2010). The parameter signs will represent the direction of the paths among latent variables, which will indicate if the direction of the relationship was as hypothesized (Diamantopoulos & Siguaw, 2010). The estimated parameter magnitude will show the amount of strength of the hypothesized relationship and was considered significant at $p < 0.05$ (Diamantopoulos & Siguaw, 2010). R^2 for the structural equations will show the variance amount for each accounted for dependent latent variable, with high values indicating greater connection between the hypothesized predecessor (Diamantopoulos & Siguaw, 2010; Joreskog, 2000). Testing the relationship between knowledge management and IS project success through the operational variables in the aforementioned manner will provide project managers useful information to resolve knowledge management issues proactively throughout the project lifecycle. Additionally, the information provided from this study may spark future research on better ways proactive in defined project phases, leading to higher IS project success rates.

Assumptions

First, there was an assumption that the sample from the PMI-CIC was random enough to ensure validity. Since the PMI has strict standards and all of the members of the PMI-CIC are required to certify on those standards, it was assumed that the PMI-CIC was like-minded to all certified PMI project managers regardless of chapter and industry. Second, it was assumed that the project managers are actually successful in their career and not causing failures due to incompetence or inability to maintain PMI standards. Third, it was assumed that the participants will respond truthfully and only in reference to IS projects they have personally been part of, not answering on hearsay.

Limitations

For this study, the respondents are members of the PMI-CIC. Since this organization was only for project managers in central Illinois, external validity may be compromised to some extent. Additionally, the respondents could be concentrated in a specific industry, since the general region has many insurance and medical companies. Since users are self-selected from the whole population, up to the maximum number of 255, the sample was random which helps offset external validity issues. However, since the local PMI chapter members are instructed and certified with the rest of the PMI chapters, there should be minimal gaps in practices, limiting the issue with using only regional respondents.

For internal validity, there are a few things to consider. Self-reporting was a concern for internal validity because users are not restricted in their responses and cannot clarify questions they may have. There was always a potential the respondent might answer with their perception of what they think the answer should be instead of their observations as well. All of which can threaten internal validity. To help ensure there are no internal validity issues, CFA and Cronbach's alpha calculations on each variable will show if data are consistent (Zikmund, 2003).

Other limitations of the study concern the variable relationships. Because a correlational analysis will not show behavior causes, relationships among the variables are only inferred (Zikmund, 2003). Therefore, causality between variables cannot be determined. Additionally, correlational analysis can only explain relationships, not model and cannot account for measurement errors (Guarino, 2004). To offset these concerns, SEM was used (Guarino, 2004; Schumacker & Lomax, 2010). Using SEM ensures validity among the variable relationships (Guarino, 2004; Schumacker & Lomax, 2010).

Delimitations

For this study, delimitations were made to narrow the scope into a more manageable size. One delimitation was restricting the respondents to those who are PMI certified. This delimitation ensures the respondents are knowledgeable in the field and are verified as experts, minimizing some of the internal validity issues. Another delimitation was the project managers must to have two years experience with IS projects. This removes other project management fields that could function differently than IS projects. The study will also be restricted to knowledge management factors, removing all other factors for consideration besides the IS project success factors. These delimitations will ensure the study scope was manageable with reliable responses for analysis.

Ethical Assurances

In this type of study, the main ethical assurance was the integrity of the data and the results. To ensure integrity, reliability and validity are a key ethical concern (Zikmund, 2003). In order to ensure reliability and validity, instruments were used that have been previously shown to have these quality traits. Additionally, the data was analyzed with Minitab, QIMacros, and LISREL to offset human errors from manual calculation. Cronbach's alpha was calculated to ensure construct consistency and CFA was used to ensure validity. Conclusion and external validity for this human subject study was achieved by allowing participants to contribute without selection up to a 255 maximum and using appropriate analytics for this study (Zikmund, 2003). Using the aforementioned selection method removes bias that could be introduced from a selector (Zikmund, 2003). Additionally, there was no storage of users for selection since there was not a selection process, which ensures anonymity (Zikmund, 2003). These assurances help ensure valid results are reported.

Summary

The purpose of this quantitative correlational study was to examine the relationships between the presence and quality of knowledge management and IS project success in order to identify knowledge management characteristics. There has been research conducted on many areas of project success factors, but little research exists on the relationship between knowledge management characteristics and IS project success as predictors of success. This study will address this gap by assessing the relationship between knowledge management and information systems project success using a quantitative correlational method in order to collect and analyze the data. This chapter presented the research questions and hypotheses for this study. Additionally, this chapter presented the research method and design. Presentation of the following key factors for this study was also contained herein: the participants and their selection process, the process used for conducting the study, and the analysis methods utilized. This chapter also addressed the assumptions, limitations, and ethical considerations for this study.

Chapter 4: Findings

The purpose of this quantitative correlational study was to examine the relationships between the presence and quality of knowledge management (KM) and IS project success (ISPS) in order to identify knowledge management characteristics that are predictors of IS project success. To accomplish the aforementioned, a correlational analysis between the independent variable (knowledge management) and the dependent variable (IS project success) was completed. The results of the correlational analysis were used for structural equation modeling (SEM) to form a baseline model. In order to capture knowledge management appropriately for SEM, knowledge management was operationalized into four categories: knowledge capture (KC), knowledge retention (KR), knowledge transfer (KT), and knowledge application (KA) (Sedera & Gable, 2010).

In this chapter, the study findings are presented. The first section contains the results, while the second section contains the evaluation of findings, and the third section contains the summary of the findings. The results section contains the statistical analysis. In the evaluation of findings section, the interpretation of the results will be presented. In the third and final section, a summary of the results and a conclusion will be included.

Results

This section is comprised of two subsections. The first subsection contains the descriptive statistics for each variable and the validity and reliability of the study measures. The second subsection contains the assessment of the various models built for SEM. Tested assumptions for normality are also contained herein. The results of the hypothesis testing itself are contained herein, however the significance of the findings are elsewhere.

Respondents and demographics. For this study, the target population was project managers and leaders of IS projects who maintain a Project Management Institute (PMI) certification. The participants were current participating members of the Project Management Institute Central Illinois Chapter (PMI-CIC). There are currently 2,000 members of the PMI-CIC. G*Power's a priori power analysis was used to determine the sample size. A significance level of 0.05 with 0.90 statistical size, and effect size of 0.02 were used for the analysis. A 255 sample size was recommended and 255 full responses were received via the Surveymonkey.com survey. All completed surveys were valid.

Once the data were collected, it was exported to Microsoft Excel (2007). The demographics data were analyzed with basic formulas in Excel and are shown in (Appendix B). Of the PMI-CIC members that completed the surveys, 57% were males (145) and 43% were females (110). From the education demographic, 61% (156) had a bachelor's degree as their highest degree and 21% (53) had a graduate degree, with the remaining 18% (46) having at least a high school diploma. From an experience perspective, the highest result with 38% (97) was 10-14.99 years experience while 13% (32), 26% (67), 21% (53), and 2% (6) had 2-4.99, 5-9.99, 15-19.99, and 20 or more years experience, respectively.

Construct validity and reliability. This study utilized Sedera and Gable's (2010) framework Knowledge Management Competency (KMC) and Gable et al.'s (2008) framework was Impact Measurement Model (IMM), collectively KMC-IMM as utilized in Sedera and Grable's 2010 study (Appendix A) to gage both the independent and dependent variables. This survey instrument utilized a 5-point closed-ended Likert questionnaire. When evaluating this model, the authors utilized the Multiple Indicator

Multiple Case (MIMIC) model to test validity (Sedera & Gable, 2010). As a result, the KMC-IMM model testing produced a 0.077 absolute fit indicator and 0.88 goodness of fit indicator, which indicated the model was a good fit (Sedera & Gable, 2010). The model also tested with Partial Least Squares (PLS). With the significance level set to 0.05, all operationalized variables were at or above 0.6, ensuring construct validity (Sedera & Gable, 2010). Cronbach's alpha was utilized for construct reliability, which was determined 0.702, which was greater than the 0.70 minimum requirements (Sedera & Gable, 2010).

To test internal consistency of the variables, Cronbach's alpha and composite scores were calculated as shown in Table 2. The average score for each question was calculated by adding the scores for each question in a subscale and then dividing it by the items in the subscale (Niazi et al., 2008). KMC had an overall alpha score of $\alpha = 0.823$ with statistically significant ρ values at 1%. At the operationalized variable level, Cronbach's alpha was calculated as follows: KC= 0.749, KR = 0.825, KT = 1, and KA = 0.721. IMM scored 0.894 at 1% significance. 0.70 is the minimum benchmark for Cronbach's alpha, therefore, internal validity consistency is acceptable and reliable (Simon & Goes, 2010).

Table 2
Cronbach's Alpha for KMC-IMM

Variable	α
Knowledge creation	0.749
Knowledge retention	0.825
Knowledge transfer	1.000
Knowledge application	0.721
Knowledge Management Overall	0.823
IS Project Success	0.894

This study also employed SEM. For reliability and validity of the constructs, confirmatory factor analysis (CFA) was utilized. A detailed review of the CFA is discussed elsewhere in this chapter.

Descriptive statistics. Descriptive statistics were calculated on all constructs to determine if the data fell within a normal distribution using Anderson-Darling in QIMacros. As shown in Table 3 and in the histograms in Appendix C , all construct data had a non-normal distribution. This is evident based visual inspection of the graphs and review of the skewness calculation outside the range -1.000 to +1.000 and kurtosis outside of range -2.000 to +2.000, which caused all variables except KA to be non-normal (Trochim & Donnelly, 2008). Additionally, Anderson-Darling results indicated a non-normal distribution at both 1% or 5% significance level based off the comparison of A-squared and the critical values for those significance levels, in which A-squared must be lower, as shown in Table 4 (Trochim & Donnelly, 2008). Review of A-squared resulted in KA being non-normal as well. Once this was discovered, the researcher switched to the nonparametric equivalents for calculations, as is addressed later sections.

Table 3
Construct Descriptive Statistics

Variable	Std Dev	Mean	Mode	Min	Max	Kurt	Skew
Knowledge creation	0.2513	4.1203	4.000	3.000	5.000	4.365	0.510
Knowledge retention	0.1928	4.0157	4.000	3.000	5.000	22.781	2.385
Knowledge transfer	0.3829	4.1216	4.000	3.000	5.000	2.479	1.199
Knowledge application	0.3657	4.1333	4.000	3.000	5.000	1.993	0.816
IS Project Success	0.1676	4.0968	4.000	3.645	4.645	1.291	1.205

Table 4
Construct Normalcy Test

Variable	A-Squared	95% CV	99% CV	ρ
Knowledge creation	28.231	0.787	1.092	0.000
Knowledge retention	87.450	0.787	1.092	0.000
Knowledge transfer	66.489	0.787	1.092	0.000
Knowledge application	43.429	0.787	1.092	0.000
IS Project Success	24.477	0.787	1.092	0.000

Note: A-squared must be less than the CV for the data to be normally distributed.

Correlational analysis. Since the data distribution for each variable is non-normal, Spearman’s rank-order correlation coefficient (r_s) was used in place of Pearson’s correlation to calculate the correlation coefficient for each independent variable and dependent variable pair (Trochim & Donnelly, 2008). It is important to note that, unlike Pearson's correlation, Spearman's correlation calculates monotonic relationships (Trochim & Donnelly, 2008). This means that the relationship calculated shows simultaneous movement in the variable pairs but does not determine the type of impact between the pairs (i.e. positive or negative movement) (Trochim & Donnelly, 2008). When interpreting Spearman's correlation, a detectible correlation is accepted when calculated at or above 0.20 (Trochim & Donnelly, 2008). The results, as seen in Table 5, show a statistically significant relationship in all variable pairs as every r_s is above the threshold of 0.20, making p=0.00. The strongest relationship was KC and ISPS which was calculated at *rs*=0.597.

Table 5
Spearman's Rank-Order Correlation (r_s) between Dependent and Independent Variables

Variable Pair	r_s	r_s^2	ρ
KC and ISPS	0.597	0.356	0.000
KR and ISPS	0.227	0.052	0.000
KT and ISPS	0.461	0.213	0.000
KA and ISPS	0.489	0.239	0.000

Based on the above calculations and significance testing, the relationships between the independent and dependent variables for the hypothesized model have a statistically significant monotonic relationship. Therefore, the hypothesized model is acceptable for establishing a baseline for SEM. Figure 10 depicts the hypothesized model.

Figure 10. Hypothesized Model.

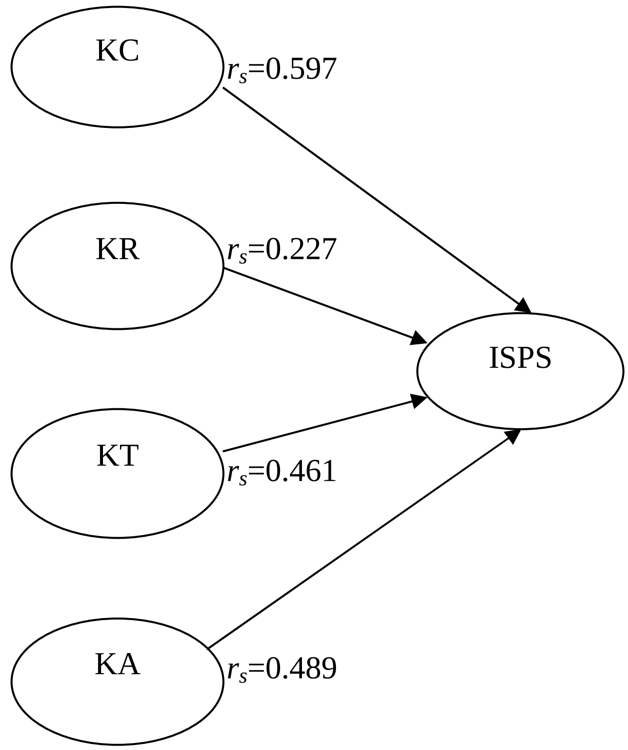

Figure 10. The Hypothesized Model

Structural Equation Modeling analysis. After the development of the hypothesized model, validation of the model using SEM was necessary. To accomplish this, the hypothesized model had to be broken down into the measurement model first and then the structural model (Schumacker & Lomax, 2010). The hypothesized model was analyzed in LISREL, which produced the goodness of fit indices for review. The indices utilized were the Comparative Fit Indices (CFI), the Root Mean Square Error of Approximation (RMSEA), the standardized Root Mean Square Residual (RMR), and the Non-Normed Fit Index (NNFI). Afterward, adjustment of the measurement model was completed (Hoyle, 1995; Hu & Bentler, 1999; Schumacker & Lomax, 2010). Finally, the structural model was built and assessed in similar fashion. Those results and methods are below.

The measurement model. The first step in evaluating the measurement model was to perform a confirmatory factor analysis (CFA). Additionally, testing the goodness-of-fit indices was also necessary. For this study, hitting several benchmarks was expected in order to validate the measurement model. Of the goodness-of-fit indices, RMSEA values below 0.05 are the best fit, but values under 0.08 are considered acceptable and were used for this study (Diamantopoulos & Siguaw, 2010; Schumacker & Lomax, 2010). NNFI and CFI values needed to be 0.95 or higher to indicate a good fit (Hu & Bentler, 1999; Diamantopoulos & Siguaw, 2010). SRMR values should be below 0.08 for a good fit as well (Hu & Bentler, 1999).

The Spearman's correlation of the measurement model variable pairs is presented in Table 6 and the goodness-of-fit indices are presented in Table 7. The factor loadings are presented in Appendix D. Figure 11 contains the measurement model. The CFI and NNFI values were 0.615 and 0.590, respectively. The RMSEA and SRMR values were 0.074 and .0779, respectively. Under the guidelines previously set, CFI and NNFI needed to increase to .95 or higher to ensure a good fit. After review of the goodness-of-fit indices, it was determined that measurement model needed modification.

Table 6
Spearman's Rank-Order Correlation (r_s) between all Variables

Variables	KC	KR	KT	KA	ISPS
KC	1.000				
KR	0.223	1.000			
KT	0.372	0.321	1.000		
KA	0.504	0.334	0.442	1.000	
ISPS	0.597	0.227	0.461	0.489	1.000

Note: $p=0.000$ for all variable pairs

Table 7
Measurement Model Goodness-of-fit Indices

Index	Value
Root Mean Square Error of Approximation (RMSEA)	0.074
Non-Normed Fit Index (NNFI)	0.590
Comparative Fit Index (CFI)	0.615
Standardized Root Mean Square Residual (SRMR)	0.078
P-Value for Test of Close Fit (RMSEA < 0.05)	0.000

Figure 11. Measurement Model

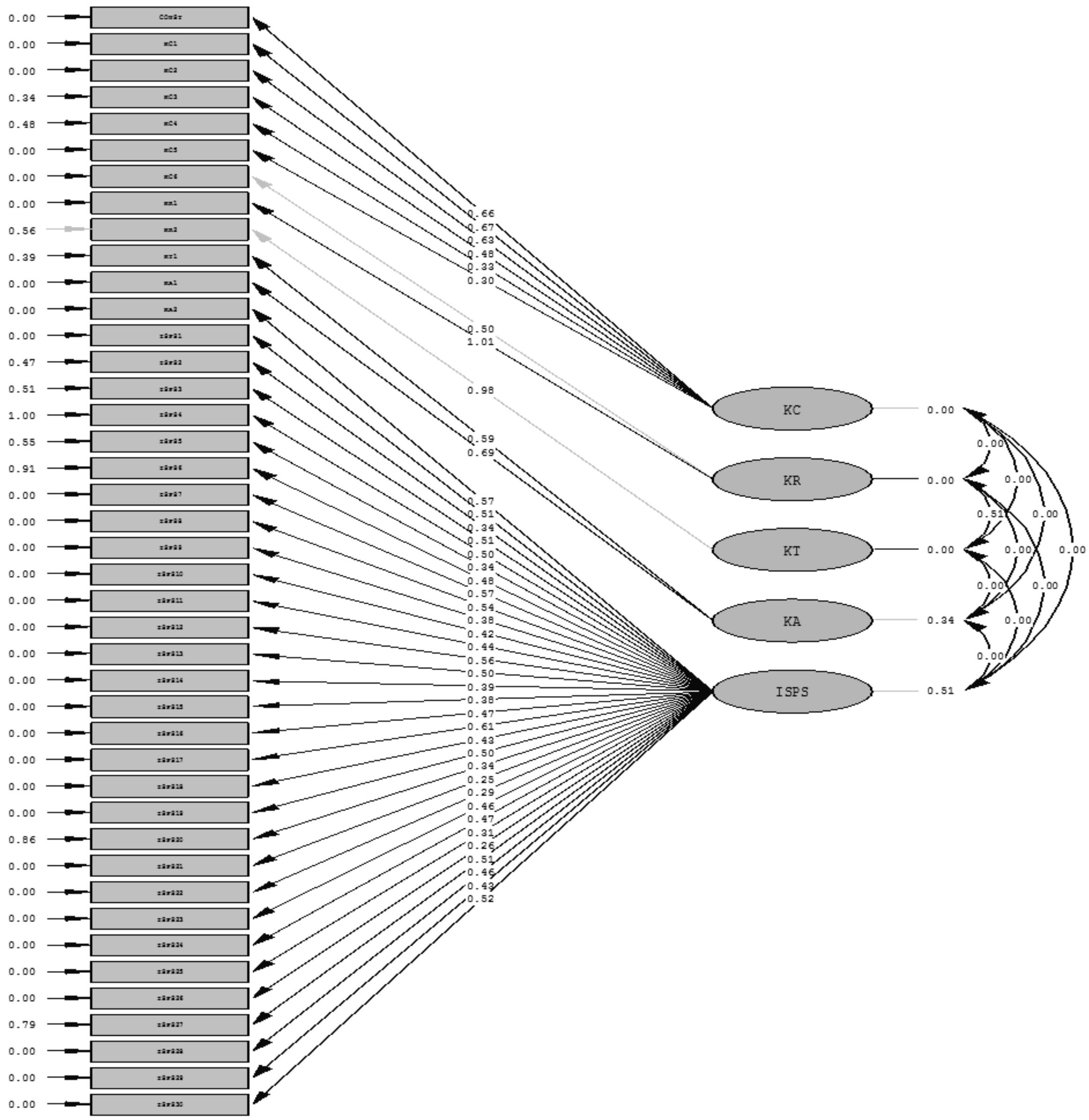

Figure 11. Resulting Measurement Model

Revised Measurement Model. Since the initial measurement model was not a good fit, modifications were made based on three criteria. First, standardized factor loading (SFL) significantly below 0.50 were removed since a low SFL for a variable means the variable may have a dependency with another variable, causing interference (Hair, Black, Babin, & Anderson, 2009). Second, variables that had high modification indices were removed for the same reason (Hair, Black, Babin, & Anderson, 2009). Third, constructs within the same latent variable, with high modification indices for error covariance were reviewed to determine if an error covariance should be shared (Hair, Black, Babin, & Anderson, 2009). Each modification criteria was completed in an iterative fashion, in the order presented, until the goodness-of-fit indices were acceptable. The modifications made to the initial measurement model are addressed contained in Appendix E. The new goodness-of-fit indices are in Table 8. Table 9 contains the new Spearman's correlation sans the removed variables, which shows stronger correlations after the variable removal. Figure 12 contains the new measurement model sans the removed variables and with the error covariance sharing. As presented in the referenced tables, the CFI and NNFI both increased to 0.951 while the other indices stayed in their appropriate ranges. Finally, the data and new measurement model were a good fit.

Table 8
Revised Measurement Model Goodness-of-fit Indices

Index	Value
Root Mean Square Error of Approximation (RMSEA)	0.066
Non-Normed Fit Index (NNFI)	0.951
Comparative Fit Index (CFI)	0.951
Standardized Root Mean Square Residual (SRMR)	0.061
P-Value for Test of Close Fit (RMSEA < 0.05)	0.062

Table 9

Revised Spearman's Rank-Order Correlation (r_s) between all Variables

Variables	KC	KR	KT	KA	ISPS
KC	1.000				
KR	0.332	1.000			
KT	0.269	0.358	1.000		
KA	0.330	0.367	0.446	1.000	
ISPS	0.52	0.286	0.461	0.496	1.000

Note: p=0.000 for all variable pairs

Figure 12. Revised Measurement Model

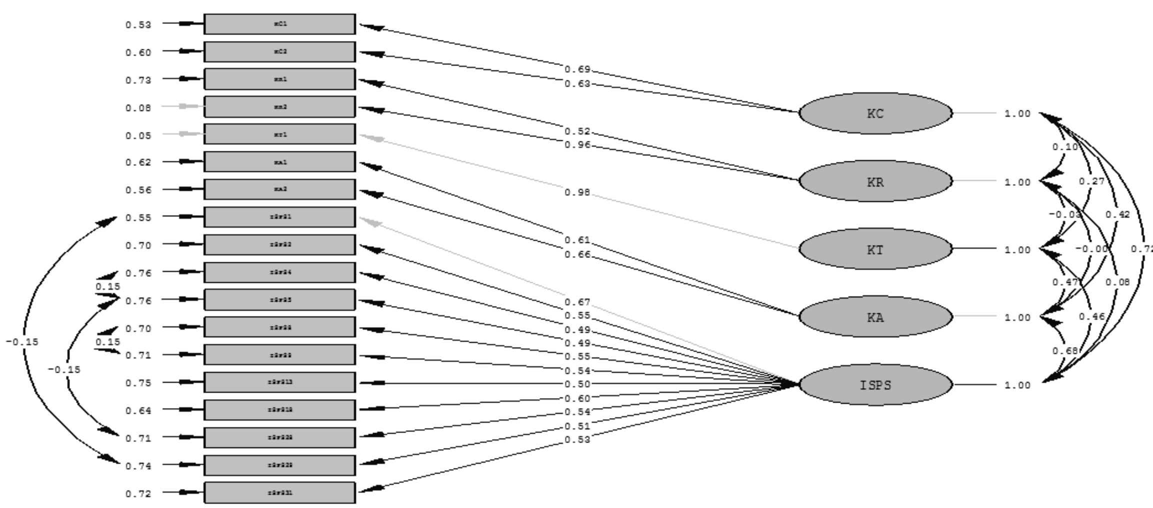

Figure 12. Results of the revisions to the measurement model

The structural model. Once the measurement model became a good fit for the study data, the structural model was created matching the variable setup as the accepted measurement model. The CFA indices for the revised structural model are shown in Table 10. Table 11 contains the hypothesized path coefficients. Figure 13 depicts the revised structural model. As shown, RMSEA was 0.061. The NNFI was 0.950 and CFI was 0.956. The SRMR was 0.59. All of the fit indicators were at acceptable levels at a statistical significance of ρ <0.001.

Table 10
Revised Structural Model Goodness-of-fit Indices

Index	Value
Root Mean Square Error of Approximation (RMSEA)	0.061
Non-Normed Fit Index (NNFI)	0.950
Comparative Fit Index (CFI)	0.956
Standardized Root Mean Square Residual (SRMR)	0.059
P-Value for Test of Close Fit (RMSEA < 0.05)	0.052

Table 11
Robust Maximum Likelihood Calculations for the Hypothesized Paths

Path	β	SE	Critical Ratio
KC and ISPS	0.946	0.151	0.627
KR and ISPS	0.160	0.109	1.461
KT and ISPS	0.306	0.088	3.474
KA and ISPS	0.072	0.129	0.546

Note: p<.001

Figure 13. The Revised Structural Model

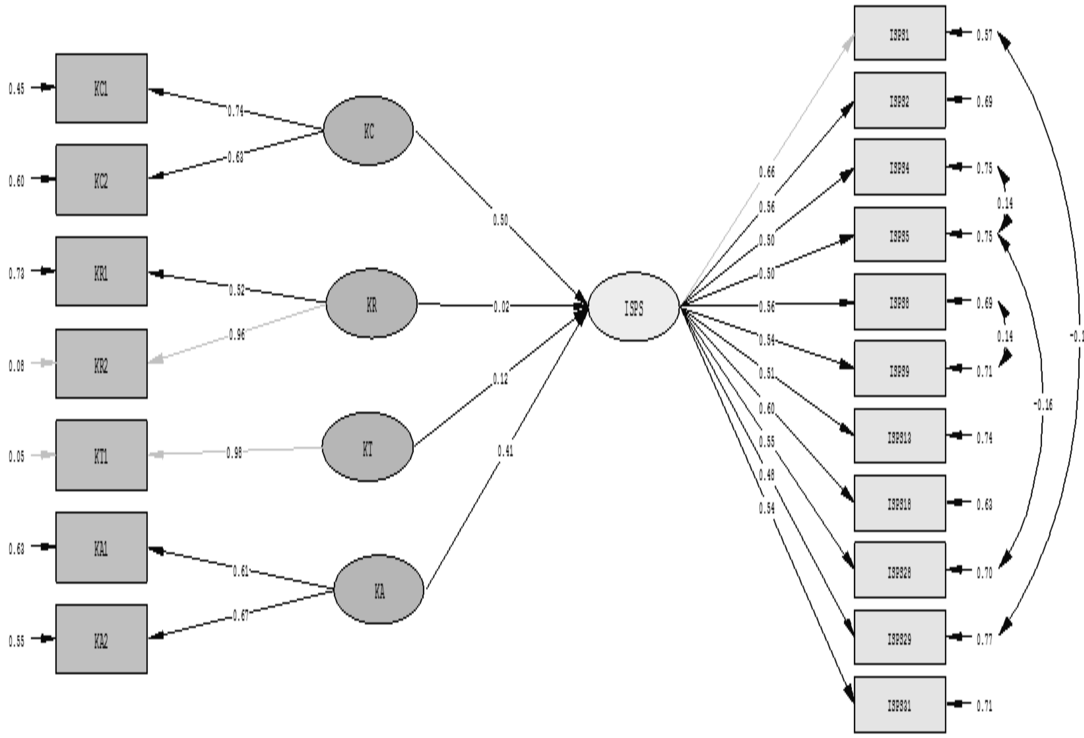

Figure 13. The Revised Structural Model.

The Research Questions. Four research questions were addressed with this study:

RQ1. To what extent, if any, does knowledge creation relate to IS project success?

H1$_0$. There was not a significant relationship between knowledge creation and IS project success.

H1$_A$. There was a significant relationship between knowledge creation and IS project success.

Spearman's rank-order of the revised model confirmed a monotonic correlation existed between knowledge creation (KC) and IS project success (ISPS) where $r_s = 0.52$ and $\rho < 0.001$ (see Table 9). Additionally, the path results between KC and ISPS was $\beta =$

0.946 where $\rho < 0.001$ (see Table 11). Given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge creation leads to better opportunities for IS project success. The alternative hypothesis $H1_A$ was supported and the null hypothesis $H1_0$ was rejected.

RQ2. To what extent, if any, does knowledge transfer relate to IS project success?

$H2_0$. There was not a significant relationship between knowledge transfer and IS project success.

$H2_A$. There was a significant relationship between knowledge transfer and IS project success.

Spearman's rank-order of the revised model confirmed a monotonic correlation existed between knowledge transfer (KT) and IS project success (ISPS) where $r_s = 0.461$ and $\rho < 0.001$ (see Table 9). Additionally, the model path results between KT and ISPS was $\beta = 0.306$ where $\rho < 0.001$ (see Table 11). Given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge transfer leads to better opportunities for IS project success. The alternative hypothesis $H2_A$ was supported and the null hypothesis $H2_0$ was rejected.

RQ3. To what extent, if any, does knowledge retention relate to IS project success?

$H3_0$. There was not a significant relationship between knowledge retention and IS project success.

$H3_A$. There was a significant relationship between knowledge retention and IS project success.

Spearman's rank-order from the revised model confirmed a monotonic correlation existed between knowledge retention (KR) and IS project success (ISPS) where r_s = 0.286 and $\rho < 0.001$ (see Table 9). Additionally, the model path results between KR and ISPS was $\beta = 0.160$ where $\rho < 0.001$ (see Table 11). Given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge retention leads to better opportunities for IS project success. The alternative hypothesis $H3_A$ was supported and the null hypothesis $H3_0$ was rejected.

RQ4. To what extent, if any, does knowledge application relate to IS project success?

$H4_0$. There was not a significant relationship between knowledge application and IS project success.

$H4_A$. There was a significant relationship between knowledge application and IS project success.

Spearman's rank-order from the revised model confirmed a monotonic correlation existed between knowledge application (KA) and IS project success (ISPS) where r_s = 0.496 and $\rho < 0.001$ (see Table 9). Additionally, the model path results between KA and ISPS was $\beta = 0.072$ where $\rho < 0.001$ (see Table 11). Given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge application leads to better opportunities for IS project success. The alternative hypothesis $H4_A$ was supported and the null hypothesis $H4_0$ was rejected.

Evaluation of Findings

The purpose of this quantitative correlational study was to examine the relationships between the presence and quality of knowledge management (KM) and IS project success (ISPS) in order to identify knowledge management characteristics that are predictors of IS project success. This section showed the conceptual framework for knowledge management as a key factor for IS project success was analyzed based on the results from the study. The results of this study showed several knowledge management traits that are predictors of IS project success.

The first examined hypothesis was that a statistically significant relationship existed between knowledge creation and IS project success. Knowledge creation was defined as the accumulation project identified knowledge that needed transferred both within the project and after project closure from both the internal and external project team members (Sedera & Gable, 2010). Previous studies had suggested that identifying knowledge during a project and post implementation could help resolve issues with current and future similar projects within an organization, increasing the chance of IS project success (Rhodes & Dawson, 2013). The findings in Table 9 and Table 11 (r_s = 0.52, $\beta = 0.946$, and $\rho < 0.001$) indicate that knowledge creation significantly predicts IS project success. Spearman's rank-order only gives a monotonic relationship, meaning this study cannot state emphatically the type of correlation that exists between knowledge creation and IS project success. However, given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge creation leads to better opportunities for IS project success.

The second examined hypothesis was that a statistically significant relationship existed between knowledge transfer and IS project success. For this study, knowledge transfer is the establishment of knowledge sharing communication networks between internal and external resources and the use of those channels (Sedera & Gable, 2010). Sharing knowledge between groups has shown to increase the chance of IS project success (Savolainen & Ahonen, 2015). The findings shown in Table 9 and Table 11 (r_s = 0.461, β = 0.306, and ρ < 0.001) indicate that knowledge transfer significantly predicts IS project success. Spearman's rank-order only gives a monotonic relationship, meaning this study cannot state emphatically the type of correlation that exists between knowledge transfer and IS project success. However, given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge transfer leads to better opportunities for IS project success.

The third examined hypothesis was that a statistically significant relationship existed between knowledge retention and IS project success. For this study, knowledge retention is the process of documenting and storing knowledge in a meaningful way (Sedera & Gable, 2010). Capturing and storing knowledge in a meaningful way makes it usefully to the organization and has been shown to increase IS project success (Almeida & Soares, 2014; Park & Lee, 2014; Rhodes & Dawson, 2013). The findings in Table 9 and Table 11 (r_s = 0.286, β = 0.160, and ρ < 0.001) indicate that knowledge retention significantly predicts IS project success. Spearman's rank-order only gives a monotonic relationship, meaning this study cannot state emphatically the type of correlation that exists between knowledge retention and IS project success. However, given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge retention leads to better opportunities for IS project success.

The fourth examined hypothesis was that a statistically significant relationship existed between knowledge application and IS project success. For this study, knowledge application was the use of shared and retained knowledge (Sedera & Gable, 2010). The findings in Table 9 and Table 11 ($r_s = 0.496$, $\beta = 0.072$, and $\rho < 0.001$) indicate that knowledge retention significantly predicts IS project success. Spearman's rank-order only gives a monotonic relationship, meaning this study cannot state emphatically the type of correlation that exists between knowledge application and IS project success. However, given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge application leads to better opportunities for IS project success.

This study conceptual framework indicated a relationship between knowledge management (operationalized to knowledge creation, knowledge retention, knowledge transfer, and knowledge application) and IS project success. Of the four hypothesized relationships, all four were found to have a monotonic, statistically significant relationship between the corresponding operationalized construct and IS project success. The findings from this study are consistent with Seder and Gable's 2010 study that initially produced the KMC-IMM framework.

Summary

This chapter contained the presentation of this study and an evaluation of the results, which included demographics and statistical analysis. Two hundred and fifty-five valid survey responses from members of the PMI-CIC chapter were utilized for calculations, SEM, and path analysis. Crohbach's alpha and Spearman's rank-order correlations were also used to validate data reliability and relationship. After the revision of the measurement model, the structural model, along with Spearman's results, was used to reject the null hypothesis on all four hypotheses, lending support to the alternative hypothesis in each case. Therefore, the hypothesized conceptual model was supported.

Chapter 5: Implications, Recommendations, and Conclusions

The problem addressed in this study was that 66% of IS projects fail each year while reporting an 89.3% failure rate in following a standardized knowledge management process (Cleveland, 2013). Throughout the literature review, knowledge management was a consistent topic of focus as a primary failure factor for IS projects (Akhavan & Zahedi , 2014; Bakker, Cambré, Korlaar, & Raab, 2011; Bartsch, Ebers, & Maurer, 2013; Choi, Lee, & Yoo, 2010; Gemino, Reich, & Sauer, 2015; Lin, Wu, & Lu, 2012; Park & Lee, 2014; Reich, Gemino, & Sauer, 2012; Savolainen & Ahonen, 2015; Teo & Bhattacherjee, 2014; Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015; Zhao, Zuo, & Deng , 2015). However, there were many areas still left to be addressed. This study addressed individual variables of knowledge management as indicators of IS project success in a joined fashion using SEM.

The purpose of this quantitative correlational study was to examine the relationships between the presence and quality of knowledge management (KM) and IS project success (ISPS) in order to identify knowledge management characteristics that are predictors of IS project success. This research concentrated on all the individual variables and their link to one another for knowledge management success and IS project success. The independent variable (knowledge management) was operationalized as knowledge creation, knowledge transfer, knowledge retention, and knowledge application (Sedera & Gable, 2010). A knowledge management framework that was created by Sedera and Gable (2010) called the KMC-IMM, slightly modified from a specific vendor to non-vendor specific to be utilized for this study. The 42-question framework was converted to an anonymous, online survey. Response bias was minimized by informing participants of their anonymity, though results could still be skewed based on respondents trying to give that they thought the correct answer was. Cronbach's alpha and confirmatory factor analysis were utilized to ensure internal variable consistency (Joreskog, 2000; Zikmund, 2003). Below, this chapter contains the study implications, recommendations for practice and for future studies, and a conclusion to summarize the chapter. The aforementioned sections will all contain information drawn from the assessment of the research questions, as analyzed from this study.

Implications

Many researchers, as addressed in the literature review section, have indicated various knowledge management components as key issues for IS project outcomes. Understanding the relationship between knowledge management variables and IS project success led to the utilized study questions, which were the basis for the hypothesis addressed in this study. The results of this study are important and significant to business leaders, project teams, and project managers in organizations that complete IS projects either as a business or within their business. As shown in the literature review, knowledge management is a shared responsibility amongst all team members, all of which have a hand in its success. The implications of this study, therefore, apply to any team member for an IS project. The study findings contribute to the literature addressed herein by continuing to develop an understanding of the connection among knowledge management components and IS project success. This study was an extension of previous knowledge management studies because this study identified and analyzed knowledge management characteristics that are indicators of IS project success as a composite of knowledge management, instead of just as their individual components.

Understanding these types of relationships amongst knowledge management and IS project success is important for developing best practices that can lead to better IS project outcomes. Better IS project outcomes lead to less money lost for organizations due to IS project failure.

The implications for this study are described herein by research question and hypothesis:

RQ1. To what extent, if any, does knowledge creation relate to IS project success?

H1$_0$. There was not a significant relationship between knowledge creation and IS project success.

H1$_A$. There was a significant relationship between knowledge creation and IS project success.

The review of the data as discussed previously indicated that $H1_0$ should be rejected. Knowledge creation and IS project success have a statistically significant relationship. Results from Spearman's rank-order calculated on the revised measurement model confirmed a monotonic correlation existed between knowledge creation (KC) and IS project success (ISPS) where $r_s = 0.52$ and $\rho < 0.001$ (see Table 9). Additionally, the model path results between KC and ISPS was $\beta = 0.946$ when $\rho < 0.001$ (see Table 11). These factors all indicate a statistically significant relationship between knowledge creation and IS project success. Spearman's rank-order only gives a monotonic relationship, meaning this study cannot state emphatically the type of correlation that exists between knowledge creation and IS project success. However, given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge creation leads to better opportunities for IS project success.

Studies conducted by Gemino, Reich, and Sauer (2015) discovered that better project performance was statistically linked to better knowledge identification and documentation (knowledge creation). Their study showed the importance of identifying knowledge properly within project in order to create knowledge documents that are useful. Akhavan and Zahedi (2014) had akin results in their study, which showed that of the IS projects that were reported as failures, 50% did not properly recognize what project knowledge was (Akhavan & Zahedi, 2014). Additionally, only 17% reported transparency in knowledge creation and 83% reported knowledge creation strategies to be insufficient (Akhavan & Zahedi, 2014). No studies were found to the contrary. Thus, the results from this study support previous studies, which indicate there is a significant correlation between knowledge creation and IS project success.

RQ2. To what extent, if any, does knowledge transfer relate to IS project success?

$H2_0$. There was not a significant relationship between knowledge transfer and IS project success.

$H2_A$. There was a significant relationship between knowledge transfer and IS project success.

The review of the data as discussed previously indicated that $H2_0$ should be rejected. Knowledge transfer and IS project success have a statistically significant relationship. Results from Spearman's rank-order calculated on the revised measurement model confirmed a monotonic correlation existed between knowledge transfer (KT) and IS project success (ISPS) where $r_s = 0.461$ when $\rho < 0.001$ (see Table 9). Additionally, the model path results between KT and ISPS was $\beta = 0.306$ when $\rho < 0.001$ (see Table 11). These factors all indicate a statistically significant relationship between knowledge transfer and IS project success. Spearman's rank-order only gives a monotonic relationship, meaning this study cannot state emphatically the type of correlation that exists between knowledge transfer and IS project success. However, given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge transfer leads to better opportunities for IS project success.

The outcome of the literature review for this study uncovered a study that showed 83% of failed IS projects reported significant issues with knowledge sharing (Akhavan & Zahedi (2014). Several other studies reported that IS projects are more successful when knowledge sharing is abundant because sharing leads to better team performance and communication (Bakker, Cambré, Korlaar, & Raab, 2011; Mehta, Hall, & Byrd, 2014). To the contrary, Choi, Lee, and Yoo (2010) determined from their study that knowledge sharing had a significant impact on IS project success, but did not affect team performance. Knowledge transfer remained a pivotal piece of IS project success, regardless of its effect on team performance. Thus, the results from this study support previous studies, which indicate there is a significant correlation between knowledge transfer and IS project success.

RQ3. To what extent, if any, does knowledge retention relate to IS project success?

H3$_0$. There was not a significant relationship between knowledge retention and IS project success.

H3$_A$. There was a significant relationship between knowledge retention and IS project success.

The review of the data as discussed previously indicated that H3$_0$ should be rejected. Knowledge retention and IS project success have a statistically significant relationship. Spearman's rank-order calculated on the revised measurement model confirmed a monotonic correlation existed between knowledge retention (KR) and IS project success (ISPS) where $r_s = 0.286$ when $\rho < 0.001$ (see Table 9). Additionally, the model path results between KR and ISPS was $\beta = 0.160$ when $\rho < 0.001$ (see Table 11). These factors all indicate a statistically significant relationship between knowledge retention and IS project success. Spearman's rank-order only gives a monotonic relationship, meaning this study cannot state emphatically the type of correlation that exists between knowledge retention and IS project success. However, given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge retention leads to better opportunities for IS project success.

According to Akhavan and Zahedi (2014), 33% of failed IS projects reported an 83% failure rate for knowledge storage and recall from a technology perspective. A study by Gemino, Reich, and Sauer (2015) found IS project leaders reported higher project success rates when higher levels of project documentation were reported and easily usable. Thus, the results from this study support previous studies, which indicate there is a significant correlation between knowledge retention and IS project success.

RQ4. To what extent, if any, does knowledge application relate to IS project success?

$H4_0$. There was not a significant relationship between knowledge application and IS project success.

$H4_A$. There was a significant relationship between knowledge application and IS project success.

The review of the data as discussed previously indicated that $H4_0$ should be rejected. Knowledge application and IS project success have a statistically significant relationship. Results from Spearman's rank-order calculated on the revised measurement model confirmed a monotonic correlation existed between knowledge application (KA) and IS project success (ISPS) where $r_s = 0.496$ when $\rho < 0.001$ (see Table 9). Additionally, the model path results between KA and ISPS was $\beta = 0.072$ when $\rho < 0.001$ (see Table 11). These factors all indicate a statistically significant relationship between knowledge application and IS project success. Spearman's rank-order only gives a monotonic relationship, meaning this study cannot state emphatically the type of correlation that exists between knowledge application and IS project success. However, given the review of previous studies and the Spearman's rank-order outcomes, it is assessed that better knowledge application leads to better opportunities for IS project success.

Knowledge application was an area with scarce information. According to a study by Choi, Lee, and Yoo (2010) effective knowledge application within an organization leads to better future system outcomes, but the effects of knowledge application on IS project success is relatively unknown. Additional studies reported similar findings for future IS project success (Bartsch, Ebers, & Maurer, 2013; Park & Lee, 2014; Savolainen & Ahonen, 2015). Thus, the results from this study support previous studies, which indicate there is a significant correlation between knowledge application and IS project success, at least on future IS project success.

As companies continue to amalgamate technology into their business in an attempt to gain efficiencies, projects that fail become a liability to the company, negatively influencing operating budgets and income. It has become increasingly important for organizations to minimize losses due to IS project failure by addressing project failure theories. This study provided additional information on key knowledge management factors that were considered indicators of IS project success. The study findings are yet another step toward informing practitioners and researchers on the relationship amongst knowledge management characteristics and IS project outcomes, helping with the development of best practices to help avoid future IS project failures.

Recommendations for Practice

From a practical standpoint, the revised structural model from the study suggests a few modifications the knowledge management best practices. Initially, the knowledge creation construct was measured by six questions. Recommendations from the low standard factor loadings suggested removing four of those factors to improve the data fit. Removal of those factors removed the following sections from creation best practices: vendor consultant knowledge of the vendor (external knowledge), vendor consultant knowledge of the company (external knowledge), company understanding of company processes (internal knowledge), and company knowledge of the vendor (internal knowledge). Essentially, the new framework addresses only external knowledge creation by vendors as indicators of knowledge creation success, since the other variables appeared to have strong latent relationships. Therefore, focus on external knowledge creation throughout an IS project should be emphasized. This is highlighted in the literature review as well (Akhavan & Zahedi, 2014; Gemino, Reich, & Sauer, 2015). This is in addition to the best practices already addressed by the framework for knowledge transfer, knowledge retention, and knowledge application.

Recommendations for Future Research

Future research on the relationship between knowledge management and IS project success is still needed. This study addressed four operationalized variables, but there were latent affects that were discovered. As discussed, 75% of the knowledge creation indicators were removed due to poor loadings. A future study may evaluate what the latency effects were on those indicators. The literature review had suggested that knowledge creation itself is poorly understood which could mean that knowing what to create may be an issue or the importance of the knowledge created (Akhavan & Zahedi, 2014). Additionally, knowledge transfer was measured by one indicator. Though the reliability of the instrument was good, there may be an opportunity to expand knowledge transfer indicators to determine if all indicators are created equal.

This study could be improved upon by having a wider demographic. Due to ease of access, the participants were all IS project managers from central Illinois. Since the main employers in central Illinois are government, insurance, and healthcare, there may be an opportunity to expand into other sectors such as manufacturing. Additionally, expanding into another country could also provide results that are different based on cultural differences.

Conclusions

The purpose of this quantitative correlational study was to examine the relationships between the presence and quality of knowledge management (KM) and IS project success (ISPS) in order to identify knowledge management characteristics that are predictors of IS project success. Thus, this research addressed all the individual variables and their link to one another for knowledge management success and IS project success. The knowledge management (independent) variable was operationalized as knowledge creation, knowledge transfer, knowledge retention, and knowledge application (Sedera & Gable, 2010). The implications from this study are that knowledge creation, knowledge transfer, knowledge retention, and knowledge application have a monotonic correlational relationship with IS project success. Thus, IS project teams need to consider these factors as key success factors and utilize best practices to help avoid IS project failure. However, future research is still needed to help build best practices in all areas of knowledge management, especially knowledge creation. These studies need to expand to all cultures and industries, and latent effects need identified as well. As studies continue to grow and frameworks continue to refine, best practices in knowledge management can help shape the future of IS projects and increase IS project success.

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Appendices

Appendix A: Variable Models

Knowledge Management Competence Model (KMC) (Sedera & Gable, 2010)

External knowledge creation

1. Knowledge possessed by vendor consultants about the vendor was appropriate.
2. Knowledge possessed by the vendor consultants about the company was appropriate.
3. Knowledge possessed by the vendor consultants about the vendor product was appropriate.
4. Knowledge possessed by the vendor consultants about the company project was appropriate.

Internal knowledge creation

5. Knowledge possessed by the company about itself (e.g. business processes, information requirements, internal policies, etc.) was appropriate.
6. Knowledge possessed by the company of the vendor was appropriate.

Knowledge retention

7. Company knowledge retention strategies were effective with company staff.
8. Company staff retained the knowledge necessary to adapt the new system when required.

Knowledge transfer

9. Vendor training on the system was appropriate.

Knowledge application

10. The company has reused knowledge from the project effectively and efficiently.

Criterion item

11. Overall, project related knowledge was managed satisfactorily.

IS Impact Measurement Model (IMM) (Gable et al., 2008)

Individual-impact was concerned with how the new system (the IS) has influenced your individual capabilities and effectiveness on behalf of the organization.

1. Business partners have learned much through the presence of (the IS).
2. (The IS) enhances business partner awareness and recall of job related information.
3. (The IS) enhances business partner effectiveness in the job.
4. (The IS) increases business partner productivity.

Organizational-Impact refers to impacts of the new system (the IS) at the organizational level; namely improved organizational results and capabilities.

1. (The IS) was cost effective.
2. (The IS) has resulted in reduced staff costs.
3. (The IS) has resulted in cost reductions (e.g. inventory holding costs, administration expenses, etc.).
4. (The IS) has resulted in overall productivity improvement.
5. (The IS) has resulted in improved outcomes or outputs.
6. (The IS) has resulted in an increased capacity to manage a growing volume of activity (e.g. transactions, population growth, etc.)
7. (The IS) has resulted in improved business processes.
8. (The IS) has resulted in better positioning for the business.

Information-Quality was concerned with the quality of the new system (the IS) outputs: namely, the quality of the information the system produces in reports and on-screen.

1. (The IS) provides output that seems exactly what was needed.
2. Information needed from (the IS) was always available.
3. Information from (the IS) was in a form that was readily usable.
4. Information from (the IS) was easy to understand.
5. Information from (the IS) appears readable, clear and well formatted.
6. Information from (the IS) was concise.

System-Quality of the new system (the IS) was a multifaceted construct designed to capture how the system performs from a technical and design perspective.

1. (The IS) was easy to use.

2. (The IS) was easy to learn.
3. (The IS) meets business partner requirements.
4. (The IS) includes necessary features and functions.
5. (The IS) always does what it should.
6. (The IS) user interface can be easily adapted to the business partner's personal approach.
7. (The IS) requires only the minimum number of fields and screens to achieve a task.
8. All data within (the IS) was fully integrated and consistent.
9. (The IS) can be easily modified, corrected or improved.

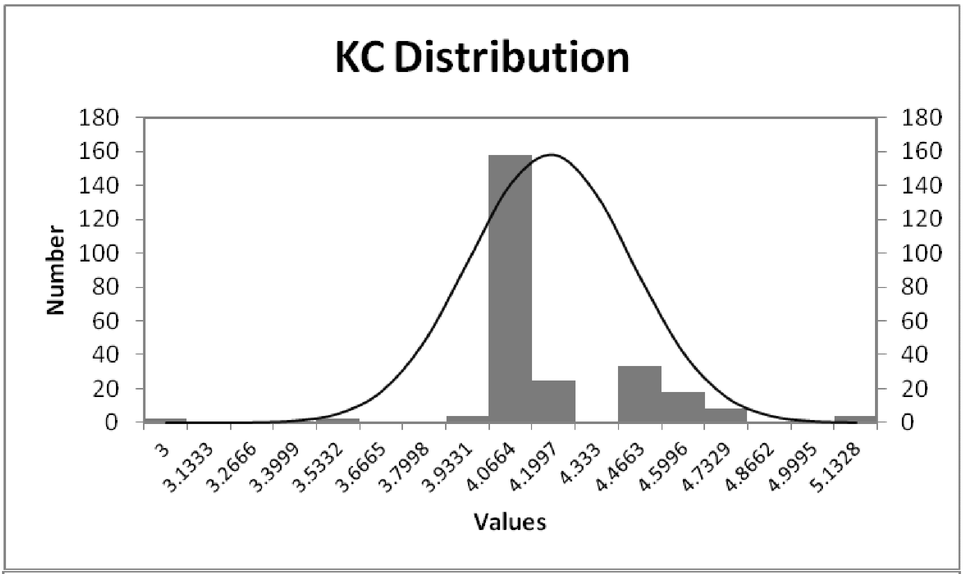
IS-Impact (criterion measures).

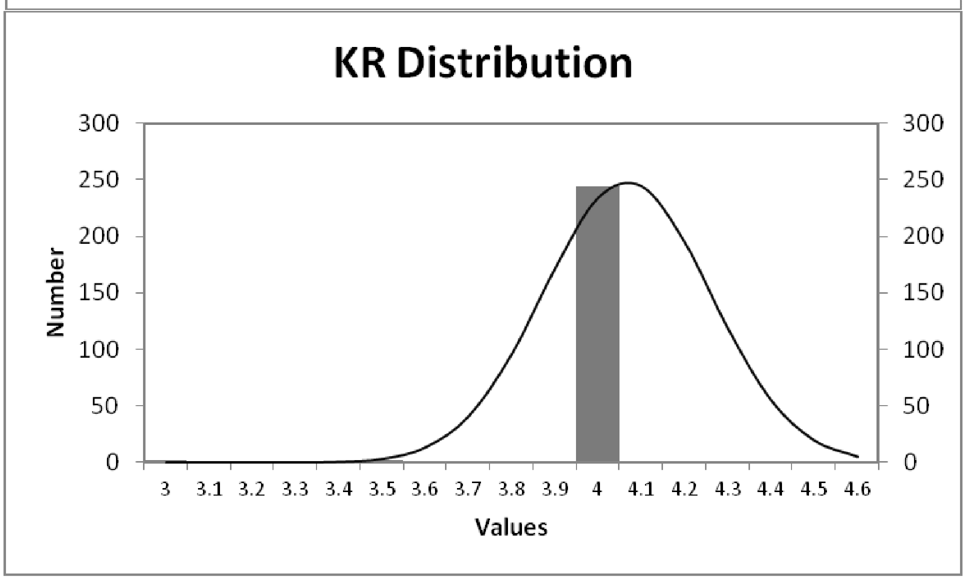
1. Overall, the impact of (The IS) on business partners has been positive.
2. Overall, the impact of (The IS) on the company has been positive.
3. Overall, the (The IS) System-Quality was satisfactory.
4. Overall, the (The IS) Information-Quality was satisfactory.

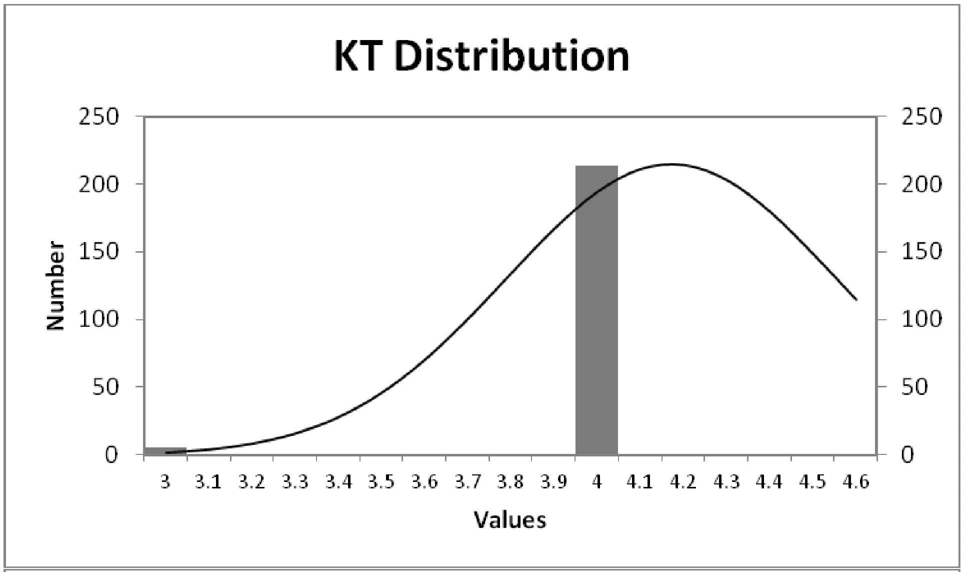
Appendix B: Demographics

Category	Value	Percentage
Gender	Female	43%
Gender	Male	57%
Experience	<2	0%
Experience	2-4.99	13%
Experience	5-9.99	26%
Experience	10-14.99	38%
Experience	15-19.99	21%
Experience	>20	2%
Education	Less than high school degree	0%
Education	High school/GED	3%
Education	Some college but no degree	8%
Education	Associate degree	7%
Education	Bachelor degree	61%
Education	Graduate degree	21%

Appendix C: Histograms






KT Distribution
Number
Values
250
200
150
100
50
0
3
3.1
3.2
3.3
3.4
3.5
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3.9
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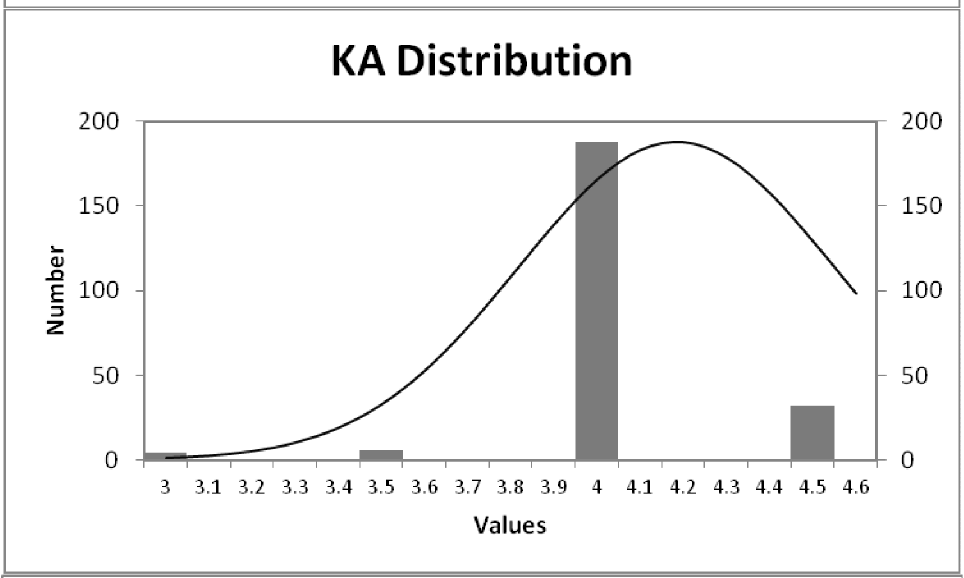
4.2
4.3
4.4
4.5
4.6


KA Distribution
Number
Values
200
150
100
50
0
3
3.1
3.2
3.3
3.4
3.5
3.6
3.7
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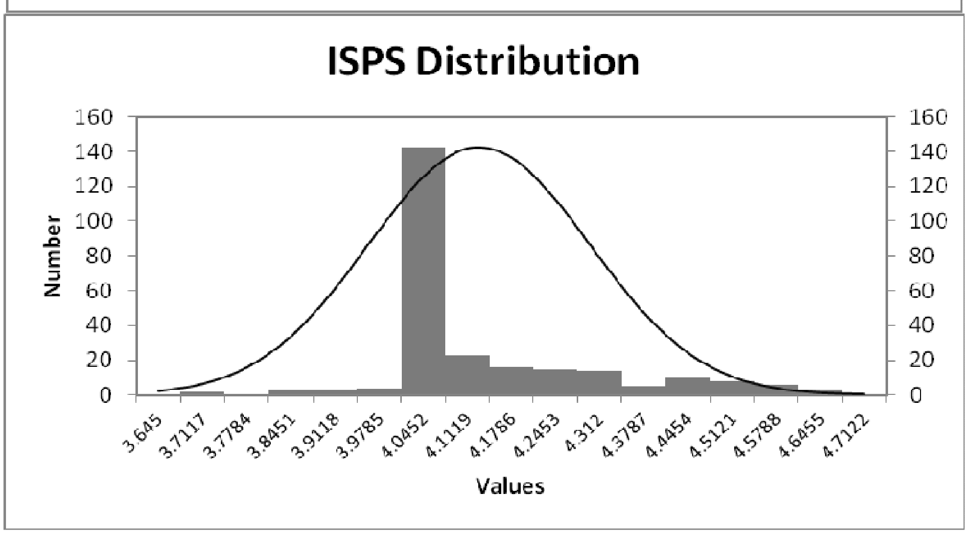
4.4
4.5
4.6


ISPS Distribution
Number
Values
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140
120
100
80
60
40
20
0
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3.7117
3.7784
3.8451
3.9118
3.9785
4.0452
4.1119
4.1786
4.2453
4.312
4.3787
4.4454
4.5121
4.5788
4.6455
4.7122

Appendix D: Standard Factor Loadings

Variables	KC	KR	KT	KA	ISPS
KC1	0.66	-----	-----	-----	-----
KC2	0.67	-----	-----	-----	-----
KC3	0.36	-----	-----	-----	-----
KC4	0.48	-----	-----	-----	-----
KC5	0.33	-----	-----	-----	-----
KC6	0.30	-----	-----	-----	-----
KR1	-----	0.50	-----	-----	-----
KR2	-----	1.01	-----	-----	-----
KT1	-----	-----	0.98	-----	-----
KA1	-----	-----	-----	0.59	-----
KA2	-----	-----	-----	0.69	-----
ISPS1	-----	-----	-----	-----	0.57
ISPS2	-----	-----	-----	-----	0.51
ISPS3	-----	-----	-----	-----	0.34
ISPS4	-----	-----	-----	-----	0.51
ISPS5	-----	-----	-----	-----	0.50
ISPS6	-----	-----	-----	-----	0.34
ISPS7	-----	-----	-----	-----	0.48
ISPS8	-----	-----	-----	-----	0.57
ISPS9	-----	-----	-----	-----	0.54
ISPS10	-----	-----	-----	-----	0.38

ISPS11	-----	-----	-----	-----	0.42
ISPS12	-----	-----	-----	-----	0.44
ISPS13	-----	-----	-----	-----	0.56
ISPS14	-----	-----	-----	-----	0.39
ISPS15	-----	-----	-----	-----	0.39
ISPS16	-----	-----	-----	-----	0.38
ISPS17	-----	-----	-----	-----	0.47
ISPS18	-----	-----	-----	-----	0.61
ISPS19	-----	-----	-----	-----	0.43
ISPS20	-----	-----	-----	-----	0.50
ISPS21	-----	-----	-----	-----	0.34
ISPS22	-----	-----	-----	-----	0.25
ISPS23	-----	-----	-----	-----	0.29
ISPS24	-----	-----	-----	-----	0.46
ISPS25	-----	-----	-----	-----	0.47
ISPS26	-----	-----	-----	-----	0.31
ISPS27	-----	-----	-----	-----	0.26
ISPS28	-----	-----	-----	-----	0.51
ISPS29	-----	-----	-----	-----	0.46
ISPS30	-----	-----	-----	-----	0.43
ISPS31	-----	-----	-----	-----	0.52

Appendix E: Construct Modifications for Revised Model

Variable	SFL<0.50	High Modification	Error Covariance Variable
KC3	0.36	-----	-----
KC4	0.48	-----	-----
KC5	0.33	-----	-----
KC6	0.30	-----	-----
ISPS1	-----	-----	ISPS29
ISPS3	0.34	-----	------
ISPS4	-----	-----	ISPS5
ISPS5	-----	-----	ISPS4 & ISPS28
ISPS6	0.34	-----	-----
ISPS7	0.48	-----	-----
ISPS8	-----	-----	ISPS9
ISPS9	-----	-----	ISPS8
ISPS10	0.38	-----	-----
ISPS11	0.42	-----	-----
ISPS12	0.44	-----	-----
ISPS14	0.39	-----	-----
ISPS15	0.39	-----	-----
ISPS16	0.38	-----	-----
ISPS17	0.47	-----	-----
ISPS19	0.43	-----	-----
ISPS20	-----	KC & KR	-----

ISPS21	0.34	-----	-----
ISPS22	0.25	-----	-----
ISPS23	0.29	-----	-----
ISPS24	0.46	-----	-----
ISPS25	0.47	-----	-----
ISPS26	0.31	-----	-----
ISPS27	0.26	-----	-----
ISPS28	-----	-----	ISPS5
ISPS29	-----	-----	ISPS1
ISPS30	0.43	-----	-----