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Establishing Relationships Between Risk Management and Knowledge Transfer

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ESTABLISHING RELATIONSHIPS BETWEEN RISK MANAGEMENT AND KNOWLEDGE TRANSFER

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ABSTRACT

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Risk management (RM) and Knowledge management (KM) have mostly been treated as separate management philosophies. Risk management is a widely taught topic in academia and is practiced in industry. Knowledge management is being taught at increasingly more colleges and many companies are discovering a need for managing knowledge. This dissertation shows that some research has been conducted to apply the principles of knowledge management in establishing risk management plans. To a lesser extent there has been research conducted to apply the philosophies of risk management to identifying knowledge gaps and maintaining corporate knowledge. Both risk management and knowledge management are broad fields. The literature review uncovers the planning, identification, analyzing, handling, documenting, and monitoring of risks as key areas of consideration for risk management. It additionally reveals knowledge transfer in the form of lessons learned, best practices and near misses as a focal investigation point for knowledge management. The question answered in this dissertation is "Does knowledge transfer have a positive impact on risk management capabilities?"

A conceptual model of the relationships across knowledge transfer and risk management was built and six hypotheses were identified and statistically tested using data collected from the project environment. A data collection instrument was developed, vetted through peer review, and distributed using the Internet. Ninety complete responses were collected and provided the raw data to statistically test the validity of the measures and the hypotheses. The results support the general hypothesis that an increase in knowledge transfer will have a positive impact on risk management capabilities in projects. Another significant result is the amount, direction, and strengths of the significant statistical correlations found in this research across the measures of inter- and intra-knowledge transfer in projects and project risk management. The results of this research show that of the knowledge transfer methods considered in this study (i.e., best practices, lessons learned, and near misses) best practices have the highest number of significant statistical correlations across the measures used, including the strongest correlation found in this investigation. Additionally, it was also noted in the results that inter-knowledge transfer was significantly correlated with 70% more risk management measures than intra knowledge transfer. These results have implications for academics and engineering managers and suggest areas for future research.

This dissertation is dedicated to my son, Jacob Haltiwanger. Continue to strive to understand the universe around you. It is through our environments we learn about ourselves. This dissertation is also dedicated to my wife, Kara Haltiwanger. Keep your drive for learning strong and your dedication to teaching the next generation close to your heart.

"Being unconquerable lies with yourself; being conquerable lies with the enemy."

-Sun-Tzu

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CHAPTER 1

INTRODUCTION

Problem Statement

Academia teaches risk management (RM) and knowledge management (KM). Companies institute risk management plans and knowledge management plans. Some companies have entire departments or groups dedicated solely to either risk management or knowledge management. But how well do we understand how the two philosophies correlate?

The two philosophies of RM and KM do share common traits (Webb, 2007). Some companies are starting to understand there are links between the two (Neef, 2005). Indeed it is hard to manage one without managing the other (Lelic, 2002). Does one philosophy belong in the domain of another? Is a major benefit of managing knowledge the ability to enhance the effectiveness of risk management (McElroy, 2003)? Or, can risk techniques be used to mitigate knowledge loss? The International Atomic Energy Agency (IAEA) uses risk management techniques to identify areas of critical knowledge and potential knowledge loss (Kolisov, Mazour, & Yaney, 2006). Or can the two philosophies be utilized in a more symbiotic manner? The Exploration Systems Mission Directorate (ESMD) at the National Aeronautic and Space Administration (NASA) is taking a knowledge-based risk approach (Lengyel, 2008). In this approach lessons learned from past projects can be turned into risk records for future projects.

Additionally, identification and mitigation methods for a potential risk are in turn recorded as lessons learned.

Research Question

Understanding what aspects of knowledge management have a role in managing risks could potentially allow engineering managers to focus their resources on those specific aspects. The literature review revealed that indeed principles of knowledge management can be applied to risk management. The literature review also showed that principles of risk management can be applied to knowledge management. However, there is a large gap in our understanding of how the two philosophies interrelated. Literature reviewed for this dissertation showed that key aspects of risk management to consider are risk planning, risk identification, risk analysis, risk handling, risk documentation, and risk monitoring. Research also showed that knowledge transfer is a key component for consideration in knowledge management. Knowledge transfer in the form of lessons learned, best practices, and near misses both within a project setting, intra-knowledge transfer, and across projects, inter-knowledge transfer, have been studied. The gap analysis conducted for this paper revealed that currently there is no research on how knowledge transfer in the form of lessons learned, best practices, and near misses impact the five key areas of risk management listed above. This paper will focus that identified gap. The research question is "Does knowledge transfer have a positive impact on risk management capabilities?" An answer to this question will bridge a gap in the body of knowledge, benefiting industry and academia alike.

Relevance of This Research

For risk management researchers the literature review establishes clear links between managing knowledge and managing risks. The literature review also identifies the wide gap in the body of knowledge concerning the links between risk management and knowledge management. This research establishes correlations between risk management and knowledge transfer. These correlations provide a basis for a better understanding of the relationships between knowledge transfer and risk management and provides areas for future research.

For knowledge management researchers the benefit is similar to that for risk management researchers. This research shows a positive relationship between knowledge transfer and risk management capabilities. Additionally, the research conducted looks at the correlations between specific aspects of knowledge transfer (best practices, lessons learned, and near misses). Understanding the correlations to risk management capabilities will not only help bridge a gap but give additional areas to explore deeper.

For industry, answers to the research question have practical benefits. By providing a better functional understanding of the relationship between knowledge transfer and risk management in project based environments decision makers can better direct resources and improve on the quality of their RM and KM programs. Empirical data will be provided that can help when trying to decide where to allocate limited funds. The research will investigate several moderating factors to the process including the length of a project, number of team members in a project, company size, project cost, and personal experience. Understanding the role these factors play in the effectiveness of risk management will allow for companies to improve upon their risk management and knowledge management plans.

CHAPTER 2

LITERATURE REVIEW

Introduction

The ancient military philosopher Sun Tzu stated "If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle" (as cited in Sawyer, 1994). What holds true then holds true today. The more that is known about a task and the risks associated with that task then the likelihood of success completing that task increases. Risk management and knowledge management are two domains that are taking root in the business management realm that deal directly with knowledge and identifying pitfalls. Risk management is an established business practice and is widely taught in academia. Knowledge management is gaining traction in business and is increasingly being taught as well. This paper investigates the links between the two philosophies, identifies the existing gap, and offers a conceptual model linking a specific aspect of knowledge management indentified in the gap, knowledge transfer, to risk management.

Knowledge transfer is the process through which one entity (individual, group, department, division, etc) is affected by the experience of another (Argote & Ingram, 2000). The field of knowledge management is large including the areas of knowledge identification, knowledge capture, knowledge creation, knowledge capture, and knowledge transfer (Kitaev & Kolisov, 2011). The literature review conducted for this paper revealed that knowledge transfer had been studied in relation to risk management capabilities but a gap existed in the empirical data proving the influence of knowledge transfer on risk management capabilities. Furthermore, the literature review conducted revealed that research has been conducted showing that lessons learned, best practices, and near misses are important components of knowledge transfer and have been empirically studied showing their impact as components of knowledge transfer. However, these components of knowledge transfer as an aggregate have not been empirically studied to show their influence on risk management. Lessons learned, best practices, and near misses are considered key components of knowledge transfer by this research paper and future references to knowledge transfer imply the subset of these three categories.

Barquin (2006) drives home the importance of risk management by citing the compromise of the personal data of 26 million veterans when a laptop was stolen from the Department of Veteran Affairs in 2006. Barquin indicates that if one looks at risk as a subset of the knowledge domain then many of the knowledge management practices clearly apply. Another author, Webb (2007) does not subvert one philosophy to the other but does find common teachings. Webb lists some shared traits of the KM and RM philosophies as: organizational wide involvement, enhancement to corporate strategy, sharing culture, encouraging lessons learned, technology acting as an enabler not a driver, and heavy reliance on business intelligence. This paper seeks to answer the research question: "Does knowledge transfer have a positive impact on risk management capabilities?" This question is addressed through a literature review and conceptualization of the relationships between risk management and knowledge transfer.

Knowledge Management Applied to Managing Risk

What is risk and what is risk management? Kaplan and Garrick (1981) state that to define risk one is really asking: "What can happen?", "How likely is that to happen?", and "If it does happen, what are the consequences?" According to Haimes (1991) in managing those risks we need to answer: "What can be done and what options are available?", "What are the trade-offs in terms of all costs, benefits, and risk?", and "What are the impacts of current management decisions on future options?" Risk management includes planning, identifying, analyzing, handling, monitoring, and documenting risks (Conrow, 2005). Conrow indicates it is essential that risk documentation be a part of these processes. Documentation is an essential part of feedback and this feedback loop is a cornerstone of both risk and knowledge management. The five areas identified by Conrow, risk planning, risk identification, risk analysis, risk handling, risk monitoring, and risk documentation, are used as the fundamental definition of risk management for this research. Further references to risk management in this paper imply consideration of those five categories.

Risk management, in one form or another, has been around for many centuries (Haimes, 2001). There may not have been an acknowledgement of the practice or following of current doctrines, but Haimes (2001) points to the durability of the ancient pyramids to support his claim. Risk management gained focus and a formalized approach in the 1900s. In 1921, Knight published *Risk, Uncertainty and Profit.* Knight discusses the difference between uncertainty, which cannot be measured, and risk, which can be measured (i.e., reducible and irreducible uncertainty). In 1971, Arrow published *Essays in the Theory of Risk Bearing* where he discusses the concept of moral hazard and optimal risk-bearing allocations. Haimes (2001) ultimately points to the formation of the Society for Risk Analysis in 1980 to show the evolution of risk management.

Risk management relies on the quality of knowledge and the efficient transfer of that knowledge. Risk researchers are beginning to study the interrelationships. Halpern-Felsher, Millstein, Ellen, Adler, Tschann, and Biehl (2001) investigated risk judgment in health promoting and health compromising behaviors. The researchers look at the effects of personal experience and learned knowledge on risk judgments. For example, the researchers state that those that have experienced an event are more likely to believe that event may happen again to them. In developing a risk assessment program they state that this fact needs to be taken into account and controlled for. Interestingly enough their research showed that participants who had experienced a behavior, both with a negative outcome and without a negative outcome, did not show significant differences in risk judgments. However, there was a significant difference between the risk judgments between those with and without the behavioral experience. Generally the more experience a participant had with a behavior (i.e. drinking and driving) the lower the risk judgment for a negative outcome (i.e. wreck) was. The authors warn about correlation and causal effects. It cannot be determined from this research if lower risk judgment leads to risky behavior or if lack of experiencing a negative outcome after experiencing a behavior lowers the individuals risk judgment. The researchers did show a correlation between those that had tacit knowledge of an event and their risk judgment versus those that had explicit knowledge and their risk judgment. Tacit knowledge as explained by Polanyi (1958) is personal knowledge that is hard to share through non-verbal, and sometimes even verbal, methods. Explicit knowledge is formalized and codified (Brown

& Duguid, 1998). The research of Halpern-Felsher, et al. (2001) shows a correlation between tacit knowledge and risk identification and handling but does not address knowledge transfer or other categories of risk management (i.e. planning, analysis, monitoring and documentation).

Fischhoff (1975) studies the effects of explicit knowledge on the effects of judgment. Fischhoff uses the terms hindsight and foresight. A hindsightful judge has outcome knowledge were as a foresightful judge does not. Questions the researcher looked to answer were how knowledge of the outcome of an event affects judgment and how aware an individual is of the effects that knowledge has on his or her perceptions. His hypotheses were that receiving outcome knowledge increases the perceived probability of occurrence and that the individual is not aware that his perception has changed due to this knowledge. The researcher used experimental group his or her where the subjects were giving a historical event and several possible outcomes. The groups were either given no additional information, the correct outcome, or an erroneous outcome. The subjects were asked to rate the probabilities of the outcomes. Several variations of the experiment were conducted. Fischhoff's conclusion was that knowledge (explicit) had an effect on judgment even when the judge took pains to make impartial probability assessments. Fischhoff's work concentrates on one particular form of knowledge, explicit, as it relates to only a few areas of risk management, identifying and analyzing risks. These two examples, Halpern-Felsher, et al. (2001), and Fischhoff (1975), show that there is an understanding that knowledge must be considered in the field of risk management. The researchers do not address knowledge transfer specifically in relation to risk management as defined by Conrow (2005).

Basili, Caldiera, and Rombach (1994) developed an infrastructure called the Experience Factory that has relevance to risk management. The basis is a feedback loop of lessons learned and re-use of experience. An important aspect of this research is that it uses lessons learned as a component of the knowledge transfer process. The feedback loop is used to cut costs, reduce risk associated with repeating mistakes, and minimize schedule impacts associated with redundant actions. Though the Experience Factory focuses on the general importance of lessons learned and not specifically as it relates to risk management, similar ideas can be found of using knowledge management to reduce risks. NASA has made extensive use of analyzing risks using both risk and knowledge management principals. The Science Applications International Corporation (SAIC) produced a detailed risk assessment of the potential of losing a space shuttle in 1995. SAIC used event and fault trees as the basis for the analysis. The trees were combined into functional failure categories and then into an integrated model. From this model a probabilistic risk assessment was created using historical empirical data gathered from flight and test operations from shuttle components, data from other types of launch vehicles, and data from components of "shuttle surrogates." This model has at its roots knowledge management principles for obtaining, storing, using, and re-using the data. NASA has also developed many different knowledge management plans for sharing data within and across programs which reduce various program risks (Leonard & Kiron, 2002). Basili, Caldiera, and Rombach (1994) establish the importance of lessons learned when considering knowledge transfer.

Colton and Ward's (2004) research considers tacit knowledge transfer through story telling. The authors emphasize story telling as a relatively unused method that they claim is an effective way to transfer knowledge within an organization. Among the disciplines that the authors specifically mention as showing positive results using story telling are change management and risk management. Story telling is effective in managing uncertainty and developing an awareness among staff (Colton & Ward., 2004). The authors are not advocating story telling as the quantitative method to obtain numerics to help manage uncertainty but rather story telling as a tool to convey the message (i.e., the knowledge) the numbers produce. The authors, while demonstrating the importance of tacit knowledge transfer, do not address the components of risk management directly.

Within the financial industry Jones (2003) explores the benefits of knowledge management. Jones presents a method of measuring the benefits of KM through case study. First a knowledge management plan was constructed to improve advice and legal consultation that the company under study provides to the financial industry. From this a score card was devised that quasi-quantitatively measured the plan's effectiveness. The main benefit listed in the area of risk was improvement of the quality of advice and a reduction in risk of legal experts not being current or aware of contemporary changes. Jones' research does show the importance of knowledge transfer of best practices. However, Jones' research was focused on the wider field of knowledge management and did not specifically look at knowledge transfer as it impacts risk management.

Aase and Nybø (2005) investigate high-risk industries. These are industries in which accidents could result in catastrophic loss of property or life. They state that these industries often do not have the luxury of learning through trial and error or from failures and must rely on models. They investigate alternative learning methods for collecting, developing, understanding, and disseminating tacit knowledge. According to the authors high risk industries are characterized by complexity, interdependencies, and proximity to hazards. Organizational redundancy can help. Redundancy can take the shape of safety margins and redundancy built into structure and equipment as well as organizational structure (cooperation, level of competence, and procedures). However, organizations must also rely on the ability to learn from unprecedented occurrences and "what-if" scenarios.

Aase and Nybø (2005) discuss requisite variety, which is internal diversity to match the variety and complexity of the environment. They also discuss informational richness which is highest in a tacit environment and declines as the information is transferred more explicitly according to the researchers. The authors state the importance of knowledge as it relates to risk. They list four distinct knowledge categories based on Cook and Brown, (1999): individual and tacit, individual and explicit, group and tacit, and group and explicit. These researches use a model-based and practice-based perspective. According to the researchers, model-based learning means disseminating and utilizing knowledge that is explicit whereas practice-based knowledge is mainly tacit in nature. The authors support practice-based learning but state both methods are needed. Under the model-based approach they discuss technical route to safety and normative route to safety. The technical route to safety relies heavily on the design of safety using technology. The normative route to safety uses rules, procedures and regulations to govern individual and collective behaviors. Neither approaches take into account extreme events according to the authors.

Practice-based learning promotes the use of imagination and requisite variety. Under this umbrella the authors list improvisation, intelligent failure promotion, storytelling, collective training, and case study sessions as ways to enhance safety. The authors insist that even scenarios with low probabilities of occurrence need to be contemplated and played out. The authors conclude that most high risk industries use model-based approaches and that these approaches do add significant value. However, the robustness of this learning can greatly be enhanced by adding practice-based learning. The authors show the importance of knowledge transfer in high risk industries but do not test the relationship of knowledge transfer on risk management.

Regev, Shtub, and Ben-Haim (2006) use the concept of knowledge gap analysis to manage risks. The researchers point out that "A Guide to the Project Management Body of Knowledge," or PMBOK®, lists project risk management as one of the nine areas of bodies of knowledge for project management. Regev, et al.'s (2006) use of knowledge gap analysis is based on Ben-Haim and Laufer's (1998) non-statistical approach for analyzing risks. This framework evaluates the gap between the information available to a project manager and the information that is needed to develop a reliable schedule. The researchers note that spiral models, established in the computer software development industry, use a similar idea. The spiral model focuses on the widest knowledge gap at each cycle and attempts to reduce or eliminate that gap. The process is repeated until the project is completed. The researchers claim that this method of risk analysis is especially beneficial where lack of past data, i.e. research and development, make statistical risk quantification unreliable. Regev, et al. consider the implications of knowledge transfer through an interactive process and the effects it has on risk analysis in building a detailed model on identifying knowledge gaps for risk analysis but do not test the relationship of knowledge transfer on risk management.

Dillon and Tinsley (2005) look at the interpretation of "near miss" events. The researchers describe a "near miss" event as one in which the outcome is not hazardous but in which a hazardous or fatal event could have occurred. Their research supplied evidence that knowledge gained from a near miss experience, either tacit or explicit knowledge, does skew judgment. Their research also showed that an increase in cognitive load can influence the bias of decision making (i.e. the more a judge has to deal with, as in a crisis situation, the more likely that person is to rely on experience and past knowledge rather than on statistical data). Dillon and Tinsley's findings support Klein, et al's. (1989) Recognized Prime Decision (RPD) Making Model. In the RPD, the decision maker relies on knowledge, training, and experience to recognize and select a plausible course of action. Dillon and Tinsley's (2005) findings are important in the risk mitigation field as they allow risk managers to attempt to account for and control these factors. Their findings are important to the knowledge management field as it shows direct impact of knowledge bias in a crisis situation and the potential impact for knowledge workers attempting to gain information in a crisis situation. The authors establish importance of studying not only events that have occurred but events that almost occurred. They show the knowledge transfer aspect but do not directly show the relationships between near misses and the components of risk management.

Kim and Miner (2007) take an approach of looking at failures and *near failures*. From a risk point of view the researchers provide qualitative evidence that failure experience can modify risk behavior. Entities learn from failure and near failure by reducing the risk from what they perceive as leading to that event. From a knowledge management point of view the researchers emphasize the importance of studying near failures. They state that near failures not only provide information on events that lead an organization (or project) to the brink of failure but also contain information on how that particular situation was overcome. The researchers provide evidence that not only successful lessons learned need to be captured but knowledge of areas of risk and near failures and *near misses* need to be captured as well. Again, the authors establish importance of studying not only events that have occurred but events that almost occurred. They show the knowledge transfer aspect but do not directly show the relationships between near misses and the components of risk management.

The gap appearing from the literature review on knowledge management applied to managing risks is in the area of knowledge transfer as it applies to risk management. The researchers either look at knowledge transfer and mention implications to risk management but do not test the relationship (Aase and Nybø, 2005; Basili, Caldiera, & Rombach, 1994; Colton & Ward, 2004; Dillon and Tinsley's, 2005; Jones, 2003; Kim and Miner, 2007; Regev, Shtub, & Ben-Haim, 2006) or they do not specifically address knowledge transfer in their risk management research (Fischhoff, 1975; Halpern-Felsher, Millstein, Ellen, Adler, Tschann, & Biehl, 2001). Additionally the literature review is establishing areas of knowledge transfer that must be considered: lessons learned (Basili, Caldiera, & Rombach, 1994), best practices (Jones, 2003), and near misses (Dillon & Tinsley's, 2005; Kim & Miner 2007). These researchers provide evidence that these individual components of knowledge transfer do influence aspects of risk management capabilities but the aggregate has not been empirically studied with respect to risk management as defined by Conrow (2005). Table 1, at the end of the literature review, summarizes the literature on knowledge management as it applies to managing risks and the identified gaps.

Risk Management Applied to Managing Knowledge

Knowledge management has roots beginning in the early 1900s. Taylor (1911) laid a groundwork frame for scientific management. In the 1950s and 1960s, organizational learning gained traction by the efforts of researchers like Cangelosi and Dill (1965) and Cyert and March (1963). In 1978, Argyris and Schon advanced a theory of using single-loop versus double-loop methods of learning. In 1989, Ackoff produced his idea that content of the mind could be placed into five categories: data, information, knowledge, understanding, and wisdom. According to Ackoff this was a hierarchy where data were raw input, information was processed data, knowledge was the application of data and information, understanding was the ability to synthesize knowledge, and wisdom was moralistic and ethical evaluation of the previous categories. Knowledge management formally became a major field in the 1990s. Prusak (2001) states that the advent of computing technology and power helped to show the increase value of knowledge. With access to information becoming ever more available the value of cognitive skills becomes more evident. Prusak states that in 1993 he and a few colleagues held the first dedicated knowledge management conference. Along the lines of Ackoff (1989), the attendees felt that knowledge was inherently different from data or information and that even "perfectly" managed information alone would not lead to greatly improved productivity. However, at the time there were few knowledge management projects under study. During this time the knowledge management field was being expanded by researchers like Nonaka and Takeuchi (1995) and Leonard-Barton (1995).

Prusak (2001) discusses: Kenneth Arrow's 1962 article "Learning by Doing"; the Rand Corporation analyzing and codifying the effects of decreased production time, and improving quality of repetitive projects in the 1950s; and Emile Durkheim's (1895) social fact, or the real behaviors of sociological thinking. Prusak indicates that knowledge management is founded on concepts such as these; the studying of how people and groups share, or do not share, knowledge. He claims that knowledge tools need to be developed from observation and not purely from theory. According to Prusak three practices have added the most content to the body of knowledge: information management, quality management, and the human capital movement. He posits that both information management and knowledge management focus on the user and not necessarily the technology. He believes that while knowledge management does not have processes that lend themselves to easy measurement it does focus on the same goals as quality management: internal customers, overt processes, and shared goals. Similarly, he believes that while knowledge management tends to focus on groups and the human capital movement tends to focus on the individual, both try to emphasize the value of individuals to organizational leaders. Nonaka and Teece (1998) note that while research was initiated by management researchers a vast field of disciplines: economics, psychology, sociology, cognitive science, etc have contributed as well. Nonaka and Teece also encourage exploring entrepreneurial capabilities versus administrative capabilities.

Prusak (2001) surmises that knowledge management has two possible futures. It could go the path of quality and become imbedded into organizational thinking or it could go the path of "re-engineering" and become a hype that is quickly replaced with the new flavor of the day. Nonaka and Teece (1998) suggest that competitive advantage in open economies flows from knowledge assets that are hard to replicate. They promote the quantification of intangible assets though they admit it is a formidable undertaking. The authors indicate that little is known about information, knowledge and competencies economics and that these areas must be developed. One path to give KM more credence is to show definite metrics. Bose (2004) shows that measuring the benefits of knowledge management is difficult. Leveraging from Soliman and Youssef (2003) and Wainwright (2001), Bose defines knowledge as information that is "contextual, relevant and actionable" (p. 458). Bose further presents the following knowledge management process model: create knowledge, capture knowledge, refine knowledge, store knowledge, manage knowledge, and disseminate knowledge. He states that the three goals of knowledge management are to leverage the organization's knowledge, create new knowledge, and increase collaboration. Bose (2004) believes that enablers for this model can be grouped into the categories of technology, culture, infrastructure, and measurement.

Bose's (2004) research leverages off of several studies on measuring intellectual capital: Intellectual Capital Management Group (Ahmed, Lim, & Zairi, 1999); Canadian Management Accountant's Report (CMA, 1999); Universal Intellectual Capital Report (Von Krough, Roos & Kleine, 1999); and Roos, Roos, Dragonetti, and Edvinsson's study in 1998. Each study lists main categories (e.g, Intellectual Capital Management Groups: value extraction, customer capital, structural capital, value creation, and human capital) and then lists measurable indicators such as patents pending, training expenses, and investment in information technology. Bose (2004) also indcates that the balanced scorecard is becoming popular in the U.S. The balanced scorecard, developed by Kaplan and Norton (1996), links an organization's strategies to four key performance areas: financial, customers, internal processes, and learning/growth. The balanced scorecard takes into account the tangible (financial) and the intangible (human capital, customer capital, and structural capital). Like the other models the scorecard uses indicators to measure the intangible. There is an increase focus on economic value (Bose, 2004). This is a measure of the company's finances as well as its capital. Bose connotes that there are models that take into account intellectual capital, and that for knowledge management to excel, it must adapt models like these into its framework. Bose's (2004) comments echo Prusak's (2001) discussion on the future evolution of KM.

A risk approach to analyzing and quantifying the potential loss of knowledge would be extremely valuable along with knowledge management practices for mitigating the risk. Risk management has multiple methods for quantifying that could be leveraged for use in knowledge management or blended with knowledge management. Understanding the probabilities of the events would better allow for the various plans of action and costs associated with implementing knowledge management processes. Kontio and Basili (1996) show the use of risk applications to knowledge management as well as knowledge management applications to risk management in their discussion of the Riskit Method and the Experience Factory. Both tools were developed at the University of Maryland. The authors use a knowledge management philosophy of data, information, and knowledge to describe a given project and the management of risk for the project. According to Kontio and Basili, project context information defines the project itself and includes the definition of the risk management mandate for the project. Kontio and Basili then describe the Riskit method as a graphical qualitative analysis as a basis before quantitative analysis is pursued. The authors use a knowledge management approach of explicit knowledge transfer to define risk and then apply risk methods to qualify and quantify project knowledge risks. This is coupled with the Experience Factory to blend RM and KM further in an overall analysis method. The researchers cover Conrow's (2005) risk management categories in their research but address only explicit knowledge transfer and do not show the correlation or causal effects of knowledge transfer on risk management capabilities (Kontio & Basili, 1996).

Another example of risk management principals used in knowledge management is detailed in a publication by the International Atomic Energy Agency (IAEA), (Kolisov, Mazour, & Yanev, 2006). The IAEA uses a risk management approach to analyze loss of critical knowledge in the nuclear industry. The organization states three specific cases as the background for this approach: the quickly expanding nuclear capacity of China, the talent loss and recruitment challenges of Germany, and the aging workforce in the United States. These problems are abundant in many other countries for many other companies. The authors consider all of Conrow's (2005) risk management categories and discuss the need for best practices but do not test the correlation or causal effects of knowledge transfer on risk management. For example, in the United States there is a general trend of an aging workforce in the government as well as government contractors. Ladd and Ward (2002) cite studies that show that the workforce of the U.S. Air Force is aging and that the U.S. Air Force is having a difficult time in recruiting and retaining a knowledgeable workforce. Leonard and Kiron (2002) state that 40% of NASA's Jet Propulsion Laboratory (JPL) sector's scientific and engineering workforce is currently eligible for retirement. All of these studies point to a risk of knowledge loss.

In an effort to help its constituents the IAEA provides risk methods to help identify and mitigate knowledge loss threats. The main course of action is to identify a total risk factor, for which the IAEA developed a flow chart outlining a process that was successfully incorporated by the Tennessee Valley Authority. The IAEA uses a ranking system that resembles that of Haimes, Kaplan, and Lambert (2002). This system allows for data to be expressed in ordinal form. Risk values are assigned to attrition and the type of knowledge. These values are then multiplied to obtain a total risk factor. From this a risk mitigation plan is developed which involves monitoring and evaluating both the plan and the risks.

There are other articles concerning risk management principles applied to knowledge management but this area does need more research. Avoidance of costly mistakes and reduction of risk are among the "proven benefits" listed by Skyrme (1999) of a good knowledge initiative. This involves not only knowledge of possible consequences but methods of analysis to evaluate those consequences. Kotnour and Landaeta (2002) indicate that knowledge management across projects, inter-knowledge transfer, is critical in both creating and maintaining high performance projects as well as the organization. Landaeta (2008) evaluates the benefits and challenges of managing knowledge across projects. According to the author the elements of knowledge management across projects would promote a better collective understanding in project-based organizations. However, using project resources to manage projects' knowledge may divert needed resources from project work generating project risks that need to be addressed. Kotnour and Landaeta (2002) present a conceptual model of knowledge management across projects. A risk assessment approach to analyzing the causal relationships they identified would benefit the model in industrial application.

The literature review on risk management applied to managing knowledge shows conceptual models for using risk management to enhance knowledge management, however there is a gap in the literature with respect to the empirical testing of the relationship of knowledge transfer on risk management (Kontio & Basili, 1996; Kolisov, Mazour, & Yanev, 2006). Additionally, the literature review is showing that both inter- and intra-knowledge transfer should be considered when managing knowledge in the project environment (Kotnour & Landaeta, 2002; Landaeta, 2008). Therefore, there is a gap in the literature with respect to empirical research of the relationships between inter- and intra-knowledge transfer with risk management in the project environment. Table 1, at the end of the literature, review summarizes the literature on risk management as it applies to managing knowledge.

Risk and Knowledge Management

Neef (2005) indicates that some companies are starting to realize the interrelationships between knowledge management and risk management. According to Neef many issues that company leaders say prevent them from anticipating and reacting to crises, i.e. potential risks, are the same issues that KM experts have been dealing with for years. Similar to Neef, Lelic (2002) claims that an organization cannot manage its risks without managing its knowledge. Neef refers to the integration of the two philosophies as Knowledge Risk Management, KRM. Neef lists four key aspects of successful implementation of KRM: 1) there must be top level support, 2) "you can't manage what you can't measure" (p. 115), 3) open, transparent and verifiable reporting, and 4) a dedicated knowledge management process. Neef's position is fundamentally positivistic and constrains KRM to a realm of the discrete and quantifiable. Neef believes that effective risk management can only be handled through knowledge management.

Many forward looking companies are recognizing the synergies of the two management disciplines. Though the relationship is more complex that first thought (Webb, 2007). Webb believes that RM tends to focus on the controls and KM tends to focus on innovation and creativity. When trying to provide for a comprehensive management plan that incorporates both, path divergence and emergence can be encountered. Still Webb believes that risk management and knowledge management have a natural symbiotic relationship. Like Neef (2005), Webb (2007) provides for a model that combines the two philosophies. Again knowledge management is used as a foundation for which Webb lays the risk management principles on top off. Martin, Prior, Ward, and Holtham (2002) focus on the interconnectivity of RM and KM with a case study of a legal department within the financial services industry. According to the authors, risk management is a decision process that is based on organization, interpretation, and application of information. This is deeply tied to knowledge management which focusing on the understanding of the creation, flow, and storage of that information. These authors do not offer a model but instead illustrate with the case study how knowledge management techniques are used in combination with risk management methods, though it is not always obvious to the practitioner that he is doing so. In their summary of the case study they conclude that "any risk management approach requires a better understanding of the current asset value" (p. 7). Information and knowledge must be seen as assets in the context of risk (Martin, et al., 2002). The case study looks at intra-knowledge transfer, knowledge transfer that is contained within a group and does not look at inter-knowledge transfer, knowledge that is transferred across groups. The case study also does not discuss the specific correlations of knowledge transfer as it applies to Conrow's (2005) risk management categories.

Letens, Van Nuffel, Heene and Leysen (2008) further relate the realm of knowledge management and risk management in their approach of using a balanced approach for risk identification. Letens, et al. (2008) adapt Wilber's (1995) integral theory in their risk framework. This framework is based on identifying risk as viewed by the individual or collective and from an interior or exterior point of view. The interior individual perspective is classified by the authors as "what the entity experiences" (p. 7) the exterior individual perspective is classified as "what the entity does" (p. 7) the interior collective perspective is classified as "what the external environment of the entity experiences" (p. 7), and the exterior collective perspective is classified as "what the external environment of the entity does" (p. 7) This framework, focused on risk identification, draws parallels to Nonaka's (1994) knowledge conversion processes. Nonaka explores the tacit to tacit, tacit to explicit, explicit to explicit, and explicit to tacit knowledge conversion processes. The distinction is made from individual to groups and from internal to external. The methods of knowledge conversion differ and Letens, et al. (2008) point out so do risks identified. Letens, et al. state that each of these groups must be considered for a comprehensive risk analysis. Letens, et al. explore knowledge transfer both explicit and tacit from within and across groups but only as it applies to one of Conrow's (2005) risk management categories, risk identification.

Ahlemann (2009) developed an architecture for the specification and application of project management software. His architecture is built around a reference model. Two attributes a reference model possesses according to Ahlemann are the ability to reduce risks and the ability to enhance communication of ideas and best practices. Ahlemann explores and expands upon the existing reference models of Froese (1992) and Schlagheck (2000). Ahlemann (2009) states that Froese's (1992) model does not support work breakdown structures. Real data and "what if" scenarios cannot be evaluated with Froese's model either. According to Ahlemann (2009), Schlagheck's (2000) model is an improvement over Froese's (1992) but Schlagheck's (2000) model only allows for a single project plan. Ahlemann's (2009)model allows for consideration of more plan versions and allows for the ability to run scenarios. Ahlemann claims that the structure and improved functionality of his model allows for project management methods, including those of risk management and knowledge management, to be applied from the program level down to the work package level. Ahlemann's research demonstrates the benefits of relaying best practices to identify risk scenarios.

The literature review on risk management and knowledge management established some common trends and identified gaps in the literature. The research either addressed knowledge transfer to a specific aspect of risk management (Letens, Van Nuffel, Heene & Leysen, 2008) or the research does not test the relationship between knowledge transfer and risk management (Ahlemann, 2009; Martin, Prior, Ward, & Holtham, 2002). The literature review also builds upon the importance of considering inter and intra knowledge transfer (Letens, Van Nuffel, Heene & Leysen, 2008) and also the consideration of best practices (Ahlemann, 2009). Table 1 gives a summary of literature studied and shows the gap identified through the literature review.

Table 1

Literature Summary and Gap Analysis

AUTHOR(s)	SUMMARY	GAP ANALYSIS
Aase and Nybø (2005)	Studied alternative learning methods in high-risk industries. The authors show the importance of considering modes of learning and knowledge transfer in high risk industries.	The authors look at tacit, explicit, individual, and group knowledge. The authors show the importance of knowledge transfer in high risk industries but do not test the relationship between knowledge transfer and risk management.
Ahlemann (2009)	Developed a model that allows one to consider many project plans and also run scenarios. According to the author, two attributes his model possesses is the ability to reduce risk and the ability to enhance communication of information.	The author shows the link that best practices play in project risk management. The author's research addresses one of Conrow's (2005) risk management categories, risk identification but does not test the relationship between knowledge transfer and risk management.
Basili, Caldiera, and Rombach (1994)	Developed a framework called the Experience Factory. The feedback loops of lessons learned and leveraging of experience used in the Experience Factory can be adapted for risk management.	The authors establish lessons learned as an important component of knowledge transfer. The authors do not directly explore that relationship with risk management.
Colton and Ward (2004)	Describe story telling as an effective way for managing uncertainty. The authors mention storytelling for risk management as a qualitative method for communicating quantitative data.	The authors focus on tacit knowledge transfer and the research looks at the effectiveness of a specific method of tacit knowledge transfer as it relates to communicating quantitative data. These authors do not directly look at the individual components of risk management as defined by Conrow (2005).

Table 1 (continued).

Dillon and Tinsley (2005)	Investigated *near miss* events. The authors showed that knowledge from near miss events can skew judgment and needs to be taken into account.	The authors establish importance of studying not only events that have occurred but events that almost occurred. They show the knowledge transfer aspect but do not directly show the relationships between near misses and risk management.
Fischhoff (1975)	Investigated the effect of explicit knowledge on judgment. Research showed that explicit knowledge of outcomes affects a judge's ability for impartial probability assessments.	The author examines one type of knowledge, explicit, and how that impacts probability assessment. The author analyzes two components of risk management, indentifying and analyzing risks, as defined by Conrow (2005) but does not address how knowledge transfer impacts risk management.
Haimes, Kaplan, and Lambert (2002)	Focused on risk filtering, ranking, and management. The authors lay out an eight step process for working through risks. While their paper did not specifically deal with knowledge management the methodology is similar to Kolisov, Mazour, and Yanev (2006.)	The authors build a risk management model that incorporates Conrow's (2005) risk management categories but do not examine the how knowledge transfer impacts relaying that information across projects.
Halpern-Felsher, Millstein, Ellen, Adler, Tschann, and Biehl (2001)	Investigated risk judgment in health promoting and health compromising behaviors. Research showed a correlation between learned knowledge and risk behavior. Research also showed differences between tacit knowledge and explicit knowledge on risk behavior.	The authors research how tacit knowledge impacts risk judgment. This research shows a correlation between personal knowledge and risk identification and handling but does not consider knowledge transfer and risk management.
Jones (2003)	Highlighted the benefits of knowledge management. Through a case study the author shows a reduction in risk exposure by keeping legal experts current and aware of contemporary changes.	Jones' research shows the importance of knowledge transfer of best practices in the form of a knowledge management plan and risk planning. This research does consider risk management specifically but looks at knowledge management on a larger scale.
Kim and Miner (2007)	Investigated *near failures.* Their research shows the importance of studying and gaining knowledge from near failures and shows qualitatively that failure experience can modify risk behavior.	The authors establish importance of studying not only events that have occurred but events that almost occurred. They show the knowledge transfer aspect but do not directly show the relationships between near misses and risk management.

Table 1 (continued).

Kolisov, Mazour, and Yanev (2006)	Used a risk management approach to analyze the loss of critical knowledge in the nuclear industry. Risk values are assigned to attrition and type of knowledge. These values are multiplied to obtain a total risk factor. Risk mitigations plans are then developed and tailored to the risk factors.	The authors consider all of Conrow's (2005) risk management categories and discuss the need for best practices but do not test the correlation or causal effects of knowledge transfer on risk management.
Kontio and Basili (1996)	Developed a framework called the "RISKIT" method. This method uses both qualitative and quantitative analyses. KM is used to define risk and then risk methods are used to qualify and quantify project risks.	The researchers cover Conrow's (2005) risk management categories in their research but address only explicit knowledge transfer and do not show the correlation or causal effects of knowledge transfer on risk management capabilities.
Letens, Van Nuffel, Heene, and Leysen (2008)	Used a balanced approach for identifying risks. The framework looks at risk from an individual and collective point of view as well as an interior and exterior point of view. This framework is similar to Nonaka's (1994) knowledge conversion process model.	Letens, et al. explore knowledge transfer both explicit and tacit from within and across groups but only as it applies to one of Conrow's (2005) risk management categories and risk identification.
Martin, Prior, Ward, and Holtham (2002)	Used a case study to investigate the relationship between risk management and knowledge management. The authors surmise dthat risk management involves the better understanding of the current asset value. KM techniques are used to better understand that value.	The case study looks at intra-knowledge transfer, knowledge transfer that is contained within a group and does not look at inter knowledge transfer, knowledge that is transferred across groups. The case study also does not discuss the specific correlations of knowledge transfer as it applies to risk management.
Regev, Shtub, and Ben-Haim (2006)	Used knowledge gap analysis to manage risks. Similar to a spiral model this method focuses on the widest knowledge gap in each cycle and seeks to eliminate or reduce it.	The authors consider the implications of knowledge transfer through an interactive process and the effects it has on risk analysis but do not show the correlation or causal effects of knowledge transfer to risk management.

Review of the literature showed that lessons learned, best practices and near misses were all categories that are important to knowledge transfer. The literature review also showed that inter knowledge transfer as well as intra knowledge transfer should be considered (Kotnour & Landaeta, 2002; Landaeta, 2008; Letens, Van Nuffel, Heene & Leysen, 2008). There is a clear gap in the literature in the area of the relationships between knowledge transfer, in the forms of lessons learned, best practices, and near misses, and how they relate to Conrow's (2005) risk management capabilities. This gap is shown in Tables 2 for gaps related to knowledge transfer and Table 3 for gaps related to risk management capabilities. Tables 2 and 3 are complementary and when viewed together only the last column, Haltiwanger (2012), fills the gaps in all the columns for both Tables.

Table 2

Gap Details

			Authors (Year)				
			Aase and Nybø (2005)	Ahlemann (2009)	Basili, Caldiera, and Rombach (1994)	Colton and Ward (2004)	Dillon and Tinsley (2005)
Knowledge Transfer	Inter-project learning	Lessons Learned	X		X	X	
Knowledge Transfer	Inter-project learning	Best Practices	X	X			
Knowledge Transfer	Inter-project learning	Near Misses					X
Knowledge Transfer	Intra-project learning	Lessons Learned	X		X	X	
Knowledge Transfer	Intra-project learning	Best Practices	X	X			
Knowledge Transfer	Intra-project learning	Near Misses					X
Risks Management Capabilities		Risk Planning	X				
Risks Management Capabilities		Risk Identification		X	X		X
Risks Management Capabilities		Risk Analysis				X	
Risks Management Capabilities		Risk Handling					
Risks Management Capabilities		Risk Monitoring					
Risks Management Capabilities		Risk Documentation			X		

Table 2 (continued).

			Authors (Year)				
			Fischhoff (1975)	Haimes, Kaplan, and Lambert (2002)	Halpern-Felsher, Millstein, Ellen, Adler, Tschann, and Biehl (2001)	Jones (2003)	Kim and Miner (2007)
Knowledge Transfer	Inter-project learning	Lessons Learned	X				
		Best Practices				X	
		Near Misses					X
	Intra-project learning	Lessons Learned			X		
		Best Practices				X	
		Near Misses					X
Risks Management Capabilities		Risk Planning		X		X	X
		Risk Identification	X	X	X		X
		Risk Analysis	X	X			
		Risk Handling		X	X		
		Risk Monitoring		X			
		Risk Documentation		X			

Table 2 (continued).

			Authors (Year)				
			Kolisov, Mazour, and Yanev (2006)	Kontio and Basili (1996)	Letens, Van Nuffel, Heene,and Leysen (2008)	Martin, Prior, Ward, and Holtham (2002)	Regev, Shtub, and Ben-Haim (2006)
Knowledge Transfer	Inter-project learning	Lessons Learned			X		X
		Best Practices			X		
		Near Misses					
	Intra-project learning	Lessons Learned			X	X	X
		Best Practices			X	X	
		Near Misses				X	
Risks Management Capabilities		Risk Planning	X	X			
		Risk Identification	X	X	X		
		Risk Analysis	X	X			X
		Risk Handling	X	X			
		Risk Monitoring	X	X			
		Risk Documentation	X	X			

Table 2 (continued).

			Authors (Year)		
			Kotnour (1999, 2000)	Landaeta (2008)	Haltiwanger (2012)
Knowledge Transfer	Inter-project learning	Lessons Learned	X	X	X
		Best Practices		X	X
		Near Misses		X	X
	Intra-project learning	Lessons Learned	X		X
		Best Practices			X
		Near Misses			X
Risks Management Capabilities		Risk Planning			X
		Risk Identification			X
		Risk Analysis			X
		Risk Handling			X
		Risk Monitoring			X
		Risk Documentation			X

Research Hypotheses

The authors and researchers cited in this dissertation present convincing arguments that there is a substantial relationship between risk and knowledge management. Principles of risk management are effectively being applied to enhance knowledge management. Additionally, knowledge management is being used as a tool to improve risk management strategies. Furthermore evidence exists that practices of the two can be combined in different ways to obtain a more holistic view. McElroy (2003), President of the Knowledge Management Consortium, believes that knowledge management's greatest value may lay with enhancing risk management.

The literature review showed that the gap is in this field of study is in the area of knowledge transfer as it impacts risk management. The researchers either did not empirically test the relationship of knowledge transfer on risk management capabilities (Aase & Nybø, 2005; Ahlemann, 2009; Basili, Caldiera, & Rombach, 1994; Colton & Ward, 2004; Dillon and Tinsley's, 2005; Jones, 2003; Kim &Miner, 2007; Kontio & Basili, 1996; Kolisov, Mazour & Yanev, 2006; Martin, Prior, Ward, & Holtham, 2002; Regev, Shtub, & Ben-Haim, 2006), or they specifically look at knowledge transfer but only at one aspect of risk management (Letens, Van Nuffel, Heene & Leysen, 2008), or they do not specifically address knowledge transfer in their risk management research (Fischhoff, 1975; Halpern-Felsher, Millstein, Ellen, Adler, Tschann, & Biehl, 2001). From this literature review the gap of the relationship between knowledge transfer and risk management was established and the research question formed, "Does knowledge transfer have a positive impact on risk management capabilities?"

The literature review also revealed aspects of knowledge transfer to consider. Lessons learned (Basili, Caldiera, & Rombach, 1994), best practices (Ahlemann, 2009; Jones, 2003) and near misses (Dillon & Tinsley, 2005; Kim & Miner 2007) are important aspects of knowledge transfer that have not being studied before with respect to their relationship with risk management. Additionally, inter- and intra-knowledge transfer should be considered (Kotnour & Landaeta, 2002; Landaeta, 2008; Letens, Van Nuffel, Heene & Leysen, 2008) in research performed in the project environment. Therefore, in order to answer the research question set to close the current gap in the literature, a conceptual model was formed, Figure 1, showing the relationship between knowledge transfer (in the form of lessons learned, best practices, and near misses) and risk management capabilities and an expanded conceptual model was formed to show those knowledge transfer aspects as subsets of inter knowledge transfer and intra knowledge transfer, Figure 2. These research models provide a representation of the relationships (i.e., hypotheses) between knowledge transfer and risk management that will be investigated in this dissertation. The empirical testing of these relationships (i.e., hypotheses) is expected to close an important gap in the current literature of knowledge management and risk management. Based on the literature review, research question, and conceptual models the core hypothesis was formed. This hypothesis tests the relationship between knowledge transfer and risk management capabilities. Secondary to the core research hypothesis, a second group of hypotheses was also formed. One hypothesis tested the expanded research model and the other hypotheses tested the effect certain moderating factors potentially played on the relationship between knowledge transfer and risk management capabilities. These hypotheses were of a supportive nature and were intended to provide additional insight into the relationship between knowledge transfer and risk management capabilities.

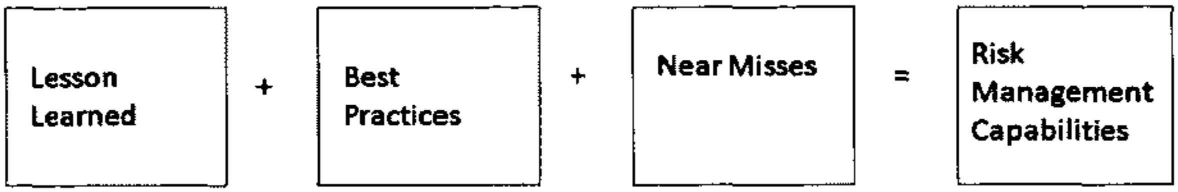

Figure 1. Basic Research Model

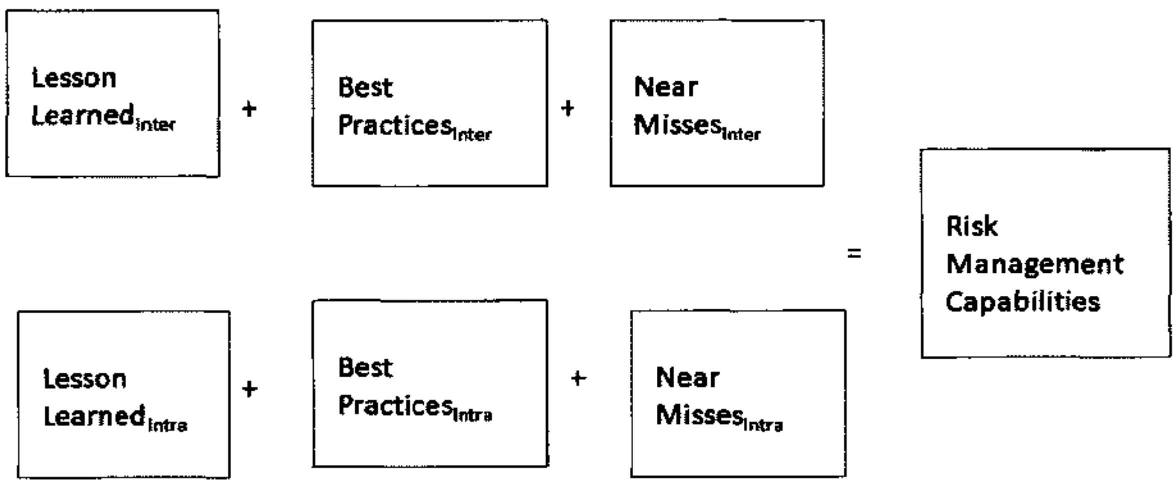

Figure 2. Expanded Research Model

The main hypothesis developed, H1, was developed to test and answer the research question, "Does knowledge transfer have a positive impact on risk management capabilities?" The sub hypothesis, H1a, was developed based on the literature review to determine if one form of knowledge transfer, inter knowledge transfer, would have a greater impact on risk management capabilities than another form of knowledge transfer, intra knowledge transfer. Investigating hypothesis H1a provides further insight into the relationship between knowledge transfer and risk management capabilities by testing these two types of knowledge transfer.

- H1: An increase in knowledge transfer will have a positive impact on risk management capabilities.
- H1a: Inter knowledge transfer has a more positive impact on risk management capabilities than intra knowledge transfer.

Research shows that building knowledge increases project performance and that both inter and intra project learning contribute to building of that knowledge (Kotnour, 2000). Landaeta (2008) offers evidence that there is a correlation between increasing the body of knowledge obtained from other projects and project performance. Hypothesis 1A, for this investigation, will focus on inter- and intra- project knowledge transfer and the impact on risk management capabilities. Knowledge transfer, both inter and intra, will be measured by the frequency of sharing lessons learned, best practices, and near misses.

Additional hypotheses were developed using the main hypothesis as the basis. These hypotheses were supportive in nature and look at the moderating effect of certain variables. These hypotheses were developed with the intent of adding additional insight to the core hypothesis by looking at potential influencers on the knowledge transfer and risk management capabilities relationship. The moderating variables are length of the project, number of team members on the project, company size based on the number of employees the company has, and project management methodologies. Hypothesis 2 is that the length of the project will have a positive moderating effect. This is based on a longer time frame giving more opportunities to share knowledge and improve upon risk management. Based on this author's own experience longer projects have provided the time to implement both knowledge management and risk management programs and review those programs at various stages of the project's life cycle. Hypothesis 3 is that the number of team members will have a positive moderating effect. This is based on more individuals to share knowledge and conduct risk management. Based on the experience of this author, larger teams have had more opportunities to transfer knowledge and a greater pool to gather that knowledge from. Hypothesis 4 is that the company's size will not have a statistically significant impact on the first hypothesis. A larger company may have more resources and overall capital but there is not a guarantee that those resources and funds will translate to the particular project being worked (Webb, 2007). Hypothesis 5 is that the project's cost will not have a statistically significant impact on the first hypothesis. The rationale for Hypothesis 5 follows that of Hypothesis 4. Total funding for a project does not guarantee that the team or the company will focus on knowledge management or risk management as integral components of project management. Hypothesis 6 is that experience; project management experience, risk management experience, or knowledge management experience will have a positive moderating effect on the first hypothesis. Based on personal experience individuals learn over time and are able to adapt and implement based on those experiences (Dillon & Tinsley, 2005; Klein, et al.,1989).

Additional Hypotheses

- H2: The length of a project will have a positive effect on the relationships of knowledge transfer and risk management capabilities.

- H3: The number of team members on a project will have a positive effect on the relationships of knowledge transfer and risk management capabilities.
- H4: A company's size, based on the number of employees will not have a significant effect on the relationships of knowledge transfer and risk management capabilities.
- H5: Project cost will not have a significant effect on the relationships of knowledge transfer and risk management capabilities.
- H6: Experience will have a significant effect on the relationships of knowledge transfer and risk management capabilities.

The next chapter, "Research Methodology", addresses the specific steps taken in this dissertation to empirically test the hypotheses developed to close a gap in the current literature of knowledge management and risk management.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

Myers (1997) refers to research methodology as an inquisitive strategy of moving from the realm of philosophical assumptions into that of research design and data collection. A methodology that is often used is that of empirical research. This methodology uses a "systemic investigation of an experience which should be both skeptical and ethical" (Robson, 2002). Creswell (2005) identifies steps of empirical research as: identification of a research problem, review of existing literature, specification of purpose, collection of data, analysis/interpretation of data, and reporting on/evaluating those data.

Under the umbrella of empirical research lies deductive and inductive reasoning. Common practice is to match the reasoning with a respective technique. Quantitative techniques are normally found with deductive research and qualitative techniques are normally associated with inductive techniques (Cohen & Manion, 1994). In deciding on a method Bogdan and Biklen (1992) set forth three principles to help guide the researcher:

1) Is one generating or testing a theory? Quantitative is better suited in testing theories while qualitative methods are better in the realm of theory generation according to the authors.

2) How much detail is needed to meet the objectives and is generalization an objective? According to the authors qualitative research is best suited where detail and context are paramount where quantitative methods are best suited where generalizability a goal.

3) Are key variable known or unknown? When the objective is to identify variables affecting the phenomenon under study qualitative methods work best (Creswell, 1994). Once the key variables are identified quantitative methods work well at exploring the relationship between the variables (Bogdan & Bilken, 1992).

The method used to investigate the research question will be empirical in basis. The path used follows the steps identified by Creswell (2005) for empirical research. Based on answering the questions developed by Bogdan and Biklen (1992) the reasoning used is deductive. The techniques used will be quantitative collection of data, statistical analysis, and hypothesis testing followed by qualitative interpretation of the results.

Research Design and Methods

Based upon the literature review conducted it was established that little research has been conducted on the inter-relationships between knowledge management and risk management. After the literature review revealed that there was quite a large gap in knowledge in the specific area of knowledge transfer and risk management and the research question was posed: "Does knowledge transfer have a positive impact on risk management capabilities?" From this question the main hypothesis was established:

- H1: An increase in knowledge transfer will have a positive impact on risk management capabilities.

- H1a: Inter knowledge transfer has a more positive impact on risk management capabilities than intra knowledge transfer.
- H2: The length of a project will have a positive effect on the relationships of knowledge transfer and risk management capabilities.
- H3: The number of team members on a project will have a positive effect on the relationships of knowledge transfer and risk management capabilities.
- H4: A company's size, based on the number of employees will not have a significant effect on the relationships of knowledge transfer and risk management capabilities.
- H5: Project cost will not have a significant effect on the relationships of knowledge transfer and risk management capabilities.
- H6: Experience will have a significant effect on the relationships of knowledge transfer and risk management capabilities.

The independent variables for the hypothesis are inter-knowledge transfer and intra-knowledge transfer. Knowledge transfer will considered knowledge that is spread from one individual or group to another individual or group. Where knowledge is "information that has been given meaning, and information is data that has been given structure" (Glazer 1998, p. 176, Glazer 1991, p. 2). Inter-knowledge transfer is knowledge transfer that occurs between projects and intra-knowledge transfer is knowledge that is transferred within a project. Lessons learned will be defined as knowledge gained through experience, which if shared, would promote the recurrence of desirable outcomes or preclude the recurrence of undesirable outcomes (Department of Energy Standard 7501-99, 1999). Best practices will be defined based on the United

Nations Population Fund's (UNFPA) definition of *effective practices*. A best practice is a technique or methodology that has proven successful in particular circumstances (United Nations Population Fund 2004). The definition of near miss will be an event that has a non-hazardous outcome but in which a hazardous outcome could have occurred (Dillon & Tinsley, 2005).

Conrow (2005) defines risk management comprises the acts of risk planning, risk identification, risk analysis, risk handling, risk monitoring, and risk documentation). Risk planning is the process of developing and documenting strategy and methods for performing the other steps in risk management. Risk identification is the process of examining areas and processes to identify and document the associated risk. Risk analysis is "the process of examining each identified risk issue or process to refine the description of the risk, isolating the cause and determining the effects" (Conrow, 2005, p. 8). Risk handling is setting risks at acceptable levels based on identifying, evaluating, selecting, and implementing the desired option (Conrow, 2005). Risk monitoring is the process that systematic tracking and evaluation of the performance of risk handling actions. Risk documentation is the recording, maintaining, and reporting of the other risk management steps (Conrow, 2005). Table 3 contains the independent and dependent variables as well as operational definitions of those variables.

Table 3

Definitions of Dependent and Independent Variables

Table 3 Definitions of Dependent and Independent Variables	
Variable	Operational Definition
Independent Variables	
Inter-knowledge transfer	The sharing of knowledge from one individual or group to another individual or group between projects
Intra-knowledge transfer	The sharing of knowledge from one individual or group to another individual or group within a project
Lesson learned	Knowledge gained through experience, which if shared, would promote the recurrence of desirable outcomes or preclude the recurrence of undesirable outcomes
Best practice	A technique or methodology that, has proven successful in particular circumstances
Near miss	An event that has a non-hazardous outcome but in which a hazardous outcome could have occurred.
Dependent Variables	
Risk Management Capabilities	The capability to perform risk planning, risk identification, risk analysis, risk handling, risk monitoring and risk documentation.
Risk planning	The process of developing and documenting strategy and methods for performing the other steps in risk management.
Risk identification	The process of examining areas and processes to identify and document the associated risk.
Risk analysis	The process of examining each identified risk issue or process to refine the description of the risk, isolating the cause and determining the effects.
Risk handling	Setting risks at acceptable levels based on identifying, evaluating, selecting, and implementing the desired option
Risk monitoring	Systematic tracking and evaluation of the performance of risk handling actions
Risk documentation	The recording, maintaining, and reporting of the other risk management steps

Survey

The quantitative technique requires data collection. The field study is one quantitative method used. Under the umbrella of field study is the survey. The survey is a means for describing, comparing, or explaining a group's knowledge, attitudes, and behaviors (Fink, 2003). Along the same lines Creswell (2005) states that surveys "provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population" (p. 153). Surveys provide for high external validity (Bowen, 1995).

Important steps of the survey are setting objectives, designing the survey, preparing a reliable and valid instrument, administering, analyzing, and reporting results (Fink, 2003). The objectives for this survey are developed from the hypotheses. Survey design considers the type of survey, types of questions asked, survey sampling, sampling methods, sample size, and response rate. Types of surveys are self-administered questionnaires, interviews, structured record reviews, and structured observations. Self-administered questionnaires are surveys in which the individual respondents complete themselves. Of the different types of self-administered questionnaires the web-based survey was chosen. Advantages of a web-based survey included cost, short collection time, and ease of data transfer (de Leeuw, 2008).

Open or closed questions can be asked. In open questions respondents provide answers in their own words. In closed questions respondents choose from a predetermined set of answers. According to Fink (2003), open questions allow respondents to describe the world as they see it and in closed questions respondents answer questions as the surveyor sees it. Open questions must be interpreted and cataloged, and unless the surveyor is trained in qualitative techniques complexity can arise in comparing and interpreting the results. Closed questions are more difficult to construct but lend themselves better to statistical analysis and interpretation (Fink, 2003).

Answers to closed questions can be nominal, ordinal, or numerical. Nominal answers require respondents to place themselves in a category (i.e. male or female), ordinal answers require respondents to rate the answer (i.e. very positive to very negative), and numerical answers require respondent to give a number (i.e. age). The survey will use ordinal answers to collect data on independent and dependent variables, a mixture of nominal, ordinal, and numerical answers will be used to collect data on moderating variables.

Two sampling methods are probability sampling and nonprobability sampling. In probability sampling all members of the target population have a know probability of being included in the survey. Probability sampling uses random sampling techniques. While in a nonprobability sampling subjects are chosen by judgment and not all members of the target population have a chance of being chosen. The main advantage to nonprobability sampling is convenience and cost, while the main disadvantage is the possibility of selection bias (Fink, 2003). Fink (2003) indcates that often nonprobability sampling is appropriate for surveys. For this survey a convenience sample will be chosen.

There is a wide range of recommendations for sample size based on total numbers and participants per variable. Hair, Anderson, Tatham, and Black (1995) recommend 15 to 20 observations per independent variable for generalizability, a minimum ratio of 5 to 1, and having at least 50 total observations when performing factor analysis. Gorsuch

(1983) repeats the recommendation for a minimum ratio of 5 to 1, while Everitt (1975) recommends the ratio should be at least 10 to 1. A target of 20 observations per independent variable was established with a minimum of 50 observations needed for factor analysis. With six independent variables this gives a target value of 120 surveys.

Response and non-response rate must be considered. Both non-response to an entire survey and non-response to individual questions can introduce bias (Fink, 2003). Fink (2003) lists identifying larger number of respondents, using surveys that interest the respondents, sending reminders, and following up with non respondents as a few measures to increase response rates. The population will be individuals in a project based environment that are were involved with risk management for a past project. Solicitations will be made through contacts at Old Dominion University and on-line social networks (i.e. LinkedIn®) for individuals working in project based companies.

Figure 3 is a flow chart of the proposed survey development process.

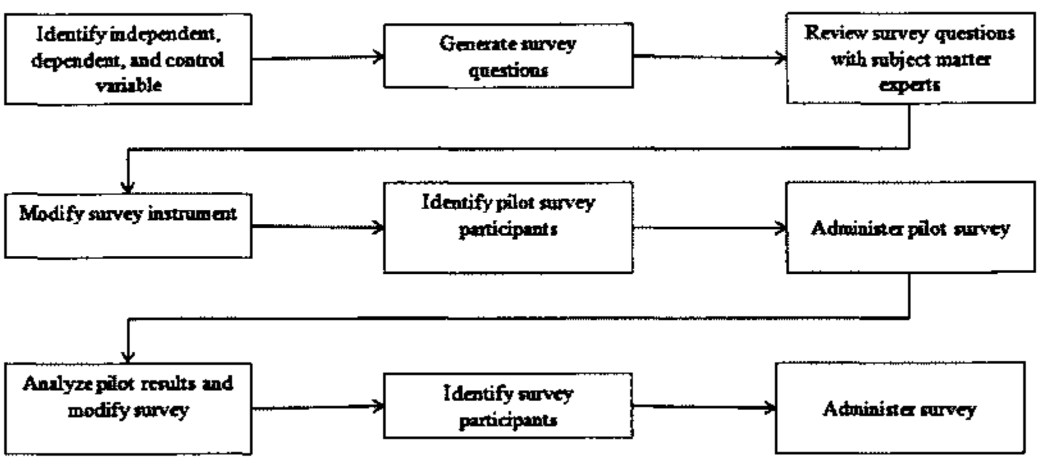

Figure 3. Survey Development

The initial survey developed is shown in Appendix A. Table 4 lists the questions as they relate to the independent, dependent, and moderating variables.

Table 4

Question Categorization

Table 4 Question Categorization	
Variable	Questions
Independent Variables	
Best Practices	Intra (1,2) Inter (3,4)
Lesson learned	Intra (5,6) Inter (7,8)
Near misses	Inter (9, 10) Intra (11, 12)
Dependent Variables	
Risk planning	13, 14, 25
Risk identification	15, 16, 26
Risk analysis	17, 18, 27
Risk handling	19, 20, 28
Risk documentation	21, 22, 29
Risk monitoring	23, 24, 30
Moderating Variables	
Number of team members	31
Length of project	32
Company Size	33
Education Level	34
Project Cost	35
PM Experience with Company	36
Total PM Experience	37
Total KM Experience	38
Total RM Experience	39

Research Validity and Data Analysis

The survey instrument will undergo validity and reliability scrutiny. Validity measures how effective the instrument measures what is intended and reliability is a measure of how reproducible the instrument's data are (Litwin, 1995). Of particular concern are: reliability - consistency between the measures of a construct, content validity - how well the instrument covers the domain of the concept, face validity- how well the instrument "looks like" it measures what it is intended to measure, unidimensionality - how well the indicators represent a single concept, internal validity - the extent to which the correlation being tested is between the variables and not an outside factor, external validity - the extent to which the findings may be generalized, and nomological validity - the extent to which the constructs relate to each other in a manner consistent with theory (Ahire & Devaraj, 2001).

Reliability will be measured using Cronbach's Alpha. Acceptance criteria will be an alpha of greater that 0.6 as being good (Ahire & Devaraj, 2001) with a minimum alpha of 0.5 (Nunnally, 1967). Content validity is captured by the use of prior literature and the use of subject matter experts. Pilot studies were utilized to ensure face validity. For unidimensionality, Confirmatory Factor Analysis (CFA) was performed using principal components. A 0.4 minimum value for small sample sizes were used (Girden, 2001). For internal validity, descriptive statistics as well as data collection from different organizations were used. For external validity inferential statistics were used. Finally, for nomological validity the relationships were evaluated using correlation, regression and other multivariate analysis procedures. Normality was checked. If data are normal then Pearson correlation coefficients was determined. If the data are determined to be non-normally distributed then the correlation coefficients were determined using Spearman's rank correlation coeffiecent. A skewness analysis was performed to determine the correct correlation analysis method. The reliability and validity checks ensured applicability, consistency, and neutrality. Figure 4 shows the data analysis flow chart.

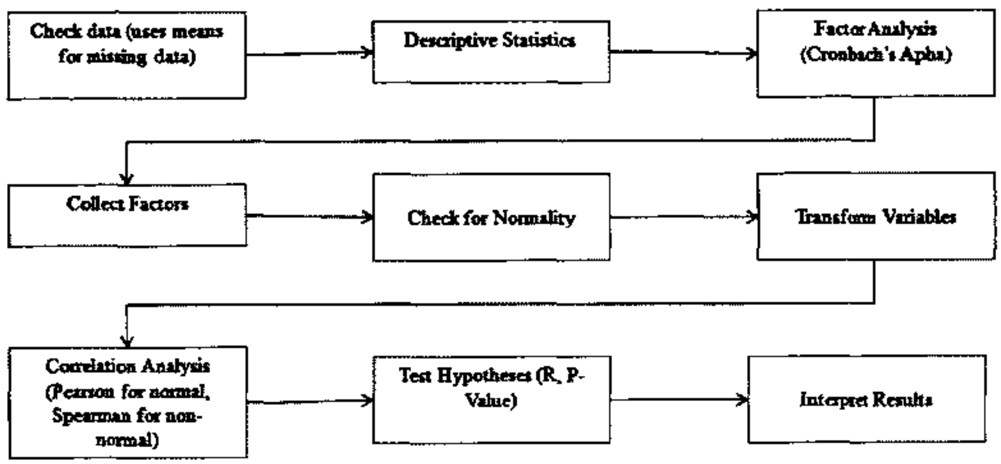

Figure 4. Data Analysis Flow Chart

CHAPTER 4

RESULTS

This research investigated the links between knowledge management and risk management. The basis of this research was a detailed literature review showing both that links between KM and RM existed and that there was a wide gap in the body of knowledge in this area (Hatiwanger, Landaeta, Pinto, & Tolk, 2010). The literature review went further to identify a specific gap in the body of knowledge on the relationship of knowledge transfer and risk management capabilities. From the literature review a conceptual model was formed and hypotheses built. A survey was developed, vetted through peer review and distributed. Solicitations for participation were made via the internet and data were collected. Quantitative data analysis was performed followed by qualitative interpretation. Results supported the main hypothesis that an increase of knowledge transfer has a positive impact on Risk Management capabilities. The results of this analysis follow.

Survey

The initial survey was developed using adapting questions from previous research of Kotnour (2000) and Landaeta (2008). Kotnour's (2000) research focused on learning and project performance while Landaeta's (2008) focused on knowledge transfer and project performance. These questions were evaluated and determined to be well suited and were modified based on the literature review to fit this research. The initial survey instrument is shown in Appendix A. Request for approval was submitted to and granted by the Old Dominion University Institutional Review Board (IRB), Appendix B.

The survey was then piloted to a group of project managers, risk management workers, and knowledge management workers. Participation in the survey was voluntary and the participants were informed they could decline to participate in the survey at any point in the process without risk of any adverse implications or effects. The participants of the pilot remained anonymous in the final documentation of results. The pilot survey is shown in Appendix C.

The results of the pilot were quantitatively and qualitatively analyzed. Quantitative analysis was partially successful. Some questions were rated as "clear/understandable" but were rated either as knowledge management related or risk management related depending on the participants area of expertise. Examples of this were questions related to lessons learned. Depending on whether the participant was a risk management worker or a knowledge management worker, the participant rated the question as being risk management related or knowledge management related. Qualitative analysis was conducted by reviewing the comments section for each question and the comment section for the survey as a whole. The survey instrument was modified using information gained from the quantitative and qualitative analysis. The modified survey was discussed with the pilot participants and was then distributed to the dissertation committee for approval. The final survey is shown in Appendix D.

Several on-line services were investigated as potential vehicles for distribution of the survey. Examples of services investigated were "Instant Survey", "Survey Gizmo", "Survey Monkey", and "Zoomerang". After evaluating each for cost, ease of survey development, survey types, distribution methods, visual appeal, and how the results were packaged "Survey Monkey" (www.surveymonkey.com) was chosen. The final survey, Appendix D, is as it appears developed through "Survey Monkey". All survey responses were anonymous and none of the information could be tracked back to any individual or company, directly or indirectly. Several methods were used to solicit participation. A link to the survey was posted on forums and groups dedicated to project management. A link to the survey was sent to professors in the project management field to forward to individuals they believed fit the profile of the participants needed for the survey. A link to the survey was e-mailed by the survey author to individuals that worked as project managers, knowledge management workers, or risk management workers in a project based environment. It was desired to have a blend of business sizes and types. Participants were selected from small businesses, 99 or fewer employees, medium businesses, 100 to 499 employees, and large businesses, 500 or more employees. A variety of business areas that involved project management were also obtained. These areas included Department of Defense (DOD) and DOD contractors, Department of Energy (DOE) and DOE contractors, university research and development, housing construction, civil construction, financial project, medical project, and automobile construction. These determinations were made by reading individual profiles on social networks like LinkedIn®.

The number of total respondents reached could not be calculated as "Survey Monkey" did not monitor the number of times the survey was visited and readership of the forums the survey was posted to could not readily be obtained. Through the use of separate survey collectors it was determined that the highest number of responses was obtained from individual e-mails sent out by the author of the survey. There were a total of 90 responses and the categorization of the responses is shown in Table 5. These primary contact solicitations resulted in 75 responses. Secondary contact solicitations resulted in 10 responses and web postings resulted in 5 responses. The total number of responses, 90, fell within the criteria of 50-120 completed surveys established based on the number of variables (Everitt,1975; Gorsuch,1983; Hair, Anderson, Tatham, & Black,1995)

The response rate could be calculated from the first two categories. It was known (and is shown in Table 5) how many individuals were contacted and how many responses were made. For the third category, Web Posted, it was not possible to determine how many individuals read or opened the link to the survey. Membership to the sites the links were posted was obtained and the number of responses was known. This information is accounted for in Table 5; however, it is believed that the response rate is artificially skewed as the direct number of individuals that the survey reached cannot be accounted for. The data in Table 5 that account for Web Posted survey information are denoted by a "*". Additionally, by using a built-in function selection in "Survey Monkey" the respondents were not allowed to partially fill out a survey. All questions had to be answered in order to submit the survey. This function was due to the fact that there were between three and four questions per independent and dependent variable. To help ensure internal validity was maintained it was determined that all questions on each variable be answered in order to complete the survey.

Table 5

Response Categories

Collector Group	Number of Recipients Contacted	Number of Responses	Response Rate
Author Sent E-mails (Primary Contact)	360	75	20.8%
Professor Sent E-mails (Secondary Contact)	53	10	18.9%
Web Posted	800*	5*	0.6%*
Total	1213*/413	90*/85	0.7%*/20.6%

Analysis

Data analysis was conducted based on the discussion laid out in the Research Methodology section of this paper and summarized in Figure 4 shown in that section. Summary results were obtained from Survey Monkey and are shown in Appendix E. Survey Monkey also provided data in Excel and SPSS format. Both data sets were downloaded and reviewed. SPSS version 20 was the primary tool used for data analysis. Analysis results are shown in Appendices F and G.

The first check was to determine if the data set met the minimum requirement of 50 data points per question. 90 data points per question were obtained. So while the goal of 120 data points per question was not obtained, the number of data points per question was well above the 50 observation threshold. Next descriptive statistics were used to help determine data validity and the variables were checked for normality and skewness, Appendix F. Exploratory Factor Analysis was performed to determine if variables were part of a construct. Knowledge transfer and risk management capability variables were explored in relation to Table 5. Variables with factors greater than 0.4 were determined to be associated with the construct. Additionally, the overall Kaiser-Meyer-Olkin (KMO) measure was investigated for sampling adequacy and Bartlett's Test of Sphericity was used to determine strength of correlation. A large correlation between variables was defined as a KMO greater than 0.6 and a significant Bartlett Test (Garson, 2009). These tests were used to confirm unidimensionalty.

The construct for knowledge transfer had 12 variables that loaded onto one factor. However, based on the research of Landaeta (2008) it was known that inter knowledge transfer and intra knowledge transfer can be separated out into separate factors. For Hypothesis 1, An increase in knowledge transfer will have a positive impact on risk management capabilities, the results of all knowledge transfer variables loaded onto one factor is shown in Table 6. KMO and Bartlett's Test is shown in Table 7. All loading was greater than 0.4, KMO was 0.860, and Bartlett's Test was significant.

Table 6

Knowledge Transfer Factor Summary

Component Matrix[a]

	Component
	1
Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	.871
Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	.794
Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	.893
Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:	.856
Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	.834
Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	.855
Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	.907
Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:	.873
Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	.816
Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	.767
Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	.814
Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:	.839

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table 7

KMO and Bartlett's Test for Knowledge Transfer

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.860
Bartlett's Test of Sphericity	Approx. Chi-Square	1381.693
	df	66
	Sig.	.000

For Hypothesis 1a, Inter knowledge transfer has a more positive impact on risk management capabilities than intra knowledge transfer on Risk Management capabilities, the results of intra knowledge transfer variables loaded onto one factor is shown in Table 8. KMO and Bartlett's Test is shown in Table 9. All loading was greater than 0.4, KMO was 0.797, and Bartlett's Test was significant. Also for Hypothesis 1a the results of inter knowledge transfer variables loaded onto one factor is shown in Table 10. KMO and Bartlett's Test is shown in Table 11. All loading was greater than 0.4, KMO was 0.823, and Bartlett's Test was significant.

Table 8

Intra Knowledge Transfer Factor Summary

Component Matrix[a]

	Component
	1
Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	.844
Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	.858
Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	.888
Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	.904
Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	.813
Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	.778

Extraction Method: Principal Component Analysis.

Table 9

KMO and Bartlett's Test for Intra Knowledge Transfer

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.797
Bartlett's Test of Sphericity	Approx. Chi-Square	525.318
	df	15
	Sig.	.000

Table 10

Inter-Knowledge Transfer Factor Summary

Component Matrix[a]

	Component
	1
Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	.886
Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:	.887
Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	.908
Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:	.911
Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	.840
Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:	.879

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table 11

KMO and Bartlett's Test for Inter Knowledge Transfer

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.823
Bartlett's Test of Sphericity	Approx. Chi-Square	570.577
	df	15
	Sig.	.000

The construct of Risk Management capabilities consisted of 18 variables. Exploratory Factor Analysis was run on these variables. Two components were revealed. The first component represented 12 questions and the second component represented six questions. The first component loaded well for questions that began "We were able to…." and the second component loaded well for questions that began "As the project progress…." The first component represents a static look at perceived capabilities, a summary view of risk management capabilities. The second component represents a dynamic look at perceived capabilities, a view of how risk management capabilities changed over time. This differentiation is new finding and was not identified in the literature review. Table 12 shows factor loading for these variables and Table 13 shows the KMO and Bartlett's Test. For each component, all loading was greater than 0.4, KMO was 0.895, and Bartlett's Test was significant.

Table 12

Risk Management Capabilities Factor Summary - 2 Components

Rotated Component Matrix[a]

	Component	
	1	2
We were able to implement project risk plans accurately/effectively	.770	.134
We were able to implement project risk plans no struggles/efficiently	.814	.185
We were able to identify project risks accurately/effectively	.803	.251
We were able to identify project risks no struggles/efficiently	.742	.248
We were able to analyze project risks accurately/effectively	.858	.196
We were able to analyze project risks no struggles/efficiently	.833	.155
We were able to handle project risks accurately/effectively	.795	.320
We were able to handle project risks no struggles/efficiently	.777	.266
We were able to document project risks accurately/effectively	.794	.332
We were able to document project risks no struggles/efficiently	.790	.355
We were able to monitor project risks accurately/effectively	.877	.219
We were able to monitor project risks no struggles/efficiently	.832	.256
Table 12 Risk Management Capabilities Factor Summary- 2 Components (Continued)	Component 1	Component 2
As the project progressed, our risk planning capabilities improved.	.140	.837
As the project progressed, our ability to identify risks improved.	.204	.876
As the project progressed, our ability to analyze risks improved.	.251	.839
As the project progressed, our risk handling improved.	.275	.844
As the project progressed, our risk documentation methods improved.	.352	.694
As the project progressed, our ability to monitor risks improved.	.225	.809

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Table 13

KMO and Bartlett's Test for Risk Management Capabilities - 2 Components

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.895
Bartlett's Test of Sphericity	Approx. Chi-Square	1644.324
	df	153
	Sig.	.000

Risk Management capabilities were also forced onto one factor. Factor loading, KMO, and Bartlett's Test of Sphericity were studied to determine if the 18 variables could be represented by one factor. Table 14 shows factor loading for these variables and Table 15 shows the KMO and Bartlett's Test. All loading was greater than 0.4, KMO was 0.895, and Bartlett's Test was significant.

Table 14

Risk Management Capabilities Factor Summary - 1 Component

Component Matrix[a]

	Component
	1
We were able to implement project risk plans accurately/effectively	.724
We were able to implement project risk plans no struggles/efficiently	.788
We were able to identify project risks accurately/effectively	.814
Table 14 Risk Management Capabilities Factor Summary 1 Component (Continued)	Component 1
We were able to identify project risks no struggles/efficiently	.761
We were able to analyze project risks accurately/effectively	.831
We were able to analyze project risks no struggles/efficiently	.789
We were able to handle project risks accurately/effectively	.844
We were able to handle project risks no struggles/efficiently	.800
We were able to document project risks accurately/effectively	.849
We were able to document project risks no struggles/efficiently	.858
We were able to monitor project risks accurately/effectively	.860
We were able to monitor project risks no struggles/efficiently	.841
As the project progressed, our risk planning capabilities improved.	.562
As the project progressed, our ability to identify risks improved.	.637
As the project progressed, our ability to analyze risks improved.	.657
As the project progressed, our risk handling improved.	.680
As the project progressed, our risk documentation methods improved.	.666
As the project progressed, our ability to monitor risks improved.	.619

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table 15

KMO and Bartlett's Test for Risk Management Capabilities - 1 Component

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.895
Bartlett's Test of Sphericity	Approx. Chi-Square	1644.324
	df	153
	Sig.	.000

Communalities in the constructs were evaluated to determine if the factors were well determined and converge to a proper solution. A mean level of 0.7 was established as a good measure of the factor (MacCallum, et al, 1999). MacCallum, et al. (1999) gives guidance for accepting communalities with a mean value within the range of 0.5 stating that the factors must be well determined. Reliability testing served also to gage the acceptability of those factors with communality means between 0.5 and 0.7. Cronbach's Alpha was used for determination of reliability. Ahire and Devaraj (2001) suggest a minimum value of 0.6 for Cronbach's Alpha when investigating emerging constructs. The mean of the communalities for each factor was above 0.7 except for Risk Management Capabilities which had a mean of 0.578. The alpha measure for all factors was above 0.90. The factors were determined to have high reliability and Table 16 shows the communality mean, maximum communality, and minimum communality for each factor. Table 17 shows Cronbach's Alpha summary for the constructs.

Table 16

Communality Summary

Factor	Mean Communality Value	Maximum Communality	Minimum Communality
Knowledge Transfer	0.713	0.823	0.589
Intra-Knowledge Transfer	0.720	0.817	0.605
Inter-Knowledge Transfer	0.784	0.829	0.706
Risk Management Capabilities -1 Factor	0.578	0.740	0.316
Risk Management Capabilities -2 Factors	0.722	0.818	0.605

Table 17

Cronbach's Alpha Summary

Factor	Cronbach's Alpha	Number of Items
Knowledge Transfer	0.961	12
Intra-Knowledge Transfer	0.921	6
Inter-Knowledge Transfer	0.944	6
Risk Management Capabilities-1 Factor	0.955	18
Risk Management Capabilities (Static)	0.963	12
Risk Management Capabilities (Dynamic)	0.921	6

As discussed unidimensionality was validated by using a combination of exploratory factor analysis and confirmatory factor analysis as described by Ahire and Davaraj (2001). Additionally, the overall Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to confirm unidimensionality using a minimum KMO value of 0.6 as suggested by Garson (2009). Reliability was verified by analysis of Cronbach's Alpha. A minimum value of 0.6 for alpha was used as recommended by Ahire and Davaraj (2001). For content and face validity a through literature review was conducted. Questions were adapted from published research. Subject matter experts were consulted in the development of the survey and the survey was piloted. The pilot population consisted of individuals with project management, risk management, and knowledge management backgrounds. The pilot comments were analyzed and incorporated. The final survey was reviewed by committee prior to distribution. For nomological validity standard correlation, regression, and multivariate procedures were followed. A minimum "cut-off" value of 50 observations was established from published researched as previously discussed. For internal validity a single survey was used throughout the duration and diversity within the population was obtained. The participants came from different organizations of varying sizes, different size companies, held various job titles, and worked on projects of varying magnitudes. For external validity was verified in a means similar to internal validity. According to Bowen (1995) a survey instrument can provide for high external validity provided the sample size is large and includes a heterogeneous population (different organizations, projects, etc).

Because it was established that the variables were not normally distributed a Spearman correlation for a two-tailed response was run to determine if a relationship between the variables existed. Appendix I shows the correlations between variables. Table 18 tabulates the number of significant correlations between knowledge transfer variables and risk management capability variables.

Table 18

Correlation Summary

KT Variable	Number of Sig. Correlations at 0.05	Number of Sig. Correlations at 0.01
Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	3	1
Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	4	2
Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	9	5
Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:	6	1
Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	3	1
Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	1	1
Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	2	0
Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:	0	0
Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	1	1
Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	0	0
Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	1	0
Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:	2	0

When investigated from the categories of best practices, lessons learned, and near misses the correlation tables in Appendix I show that best practices has the most significant correlations with risk management capabilities by a large margin. There were 31 significant correlations between best practices and risk management capabilities. By contrast there were eight significant correlations between lessons learned and risk management capabilities and 5 significant correlations between near misses and risk management capabilities. When investigated from an intra knowledge transfer and inter knowledge transfer viewpoint the correlation tables in Appendix I show that inter knowledge transfer has more significant correlations with risk management capabilities than intra knowledge transfer. Inter knowledge transfer had 26 significant correlations where intra knowledge transfer had 18 significant correlations with risk management capabilities.

Significant correlations were in a range of 0.20 to 0.409. The correlation between studying best practices from other projects and the perceived ability to identify project risks accurately and effectively was 0.409. Studying best practices across projects was also the knowledge management question that had the most significant correlations with risk management capabilities. This knowledge transfer aspect had 14 significant correlations with risk management capabilities. Two knowledge transfer questions had no significant correlations with risk management questions. These two questions were: "Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams", and "Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team." The implications of these findings will be elaborated on in the Discussion and Conclusion section of this paper.

When looking at the correlations from a risk management standpoint, the two questions that correlated with the most knowledge transfer questions where "As the project progressed, our risk documentation methods improved" and "As the project progressed, our ability to monitor risks improved." Each of these questions had nine significant correlations with knowledge transfer questions. The correlation range for "As the project progressed, our risk documentation methods improved" ranged from 0.207 to 0.392. The correlation range for "As the project progressed, our ability to monitor risks improved" ranged from 0.216 to 0.364. Several questions did not have any significant correlations with lessons learned, best practices, or near misses. These questions were: "We were able to analyze project risks no struggles/efficiently", "We were able to handle project risks no struggles/efficiently", and "As the project progressed, our risk handling improved". A summary table of risk management questions correlated to knowledge transfer questions is show at the end of Appendix I.

Hypothesis Testing

Linear regression with SPSS was used to test the hypotheses. Appendix H shows the hypothesis testing data. The predictive power of the model is represented by R Square. R Square is the ratio of the change of in the dependent variable that is explained by a change in the independent variable. A hypothesis was accepted if the significance level was 0.05 or below.

- H1: An increase in knowledge transfer will have a positive impact on Risk Management capabilities.

The independent variable was knowledge transfer. This was a single factor that represented Questions 1 through 12. The dependent variable was risk management capabilities and was represented by questions 13-32. The regression analysis of this hypothesis was significant (p=0.021) with low predictive capability (r^2=0.059). Table 19 shows the model summary for Hypothesis 1. An attempt to delve deeper by regressing knowledge transfer (Questions 1 through 12) against risk management capabilities-static (Questions 13 through 24) and against risk management capabilities-dynamic (Questions 25-32) resulted in regression models that were not statistically significant. The test for KT and risk management capabilities-dynamic had a significance of p=0.197. It was noted that test for KT and risk management capabilities-static had a significance of p=0.057 which was barely above the 0.05 threshold and it was noted that the predictive power was slightly less (r^2= 0.040) than the model for KT and risk management capabilities. Hypothesis 1 was supported by the data.

Table 19

Hypothesis 1 Model Summary

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.243[a]	.059	.048	.97546294	.059	5.534	1	88	.021

a. Predictors: (Constant), KM

- H1a: Inter knowledge transfer has a more positive impact on risk management capabilities than intra knowledge transfer.

The independent variables were intra-knowledge transfer and inter-knowledge transfer. The factor for intra-knowledge transfer represented Questions 1 and 2, 5 and 6, and 9 and 10. The factor for intra-knowledge transfer represented Questions 3 and 4, 7 and 8, and 11 and 12. The dependent variable was risk management capabilities and was represented by Wuestions 13-32. The analysis for intra-knowledge transfer was not significant (p=0.070). The data did not support this hypothesis.

- H2: The length of a project will have a positive effect on the relationships of knowledge transfer and risk management capabilities.

The independent variable was knowledge transfer. A single factor for knowledge transfer representing Questions 1 through 12 was used. The dependent variable was risk management capabilities and was represented by Questions 13-32. The moderating variable was project length and represented Question 32. Additionally, an interaction variable of the multiplication of the knowledge management factor and the project length variable was used. The analysis for project length was not significant (p=0.128). The data did not support this hypothesis. Table 20 shows the model summary for Hypothesis 2.

Table 20

Hypothesis 2 Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.252[a]	.064	.031	.98445078	.064	1.945	3	86	.128

a. Predictors: (Constant), LengthMod, KM, The approximate number of months in which my last project was executed Months

- H3: The number of team members on a project will have a positive effect on the relationships of knowledge transfer and risk management capabilities.

The independent variable was knowledge transfer. A single factor for knowledge transfer representing Questions 1 through 12 was used. The dependent variable was risk management capabilities and was represented by Questions 13-32. The moderating variable was team members and represented Question 31. Additionally, an interaction variable of the multiplication of the knowledge transfer factor and the team member variable was used. The analysis for project length was not significant (p=0.128). The data did not support this hypothesis. Table 21 shows the model summary for Hypothesis 3.

Table 21

Hypothesis 3 Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.252[a]	.064	.031	.98437936	.064	1.949	3	86	.128

a. Predictors: (Constant), Team size as Mod, KM, The approximate number of team memebers my project had Number

- H4: A company's size, based on the number of employees will not have a significant effect on the relationships of knowledge transfer and risk management capabilities.

The independent variable was knowledge transfer. A single factor for knowledge transfer representing Questions 1 through 12 was used. The dependent variable was risk management capabilities and was represented by Questions 13-32. The moderating variable was company size and represented Question 33. Additionally, an interaction variable of the multiplication of the knowledge transfer factor and the company size variable was used. The analysis for project length was not significant (p=0.089). The data did not support the hypothesis that company size does not have a significant effect on the relationship of knowledge transfer and risk management capabilities. Table 22 shows the model summary for Hypothesis 4.

Table 22

Hypothesis 4 Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.269[a]	.073	.040	.97987253	.073	2.244	3	86	.089

a. Predictors: (Constant), Company size as mod, My company size is approximately:, KM

- H5: Project cost will not have a significant effect on the relationships of knowledge transfer and risk management capabilities.

The independent variable was knowledge transfer. A single factor for knowledge transfer representing Questions 1 through 12 was used. The dependent variable was risk management capabilities and was represented by Questions 13-32. The moderating variable was project cost and represented Question 35. Additionally, an interaction variable of the multiplication of the knowledge management factor and project cost variable was used. The analysis for project length was not significant (p=0.108). The data did not support the hypothesis that project cost does not have a significant effect on the relationship of knowledge transfer and risk management capabilities. Table 23 shows the model summary for Hypothesis 5.

Table 23

Hypothesis 5 Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.261[a]	.068	.035	.98214558	.068	2.088	3	86	.108

a. Predictors: (Constant), Project cost as mod, I estimate the total cost of my project to be:, KM

- H6: Experience will have a significant effect on the relationships of knowledge transfer and risk management capabilities.

The independent variable was knowledge transfer. A single factor for knowledge transfer representing Questions 1 through 12 was used. The dependent variable was risk management capabilities and was represented by Questions 13-32. The analysis was run several times using different moderating variables for experience. Overall project management experience was used and represented Question 36. Overall knowledge management experience was used and represented Question 38. Overall risk management experience was used and represented Question 39. Additionally, project management experience within the company was used and represented Question 37. The intent of the company specific question was to try to determine if company specific project management experience produced significantly different results that overall project management experience. The moderating variable each time was the specific experience variable being studied. Additionally, an interaction variable of the multiplication of the knowledge transfer factor and the specific experience variable was used. The analysis for overall project management experience was not significant (p=0.134). The data did not support the hypothesis that experience would have a positive moderating effect on the relationship of knowledge transfer and risk management capabilities when considering overall project management experience. Table 24 shows the model summary for Hypothesis 6 for overall project management experience.

Table 24

Hypothesis 6 Overall Project Management Experience Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.250[a]	.063	.030	.98497152	.063	1.912	3	86	.134

a. Predictors: (Constant), TotalProjectExp, My total years of experience with project management is:, KM

The analysis for company specific project management experience was not significant (p=0.142). The data did not support the hypothesis that experience would have a positive moderating effect on the relationship of knowledge transfer and risk management capabilities when considering company specific project management experience. Table 25 shows the model summary for Hypothesis 6 for company project management experience.

Table 25

Hypothesis 6 Company Project Management Experience Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.247[a]	.061	.028	.98576841	.061	1.863	3	86	.142

a. Predictors: (Constant), Company Project Management Experience as mod, My years of experience with project management with my company is:, KM

The analysis for knowledge management experience was significant (p=0.039). It was noted that the interaction variable did not produce significant results (p=0.450) and that the coefficient was negative. The implications will be discussed in the Discussion and Conclusions section of this paper. The overall model was significant (p=0.039) and since the model was significant the coefficients were looked at next to determine if the hypothesis was supported. The P value for the KT variable was "marginally" significant (p=0.077) in this model. However, neither the KM experience variable nor the interaction variable were significant (p= 0.113 for KM experience and p=0.450 for the interaction factor). Since the interaction variable was not significant the data did not support the hypothesis. Table 26 shows the model summary for Hypothesis 6 for knowledge management experience. Table 27 shows the coefficients for the model for knowledge management as a moderator.

Table 26

Hypothesis 6 Knowledge Management Experience Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.304[a]	.092	.061	.96918808	.092	2.916	3	86	.039

a. Predictors: (Constant), My total years of experience with knowledge management is:, Total KM experience as mod, KM

Table 27

Hypothesis 6 Knowledge Management Experience Moderator Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.208	.171		-1.215	.228
	KM	.335	.187	.335	1.791	.077
	Total KM experience as mod	-.011	.015	-.141	-.759	.450
	My total years of experience with knowledge management is:	.027	.017	.167	1.601	.113

a. Dependent Variable: RM

The analysis for risk management experience was significant (p=0.019). The results for Hypothesis 6 were similar to the results for Hypothesis 5. The overall model was significant and the p value for the KT variable was "marginally" significant. In this case however the variable for RM experience was significant and the interaction variable was not (p= 0.037 for RM experience and p=0.338 for the interaction factor). Since the interaction variable was not significant the data did not support the hypothesis. In summary, none of the data for each type of experience supported Hypothesis 6. Table 28 shows the model summary for Hypothesis 6 for risk management experience. Table 29 shows the coefficients for the model for risk management as a moderator.

Table 28

Hypothesis 6 Risk Management Experience Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.330[a]	.109	.078	.96022549	.109	3.509	3	86	.019

a. Predictors: (Constant), My total years of experience with risk management is:, KM, Total RM experience as mod

Table 29

Hypothesis 6 Risk Management Experience Moderator Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.271	.169		-1.599	.113
	KM	.328	.193	.328	1.699	.093
	Total RM experience as mod	-.010	.011	-.169	-.868	.388
	My total years of experience with risk management is:	.029	.014	.226	2.118	.037

a. Dependent Variable: RM

CHAPTER 5

CONCLUSION

This section discusses the summary of the findings, limitations and recommendations for future research. This section will also explain the relevance of this research to academia and the implications to engineering managers.

Summary

A literature review on the relationships between knowledge management and risk management in project based environments was conducted. From the review it was established that there was a large gap in the body of knowledge. Conceptual models were built, research explored and a research question posed. That question was "Does knowledge transfer have a positive impact on risk management capabilities?" From that several hypotheses were formed. The first, Hypothesis 1, dealt directly with the research question. The hypothesis that an increase in knowledge transfer will have a positive impact on Risk Management capabilities was supported. The research question was answered affirmatively.

The next hypotheses delved deeper into the topic and looked at types of knowledge transfer and also looked at potential moderating effects. The second part to the first hypothesis, Hypothesis 1a, Inter knowledge transfer has a more positive impact on risk management capabilities than intra knowledge transfer, was not supported by the data. It could not be confirmed however based on related research it is being suggest as an area of future research.

The next hypotheses looked at moderating factors with relation to the influence of knowledge management on risk management capabilities. Hypothesis 2, the length of a project will have a positive effect on the relationships of knowledge transfer and risk management capabilities, was not supported by the data. This research could not confirm that longer projects produced any significant difference in the relationship between knowledge management and risk management capabilities. The third hypothesis, Hypothesis 3, the number of team members on a project will have a positive effect on the relationships of knowledge transfer and risk management capabilities, also was not supported by the data. This research could not confirm that having more resources in the form of personnel produced any significant difference in the relationship between knowledge transfer and risk management capabilities. Hypothesis 4, a company's size, based on the number of employees will not have a significant effect on the relationships of knowledge transfer and risk management capabilities, was not supported by the data. This research could not confirm that company size produced any significant difference in the relationship between knowledge transfer and risk management capabilities. For the fifth hypothesis, Hypothesis 5, project cost will not have a significant effect on the relationships of knowledge transfer and risk management capabilities, was not supported by the data. This research could not confirm that project cost produced any significant difference in the relationship between knowledge transfer and risk management capabilities.

The sixth hypothesis, Hypothesis 6, experience will have a significant effect on the relationships of knowledge transfer and risk management capabilities, gave mixed results. When using overall project management experience and company specific project management experience the results were not significant and the data did not support the hypothesis. However, when using overall knowledge management experience and when using overall risk management experience the models were significant. It was noted that in both cases that the interaction variable was not significant and the hypothesis could not be supported. These finding will be suggested for future research.

The numbers, values and relations of the significant correlations found in this research are important. This research established that of the areas of knowledge management considered in this research, best practices, lessons learned, and near misses, that best practices had the highest and most correlations with risk management capabilities. This has implications for academics and engineering managers as well as suggests areas of future research. It was also noted that inter knowledge transfer was significantly correlated with 70% more risk management capability measures than intra knowledge transfer. This would suggest that inter knowledge transfer plays a more powerful role than intra knowledge transfer when looking at risk management capabilities in a project based environment.

Limitations and Recommendations

There are several important limitations that will be discussed in this section. The sample size, while technically acceptable, was low. 90 respondents answered the survey. A larger sample size in the range of hundreds would make the results more generalizable. The sample size included small, medium, and large sized companies. The sample size also drew from various industries but these data were not collected. It is possible that there is bias in the study to one particular industry (i.e. defense contractors or research and development). Future research should account for industry. The survey was self-administered and while self-administered surveys are accepted as a standard measurement tool, self-assessment raise concerns of source biases.

The causal effect of knowledge management on risk management was established by this research but this research provides ample room to expand on this topic and further the body of knowledge. It was noted that it could not be determined whether inter knowledge transfer had a greater impact on risk management capabilities when compared to intra knowledge transfer. Based on research in the area of knowledge transfer, learning, and project management by Kotnour (2000) and Landaeta (2008) it has been established that there are clear links between knowledge transfer, learning, and project performance. Studying inter- and intra-knowledge transfer as it relates to risk management in project based environments would help further expand our understanding in this area. While exploring Hypothesis 6, experience will have a significant effect on the relationships of knowledge transfer and risk management capabilities, it was noted that both risk management experience and knowledge management experience produced significant models but upon further investigation is was seen that the interaction variable for each case was not significant. The role that experience and education play in the relationship between knowledge management and risk management is suggested as an area of expansion.

Other important areas for future research are the correlations established between aspects of knowledge management and risk management capabilities. It was established that the number of significant correlations between best practices and risk management capabilities far exceeded the number of significant correlations between near misses and risk management capabilities and the number of significant correlations between lessons learned and risk management capabilities. It was also noted that the highest correlation (0.409) was between studying best practices across projects and the ability to identify project risks accurately/effectively. Research in the specific area of how best practices in risk management are documented, socialized, and disseminated both within projects and across projects would bolster the research presented here. Additionally when inspected from a risk management capabilities standpoint the ability to document risks and monitor risk over time showed the most significant correlations with the knowledge management factors of best practices, lessons learned, and near misses. Investigating how knowledge management specifically impacts risk monitoring and risk documentation would expand on this research.

Implications

The implications to academia are to expand the current body of knowledge in the area of knowledge management and risk management in project based environments. The literature review has expanded the body of knowledge by highlighting relevant research literature, and exploring common themes, and identifying new conceptual models. The literature review also exposed the considerable gap in the current body of knowledge. The research presented in this paper furthers our understanding on the causal relationship between knowledge management and risk management capabilities. It also exposes significant correlations between certain aspects of knowledge management and risk management capabilities. This research provides several avenues to expand and bolster this area of study.

The implication to the engineering and project managers is to provide a better functional understanding of the relationship between knowledge management and risk management in project based environments. It has been established that there is significant relationship between the two by confirming Hypothesis 1, an increase in knowledge transfer will have a positive impact on Risk Management capabilities. It could not be established whether inter- or intra-knowledge transfer had a greater impact therefore this research does not provide additional guidance in that area. This research also identified areas of knowledge management, the studying and discussing best practices within and across projects, that had higher significant correlations. Specifically the highest correlation was between studying best practices across projects and the ability to identify project risks accurately/effectively. This information better equips the manager when deciding on what areas to focus on when funding is limited, provides a basis for building deck plate work models, and perhaps most of all allows the manager to have a better actionable insight on the relationships and interactions between knowledge management and risk management.

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APPENDIX A

Initial Survey

The information being requested will help academics and companies better understand relationships between knowledge management and risk management in project-based environments. Analysis of the results will be based on a combination of survey participants and can not be traced back to any one individual, event, or company. Individual responses will remain anonymous and will not be reported to any person or entity. Individual responses will not be traced back to any one individual, event, or company. Participation in this survey is voluntary, with no penalties or reprisals for not participating or completing the survey.
Please read through the definitions prior to starting the survey and refer back to the definition as needed.

Definitions
Study: Refers to reading, watching videos, or other activities which do not directly involve conversations with others.
Discuss: Refers to meetings, teleconferences, video conferences, or other activities in which conversations and interaction with peers occurred.
Lessons Learned: Knowledge gained through experience, which if shared, would promote the recurrence of desirable outcomes or preclude the recurrence of undesirable outcomes.
Best Practices: is a technique or methodology that, has proven successful in particular circumstances.
Near- Miss: an event that has a non-hazardous outcome but in which a hazardous outcome could have occurred.
Knowledge Management (KM): The set of steps, methods, and tools for the most effective and efficient use knowledge aimed to improve performance and capabilities.
Risk Management (RM): includes planning, assessing, handling, documenting and monitoring risks.
Risk Handling: Setting risks at acceptable levels based on identifying, evaluating, selecting, and implementing the desired option.

SURVEY

All questions pertain to a recent completed project, one that was not abnormally terminated , in which you formally worked as project manager or member of the project team.

Inter-Project Knowledge Transfer

1. Approximately how many times did you study lessons learned from other projects:

	Drop down menu with: 0,1,2,3….48,49,50+				

2. Approximately how many times did you study best practices from other projects:

	Drop down menu with: 0,1,2,3….48,49,50+				

3. Approximately how many times did you study near misses from other projects:

	Drop down menu with: 0,1,2,3….48,49,50+				

4. Approximately how many times you discuss lessons learned with members from other project teams:

	Drop down menu with: 0,1,2,3….48,49,50+				

5. Approximately how many times you discuss best practices with members from other project teams:

	Drop down menu with: 0,1,2,3….48,49,50+				

6. Approximately how many times you discuss near misses with members from other project teams:

	Drop down menu with: 0,1,2,3….48,49,50+				

Intra-Project Knowledge Transfer

7. Approximately how many times did you study lessons learned collected from your project:

	Drop down menu with: 0,1,2,3….48,49,50+				

8. Approximately how many times did you study best practices collected from your project:

	Drop down menu with: 0,1,2,3….48,49,50+				

9. Approximately how many times did you study near misses collected from your project:

	Drop down menu with: 0,1,2,3….48,49,50+				

10. Approximately how many times you discuss lessons learned collected from your project with members of your project team:

	Drop down menu with: 0,1,2,3….48,49,50+				

11. Approximately how many times you discuss best practices collected from your project with members of your project team:

	Drop down menu with: 0,1,2,3….48,49,50+				

12. Approximately how many times you discuss near misses collected from your project with members of your project team:

	Drop down menu with: 0,1,2,3….48,49,50+				

Risk Management Capability

13.

We were able to implement project risk plans	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

14.

We were able to identify project risks	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

15.

We were able to analyze project risks	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

16.

We were able to handle project risks	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

17.

We were able to document project risks	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

18.

We were able to monitor project risks	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

Effectiveness of Risk Management

19.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our risk planning capabilities improved.					

20.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our ability to identify risks improved.					

21.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our ability to analyze risks improved.					

22.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our risk handling improved.					

23.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our risk documentation methods improved.					

24.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our ability to monitor risks improved.					

Demographics

25.

	No.
The approximate number of team members that my project had is	

26.

	Months
The approximate number of months in which my last project was executed was	

27.

	Small (99 or fewer employees).	Medium (100 to 499 employees)	Large (over 500 employees)
My company size is approximately			

28.

	High School	Associates Degree	Bachelor's Degree	Master's Degree	Doctoral Degree
My highest level of education is most closely					

29. My years of experience with project management with my company is

	Drop down menu with: 0,1,2,3....48,49,50+				

30. My total years of experience with project management is

	Drop down menu with: 0,1,2,3....48,49,50+				

31. My total years of experience with knowledge management is

	Drop down menu with: 0,1,2,3....48,49,50+				

32. My total years of experience with risk management is

	Drop down menu with: 0,1,2,3....48,49,50+				

APPENDIX B

Old Dominion University Institutional Review Board Approval

No.: 11-048

OLD DOMINION UNIVERSITY
HUMAN SUBJECTS INSTITUTIONAL REVIEW BOARD
RESEARCH PROPOSAL REVIEW NOTIFICATION FORM

TO: Rafael Landaeta — **DATE: April 21, 2011**
Responsible Project Investigator — *IRB Decision Date*

RE: **Establishing Relationships between Risk Management and Knowledge Management**
Name of Project

Please be informed that your research protocol has received approval by the Institutional Review Board. Your research protocol is:

___ Approved
___ Tabled/Disapproved
__X_ Approved, (EXEMPT) contingent on making the changes below*

George C. Maihafer / — **April 21, 2011**
IRB Chairperson's Signature — *date*

Contact the IRB for clarification of the terms of your research, or if you wish to make ANY change to your research protocol.

The approval as exempt, does not require an annual Progress Report or , once the study is complete, a Close-out report. You must report adverse events experienced by subjects to the IRB chair in a timely manner (see university policy).

* Approval of your research is CONTINGENT upon the satisfactory completion of the following changes and attestation to those changes by the chairperson of the Institutional Review Board. Research may not begin until after this attestation.

* No Changes required

Attestation

As directed by the Institutional Review Board, the Responsible Project Investigator made the above changes. Research may begin.

George C. Maihafer / — **April 27, 2011**
IRB Chairperson's Signature — *date*

APPENDIX C

Pilot Survey

This pilot survey will be used to validate the proposed survey questions. The full survey is attached. It is not necessary to answer the actual survey questions. Please read through the question and answer the review section for that particular question. The review section contains 5 columns. For the first 4 columns, please place an "X" in the box(s) that are most appropriate. Each question has a place for comments on that question in the last column labeled "Recommendations/Assessment". Additionally, at the end of the survey there is a general comments section. This section can be used to address the survey in general or specific survey questions. If commenting on a specific survey question please refer to the survey question number. The survey will be revised based on the inputs from the pilot survey responses and posted on an on-line survey service. The survey will be sent out to multiple individuals in multiple organizations that work in a project-based environment. Thank you for your time and expertise.

SURVEY

The information being requested will help academics and companies better understand relationships between knowledge management and risk management in project-based environments. Analysis of the results will be based on a combination of survey participants and can not be traced back to any one individual, event, or company. Individual responses will remain anonymous and will not be reported to any person or entity. Individual responses will not be traced back to any one individual, event, or company. Participation in this survey is voluntary, with no penalties or reprisals for not participating or completing the survey.
Please read through the definitions prior to starting the survey and refer back to the definition as needed.

Definitions
<u>Study</u>: Refers to reading, watching videos, or other activities which do not directly involve conversations with others.
<u>Discuss</u>: Refers to meetings, teleconferences, video conferences, or other activities in which conversations and interaction with peers occurred.
<u>Lessons Learned</u>: Knowledge gained through experience, which if shared, would promote the recurrence of desirable outcomes or preclude the recurrence of undesirable outcomes.
<u>Best Practices</u>: is a technique or methodology that, has proven successful in particular circumstances.
<u>Near- Miss</u>: an event that has a non-hazardous outcome but in which a hazardous outcome could have occurred.

<u>Knowledge Management (KM):</u> The set of steps, methods, and tools for the most effective and efficient use knowledge aimed to improve performance and capabilities

<u>Risk Management (RM):</u> includes planning, assessing, handling, documenting and monitoring risks.
<u>Risk Handling:</u> Setting risks at acceptable levels based on identifying, evaluating, selecting, and implementing the desired option.

All questions pertain to a recent completed project, one that was not abnormally terminated, in which you formally worked as project manager or member of the project team.

Inter-Project Knowledge Transfer

1. Approximately how many times did you study lessons learned from other projects:

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 1:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

2. Approximately how many times did you study best practices from other projects:

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 2:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

3. Approximately how many times did you study near misses from other projects:

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 3:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

4. Approximately how many times you discuss lessons learned with members from other project teams:

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 4:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

5. Approximately how many times you discuss best practices with members from other project teams:

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 5:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

6. Approximately how many times you discuss near misses with members from other project teams:

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 6:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

Intra-Project Knowledge Transfer

7. Approximately how many times did you study lessons learned collected from your project:

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 7:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

8. Approximately how many times did you study best practices collected from your project:

	Drop down menu with: 0,1,2,3....48,49,50+				

Review of Question 8
:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

9. Approximately how many times did you study near misses collected from your project:

	Drop down menu with: 0,1,2,3....48,49,50+				

Review of Question 9:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

10. Approximately how many times you discuss lessons learned collected from your project with members of your project team:

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 10:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

11. Approximately how many times you discuss best practices collected from your project with members of your project team:

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 11:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

12. Approximately how many times you discuss near misses collected from your project with members of your project team:

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 12:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

Risk Management Capability

13.

We were able to implement project risk plans	1-with no accuracy/ not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/ not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

Review of Question 13:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

14.

We were able to identify project risks	1-with no accuracy/ not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/ not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

Review of Question 14:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

15.

We were able to analyze project risks	1-with no accuracy/no t effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/ not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

Review of Question 15:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

16.

We were able to handle project risks	1-with no accuracy/ not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/ not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

Review of Question 16:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

17.

We were able to document project risks	1-with no accuracy/ not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/ not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

Review of Question 17:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

18.

We were able to monitor project risks	1-with no accuracy/ not effectively	2	3	4-with some accuracy	5	6	7-accurately/ effectively
	1-with many struggles/ not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/ efficiently

Review of Question 18:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

Effectiveness of Risk Management

19.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our risk planning capabilities improved.					

Review of Question 19:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

20.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our ability to identify risks improved.					

Review of Question 20:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

21.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our ability to analyze risks improved.					

Review of Question 21:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

22.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our risk handling improved.					

Review of Question 22:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

23.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our risk documentation methods improved.					

Review of Question 23:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/ Assessment

24.

	strongly disagree	disagree	neutral	agree	strongly agree
As the project progressed, our ability to monitor risks improved.					

Review of Question 24:

Question is clear/under standable	Question is NOT clear/under standable	Question relates to knowledge management	Question relates to risk management	Recommendations/Ass essment

Demographics

25.

	No.
The approximate number of team members that my project had is	

Review of Question 25:

Question is clear/under standable	Question is NOT clear/under standable	Question adds value to data collection	Question does NOT add value to data collection	Recommendations/ Assessment

26.

	Months
The approximate number of months in which my last project was executed was	

Review of Question 26:

Question is clear/under standable	Question is NOT clear/under standable	Question adds value to data collection	Question does NOT add value to data collection	Recommendations/ Assessment

27.

	Small (99 or fewer employees).	Medium (100 to 499 employees)	Large (over 500 employees)
My company size is approximately			

Review of Question 27:

Question is clear/under standable	Question is NOT clear/under standable	Question adds value to data collection	Question does NOT add value to data collection	Recommendations/ Assessment

28.

	High School	Associates Degree	Bachelor's Degree	Master's Degree	Doctoral Degree
My highest level of education is most closely					

Review of Question 28:

Question is clear/under standable	Question is NOT clear/under standable	Question adds value to data collection	Question does NOT add value to data collection	Recommendations/ Assessment

29. My years of experience with project management with my company is

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 29:

Question is clear/under standable	Question is NOT clear/under standable	Question adds value to data collection	Question does NOT add value to data collection	Recommendations/ Assessment

30. My total years of experience with project management is

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 30:

Question is clear/under standable	Question is NOT clear/under standable	Question adds value to data collection	Question does NOT add value to data collection	Recommendations/ Assessment

31. My total years of experience with knowledge management is

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 31:

Question is clear/under standable	Question is NOT clear/under standable	Question adds value to data collection	Question does NOT add value to data collection	Recommendations/ Assessment

32. My total years of experience with risk management is

	Drop down menu with: 0,1,2,3….48,49,50+				

Review of Question 32:

Question is clear/under standable	Question is NOT clear/under standable	Question adds value to data collection	Question does NOT add value to data collection	Recommendations/ Assessment

GENERAL COMMENTS ON THE SURVEY:

APPENDIX D

Final Survey

THE INFORMATION BEING REQUESTED WILL HELP COMPANIES AND ACADEMICS BETTER UNDERSTAND RELATIONSHIPS BETWEEN KNOWLEDGE MANAGEMENT AND RISK MANAGEMENT IN PROJECT-BASED ENVIRONMENTS. ANALYSIS OF THE RESULTS WILL BE BASED ON A COMBINATION OF SURVEY PARTICIPANTS AND CAN NOT BE TRACED BACK TO ANY ONE INDIVIDUAL, EVENT, OR COMPANY. INDIVIDUAL RESPONSES WILL REMAIN ANONYMOUS AND WILL NOT BE REPORTED TO ANY PERSON OR ENTITY. INDIVIDUAL RESPONSES WILL NOT BE TRACED BACK TO ANY ONE INDIVIDUAL, EVENT, OR COMPANY. PARTICIPATION IN THIS SURVEY IS VOLUNTARY, WITH NO PENALTIES OR REPRISALS FOR NOT PARTICIPATING OR COMPLETING THE SURVEY.
PLEASE READ THROUGH THE DEFINITIONS PRIOR TO STARTING THE SURVEY AND REFER BACK TO THE DEFINITION AS NEEDED.

DEFINITIONS
BEST PRACTICES: is a technique or methodology that has proven successful in particular circumstances.
DISCUSS: refers to meetings, teleconferences, video conferences, or other activities in which conversations and interaction with peers is the primary method of obtaining and sharing knowledge.
KNOWLEDGE MANAGEMENT (KM): the set of steps, methods, and tools for the most effective and efficient use knowledge aimed to improve performance and capabilities.
LESSONS LEARNED: knowledge gained through experience, which if shared, would promote the recurrence of desirable outcomes or preclude the recurrence of undesirable outcomes.
NEAR- MISS: an event that has a non-hazardous outcome but in which a hazardous outcome could have occurred.
PROJECT: a temporary setting in which product is created or service is provided.
RISK ANALYSIS: is the process of examining an identified risk, isolating the cause and determining the effects.
RISK DOCUMENTATION: is the recording and maintaining of risk assessments, monitoring results, handling analysis, and risk plans.
RISK IDENTIFICATION: the process of examining project areas and technical processes to identify and document associated risks.
RISK HANDLING: setting risks at acceptable levels based on identifying, evaluating, selecting, and implementing the desired option.
RISK MANAGEMENT (RM): includes planning, assessing, handling, documenting and monitoring risks.
RISK MONITORING: the process that systematically tracks and evaluates the performance of risk handling actions against established metrics.
RISK PLANNING: the process of developing and documenting comprehensive and interactive strategies for the other steps of risk management.
STUDY: refers to reading, watching videos, or other activities which direct communication with peers is not the primary method of obtaining knowledge.

SURVEY
All questions pertain to a recently completed project, one that was not abnormally terminated , in which you formally worked as project manager or member of the project team.
All questions cover the duration you were on the project.

1. Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:

2. Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:

3. Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:

4. Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:

5. Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:

6. Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:

7. Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:

8. Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:

9. Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:

10. Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:

11. Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:

12. Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:

13. We were able to implement project risk plans:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively							

14. We were able to implement project risk plans

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently							

15. We were able to identify project risks:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively							

16. We were able to identify project risks:

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently							

17. We were able to analyze project risks:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively							

18. We were able to analyze project risks:

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently							

19. We were able to handle project risks:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively							

20. We were able to handle project risks:

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently							

21. We were able to document project risks:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively							

22. We were able to document project risks:

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently							

23. We were able to monitor project risks:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively	○	○	○	○	○	○	○

24. We were able to monitor project risks:

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently	○	○	○	○	○	○	○

25. As the project progressed, our risk planning capabilities improved.

○ strongly disagree ○ disagree ○ neutral ○ agree ○ strongly agree

26. As the project progressed, our ability to identify risks improved.

○ strongly disagree ○ disagree ○ neutral ○ agree ○ strongly agree

27. As the project progressed, our ability to analyze risks improved.

○ strongly disagree ○ disagree ○ neutral ○ agree ○ strongly agree

28. As the project progressed, our risk handling improved.

○ strongly disagree ○ disagree ○ neutral ○ agree ○ strongly agree

29. As the project progressed, our risk documentation methods improved.

○ strongly disagree ○ disagree ○ neutral ○ agree ○ strongly agree

30. As the project progressed, our ability to monitor risks improved.

○ strongly disagree ○ disagree ○ neutral ○ agree ○ strongly agree

31. The approximate number of team members that my project had is

Number [ ]

32. The approximate number of months in which my last project was executed

Months [ ]

33. My company size is approximately:

○ Small (99 or fewer employees) ○ Medium (100 to 499 employees) ○ Large (over 500 employees)

34. My highest level of education is most closely:

○ High School ○ Associates Degree ○ Bachelor's Degree ○ Master's Degree ○ Doctoral Degree

35. I estimate the total cost of my project to be:

○ Less than $50,000 ○ $50,001 to $100,000 ○ $100,001 to $1,000,000 ○ $1,000,001 to $25,000,000 ○ Greater than $25,000,000

36. My years of experience with project management with my company is:

37. My total years of experience with project management is:

38. My total years of experience with knowledge management is:

39. My total years of experience with risk management is:

APPENDIX E

Survey Summary

Dissertation Survey 2 SurveyMonkey

1. Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:

	Response Percent	Response Count
0	12.2%	11
1	15.6%	14
2	12.2%	11
3	8.9%	8
4	4.4%	4
5	11.1%	10
6	3.3%	3
7	1.1%	1
8	0.0%	0
9	0.0%	0
10	7.8%	7
11	2.2%	2
12	1.1%	1
13	0.0%	0
14	2.2%	2
15	3.3%	3
16	0.0%	0
17	0.0%	0
18	0.0%	0
19	0.0%	0

20		5.6%	5
21		0.0%	0
22		0.0%	0
23		0.0%	0
24		0.0%	0
25		1.1%	1
26		0.0%	0
27		0.0%	0
28		0.0%	0
29		0.0%	0
30		1.1%	1
31		0.0%	0
32		0.0%	0
33		0.0%	0
34		0.0%	0
35		0.0%	0
36		0.0%	0
37		0.0%	0
38		0.0%	0
39		0.0%	0
40		0.0%	0
41		0.0%	0
42		0.0%	0
43		0.0%	0
44		0.0%	0
45		0.0%	0

46	0.0%	0
47	0.0%	0
48	0.0%	0
49	0.0%	0
50	6.7%	6
	answered question	90
	skipped question	0

2. Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:

	Response Percent	Response Count
0	8.9%	8
1	10.0%	9
2	6.7%	6
3	11.1%	10
4	4.4%	4
5	3.3%	3
6	4.4%	4
7	1.1%	1
8	0.0%	0
9	2.2%	2
10	18.9%	17
11	0.0%	0
12	2.2%	2
13	0.0%	0
14	1.1%	1
15	4.4%	4
16	0.0%	0
17	0.0%	0
18	0.0%	0
19	0.0%	0
20	5.6%	5
21	0.0%	0

22	0.0%	0
23	0.0%	0
24	1.1%	1
25	1.1%	1
26	0.0%	0
27	0.0%	0
28	1.1%	1
29	0.0%	0
30	1.1%	1
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	0.0%	0
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	0.0%	0
41	0.0%	0
42	0.0%	0
43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0

48	0.0%	0
49	1.1%	1
50	10.0%	9
	answered question	90
	skipped question	0

3. Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:

	Response Percent	Response Count
0	14.4%	13
1	8.9%	8
2	11.1%	10
3	11.1%	10
4	4.4%	4
5	8.9%	8
6	4.4%	4
7	1.1%	1
8	0.0%	0
9	2.2%	2
10	12.2%	11
11	0.0%	0
12	3.3%	3
13	0.0%	0
14	0.0%	0
15	3.3%	3
16	2.2%	2

17	0.0%	0
18	0.0%	0
19	0.0%	0
20	2.2%	2
21	0.0%	0
22	0.0%	0
23	0.0%	0
24	0.0%	0
25	1.1%	1
26	0.0%	0
27	1.1%	1
28	0.0%	0
29	0.0%	0
30	1.1%	1
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	1.1%	1
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	0.0%	0
41	0.0%	0
42	0.0%	0

43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0
48	0.0%	0
49	0.0%	0
50	5.6%	5
	answered question	90
	skipped question	0

4. Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:

	Response Percent	Response Count
0	12.2%	11
1	12.2%	11
2	5.6%	5
3	8.9%	8
4	6.7%	6
5	22.2%	20
6	3.3%	3
7	0.0%	0
8	0.0%	0
9	0.0%	0
10	11.1%	10
11	0.0%	0
12	3.3%	3
13	2.2%	2
14	0.0%	0
15	2.2%	2
16	2.2%	2
17	0.0%	0
18	0.0%	0
19	0.0%	0
20	1.1%	1
21	0.0%	0

22	0.0%	0
23	0.0%	0
24	0.0%	0
25	2.2%	2
26	0.0%	0
27	0.0%	0
28	0.0%	0
29	0.0%	0
30	0.0%	0
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	0.0%	0
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	0.0%	0
41	0.0%	0
42	0.0%	0
43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0

48		0.0%	0
49		0.0%	0
50		4.4%	4
		answered question	90
		skipped question	0

5. Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:

		Response Percent	Response Count
0		10.0%	9
1		15.6%	14
2		4.4%	4
3		12.2%	11
4		6.7%	6
5		7.8%	7
6		2.2%	2
7		1.1%	1
8		1.1%	1
9		0.0%	0
10		8.9%	8
11		0.0%	0
12		4.4%	4
13		1.1%	1
14		1.1%	1
15		5.6%	5
16		0.0%	0

17		0.0%	0
18		0.0%	0
19		0.0%	0
20		5.8%	5
21		0.0%	0
22		1.1%	1
23		0.0%	0
24		1.1%	1
25		1.1%	1
26		0.0%	0
27		0.0%	0
28		0.0%	0
29		0.0%	0
30		1.1%	1
31		0.0%	0
32		0.0%	0
33		0.0%	0
34		0.0%	0
35		0.0%	0
36		0.0%	0
37		0.0%	0
38		0.0%	0
39		0.0%	0
40		0.0%	0
41		0.0%	0

42	0.0%	0
43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0
48	0.0%	0
49	0.0%	0
50	7.8%	7
	answered question	90
	skipped question	0

6. Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:

	Response Percent	Response Count
0	6.7%	6
1	13.3%	12
2	8.9%	8
3	11.1%	10
4	4.4%	4
5	7.8%	7
6	8.9%	8
7	2.2%	2
8	1.1%	1
9	0.0%	0
10	10.0%	9
11	1.1%	1
12	3.3%	3
13	0.0%	0
14	1.1%	1
15	2.2%	2
16	0.0%	0
17	0.0%	0
18	0.0%	0
19	0.0%	0
20	5.6%	5
21	0.0%	0

22		1.1%	1
23		0.0%	0
24		0.0%	0
25		1.1%	1
26		1.1%	1
27		0.0%	0
28		0.0%	0
29		0.0%	0
30		1.1%	1
31		0.0%	0
32		0.0%	0
33		0.0%	0
34		0.0%	0
35		0.0%	0
36		0.0%	0
37		0.0%	0
38		0.0%	0
39		0.0%	0
40		0.0%	0
41		0.0%	0
42		0.0%	0
43		0.0%	0
44		0.0%	0
45		0.0%	0
46		0.0%	0
47		0.0%	0

48	0.0%	0
49	0.0%	0
50	7.8%	7
answered question		90
skipped question		8

7. Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:

	Response Percent	Response Count
0	13.3%	12
1	10.0%	9
2	11.1%	10
3	12.2%	11
4	8.9%	8
5	11.1%	10
6	2.2%	2
7	2.2%	2
8	0.0%	0
9	1.1%	1
10	8.9%	8
11	0.0%	0
12	3.3%	3
13	0.0%	0
14	0.0%	0
15	6.7%	6
16	0.0%	0

17	0.0%	0
18	0.0%	0
19	0.0%	0
20	1.1%	1
21	0.0%	0
22	1.1%	1
23	0.0%	0
24	1.1%	1
25	0.0%	0
26	0.0%	0
27	0.0%	0
28	0.0%	0
29	0.0%	0
30	0.0%	0
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	1.1%	1
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	0.0%	0
41	0.0%	0
42	0.0%	0

43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0
48	0.0%	0
49	0.0%	0
50	4.4%	4
	answered question	[illegible]
	skipped question	0

8. Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:

	Response Percent	Response Count
0	16.7%	15
1	16.7%	15
2	6.7%	6
3	15.6%	14
4	4.4%	4
5	7.8%	7
6	2.2%	2
7	0.0%	0
8	2.2%	2
9	1.1%	1
10	8.9%	8
11	0.0%	0
12	1.1%	1
13	0.0%	0
14	0.0%	0
15	4.4%	4
16	1.1%	1
17	0.0%	0
18	0.0%	0
19	0.0%	0
20	3.3%	3
21	0.0%	0

22	0.0%	0
23	0.0%	0
24	0.0%	0
25	1.1%	1
26	1.1%	1
27	0.0%	0
28	0.0%	0
29	0.0%	0
30	1.1%	1
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	0.0%	0
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	1.1%	1
41	0.0%	0
42	0.0%	0
43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0

48	0.0%	0
49	0.0%	0
50	3.3%	3
answered question		90
skipped question		0

9. Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:

	Response Percent	Response Count
0	35.6%	32
1	17.8%	16
2	8.9%	8
3	5.6%	5
4	2.2%	2
5	7.8%	7
6	1.1%	1
7	2.2%	2
8	0.0%	0
9	1.1%	1
10	3.3%	3
11	0.0%	0
12	1.1%	1
13	0.0%	0
14	0.0%	0
15	3.3%	3
16	0.0%	0

17	0.0%	0
18	0.0%	0
19	0.0%	0
20	1.1%	1
21	0.0%	0
22	0.0%	0
23	0.0%	0
24	1.1%	1
25	0.0%	0
26	0.0%	0
27	0.0%	0
28	0.0%	0
29	0.0%	0
30	1.1%	1
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	0.0%	0
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	1.1%	1
41	0.0%	0

42	0.0%	0
43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0
48	0.0%	0
49	0.0%	0
50	5.6%	5
	answered question	90
	skipped question	0

10. Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:

	Response Percent	Response Count
0	33.3%	30
1	15.6%	14
2	8.9%	8
3	7.8%	7
4	1.1%	1
5	6.7%	6
6	3.3%	3
7	4.4%	4
8	1.1%	1
9	0.0%	0
10	1.1%	1
11	0.0%	0
12	1.1%	1
13	1.1%	1
14	0.0%	0
15	2.2%	2
16	0.0%	0
17	0.0%	0
18	0.0%	0
19	0.0%	0
20	3.3%	3
21	0.0%	0

22	0.0%	0
23	0.0%	0
24	1.1%	1
25	0.0%	0
26	0.0%	0
27	0.0%	0
28	0.0%	0
29	0.0%	0
30	1.1%	1
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	0.0%	0
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	1.1%	1
41	0.0%	0
42	0.0%	0
43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0

48	0.0%	0
49	0.0%	0
50	5.6%	5
	answered question	90
	skipped question	0

11. Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:

	Response Percent	Response Count
0	40.0%	36
1	17.8%	16
2	7.8%	7
3	8.9%	8
4	4.4%	4
5	3.3%	3
6	1.1%	1
7	1.1%	1
8	1.1%	1
9	0.0%	0
10	2.2%	2
11	0.0%	0
12	2.2%	2
13	0.0%	0
14	0.0%	0
15	2.2%	2
16	0.0%	0

17	0.0%	0
18	0.0%	0
19	0.0%	0
20	2.2%	2
21	0.0%	0
22	0.0%	0
23	0.0%	0
24	1.1%	1
25	0.0%	0
26	0.0%	0
27	0.0%	0
28	1.1%	1
29	0.0%	0
30	0.0%	0
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	0.0%	0
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	2.2%	2
41	0.0%	0

42		0.0%	0
43		0.0%	0
44		0.0%	0
45		0.0%	0
46		0.0%	0
47		0.0%	0
48		0.0%	0
49		0.0%	0
50		1.1%	1
		answered question	[illegible]
		skipped question	[illegible]

12. Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:

	Response Percent	Response Count
0	44.4%	40
1	17.8%	16
2	6.7%	6
3	2.2%	2
4	2.2%	2
5	6.7%	6
6	2.2%	2
7	0.0%	0
8	0.0%	0
9	2.2%	2
10	4.4%	4
11	0.0%	0
12	1.1%	1
13	0.0%	0
14	0.0%	0
15	1.1%	1
16	1.1%	1
17	0.0%	0
18	0.0%	0
19	0.0%	0
20	1.1%	1
21	0.0%	0

22		0.0%	0
23		0.0%	0
24		0.0%	0
25		0.0%	0
26		0.0%	0
27		0.0%	0
28		1.1%	1
29		0.0%	0
30		0.0%	0
31		0.0%	0
32		1.1%	1
33		1.1%	1
34		0.0%	0
35		0.0%	0
36		0.0%	0
37		0.0%	0
38		0.0%	0
39		0.0%	0
40		1.1%	1
41		0.0%	0
42		0.0%	0
43		0.0%	0
44		1.1%	1
45		0.0%	0
46		0.0%	0
47		0.0%	0

40		0.0%	0
40		0.0%	0
50		1.1%	1
		answered question	90
		skipped question	0

13. We were able to implement project risk plans:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively	4.4% (4)	2.2% (2)	7.8% (7)	33.3% (30)	18.9% (17)	16.7% (15)	16.7% (15)
							answered q
							skipped q

14. We were able to implement project risk plans

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently	4.4% (4)	5.6% (5)	11.1% (10)	34.4% (31)	23.3% (21)	16.7% (15)	4.4% (4)
							answered
							skipped

15. We were able to identify project risks:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively	3.3% (3)	2.2% (2)	4.4% (4)	21.1% (19)	26.7% (24)	22.2% (20)	20.0% (18)

answered q

skipped q

16. We were able to identify project risks:

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently	4.4% (4)	2.2% (2)	2.2% (2)	32.2% (29)	25.6% (23)	20.0% (18)	13.3% (12)

answered q

skipped q

17. We were able to analyze project risks:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively	4.4% (4)	2.2% (2)	7.8% (7)	25.6% (23)	21.1% (19)	25.6% (23)	13.3% (12)

answered q

skipped q

18. We were able to analyze project risks:

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently	5.6% (5)	3.3% (3)	8.9% (8)	24.4% (22)	22.2% (20)	23.3% (21)	12.2% (11)
							answered (
							skipped (

19. We were able to handle project risks:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively	3.3% (3)	0.0% (0)	6.7% (6)	24.4% (22)	24.4% (22)	25.6% (23)	15.6% (14)
							answered q
							skipped q

20. We were able to handle project risks:

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently	3.3% (3)	1.1% (1)	10.0% (9)	26.7% (24)	28.9% (26)	21.1% (19)	8.9% (8)
							answered
							skipped

21. We were able to document project risks:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively	4.4% (4)	3.3% (3)	8.9% (8)	15.6% (14)	18.9% (17)	20.0% (18)	28.9% (26)
							answered q
							skipped q

22. We were able to document project risks:

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently	4.4% (4)	3.3% (3)	3.3% (3)	22.2% (20)	24.4% (22)	18.9% (17)	23.3% (21)
							answered q
							skipped q

23. We were able to monitor project risks:

	1-with no accuracy/not effectively	2	3	4-with some accuracy	5	6	7-accurately/effectively
accurately/effectively	3.3% (3)	3.3% (3)	10.0% (9)	24.4% (22)	27.8% (25)	14.4% (13)	16.7% (15)
							answered
							skipped

24. We were able to monitor project risks:

	1-with many struggles/not efficiently	2	3	4-with few struggles	5	6	7-with no struggles/efficiently
no struggles/efficiently	3.3% (3)	5.6% (5)	8.9% (8)	24.4% (22)	23.3% (21)	20.0% (18)	14.4% (13)
							answered q
							skipped q

25. As the project progressed, our risk planning capabilities improved.

	Response Percent	Response Count
strongly disagree	2.2%	2
disagree	4.4%	4
neutral	15.6%	14
agree	65.6%	59
strongly agree	12.2%	11
answered question		90
skipped question		6

26. As the project progressed, our ability to identify risks improved.

	Response Percent	Response Count
strongly disagree	1.1%	1
disagree	3.3%	3
neutral	12.2%	11
agree	62.2%	56
strongly agree	21.1%	19
answered question		90
skipped question		0

27. As the project progressed, our ability to analyze risks improved.

	Response Percent	Response Count
strongly disagree	1.1%	1
disagree	5.6%	5
neutral	12.2%	11
agree	70.0%	63
strongly agree	11.1%	10
answered question		90
skipped question		0

28. As the project progressed, our risk handling improved.

	Response Percent	Response Count
strongly disagree	2.2%	2
disagree	4.4%	4
neutral	16.7%	15
agree	62.2%	56
strongly agree	14.4%	13
answered question		90
skipped question		0

29. As the project progressed, our risk documentation methods improved.

	Response Percent	Response Count
strongly disagree	3.3%	3
disagree	10.0%	9
neutral	30.0%	27
agree	43.3%	39
strongly agree	13.3%	12
answered question		90
skipped question		0

30. As the project progressed, our ability to monitor risks improved.

	Response Percent	Response Count
strongly disagree	3.3%	3
disagree	4.4%	4
neutral	22.2%	20
agree	60.0%	54
strongly agree	10.0%	9
	answered question	90
	skipped question	6

31. The approximate number of team members that my project had is

	Response Average	Response Total	Response Count
Number	30.17	2,715	90
		answered question	90
		skipped question	6

32. The approximate number of months in which my last project was executed

	Response Average	Response Total	Response Count
Months	17.51	1,576	90
		answered question	90
		skipped question	6

33. My company size is approximately:

	Response Percent	Response Count
Small (99 or fewer employees)	16.7%	15
Medium (100 to 499 employees)	20.0%	18
Large (over 500 employees)	63.3%	57
answered question		90
skipped question		0

34. My highest level of education is most closely:

	Response Percent	Response Count
High School	0.0%	0
Associates Degree	3.3%	3
Bachelor's Degree	28.9%	26
Master's Degree	58.9%	53
Doctoral Degree	8.9%	8
answered question		90
skipped question		0

35. I estimate the total cost of my project to be:

	Response Percent	Response Count
Less than $50,000	7.8%	7
$50,001 to $100,000	8.9%	8
$100,001 to $1,000,000	32.2%	29
$1,000,001 to $25,000,000	34.4%	31
Greater than $25,000,000	16.7%	15
	answered question	90
	skipped question	0

36. My years of experience with project management with my company is:

	Response Percent	Response Count
0	1.1%	1
1	13.3%	12
2	12.2%	11
3	11.1%	10
4	3.3%	3
5	11.1%	10
6	6.7%	6
7	5.6%	5
8	7.8%	7
9	1.1%	1
10	7.8%	7
11	1.1%	1
12	4.4%	4
13	1.1%	1
14	1.1%	1
15	1.1%	1
16	2.2%	2
17	0.0%	0
18	1.1%	1
19	0.0%	0
20	2.2%	2
21	0.0%	0
22	0.0%	0

23	0.0%	0
24	0.0%	0
25	2.2%	2
26	0.0%	0
27	0.0%	0
28	1.1%	1
29	0.0%	0
30	0.0%	0
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	0.0%	0
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	1.1%	1
41	0.0%	0
42	0.0%	0
43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0

48	0.0%	0
49	0.0%	0
50	0.0%	0
	answered question	90
	skipped question	0

37. My total years of experience with project management is:

	Response Percent	Response Count
0	0.0%	0
1	1.1%	1
2	2.2%	2
3	8.9%	8
4	3.3%	3
5	2.2%	2
6	0.0%	0
7	5.6%	5
8	8.9%	8
9	1.1%	1
10	8.9%	8
11	1.1%	1
12	7.8%	7
13	0.0%	0
14	1.1%	1
15	12.2%	11
16	1.1%	1
17	0.0%	0

18	1.1%	1
19	0.0%	0
20	15.6%	14
21	1.1%	1
22	0.0%	0
23	0.0%	0
24	0.0%	0
25	8.9%	8
26	1.1%	1
27	1.1%	1
28	0.0%	0
29	0.0%	0
30	3.3%	3
31	0.0%	0
32	1.1%	1
33	0.0%	0
34	0.0%	0
35	0.0%	0
36	0.0%	0
37	0.0%	0
38	1.1%	1
39	0.0%	0
40	0.0%	0
41	0.0%	0
42	0.0%	0

43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0
48	0.0%	0
49	0.0%	0
50	0.0%	0
	answered question	38
	skipped question	0

38. My total years of experience with knowledge management is:

	Response Percent	Response Count
0	3.3%	3
1	5.6%	5
2	8.9%	8
3	6.7%	6
4	4.4%	4
5	17.8%	16
6	3.3%	3
7	3.3%	3
8	6.7%	6
9	0.0%	0
10	15.6%	14
11	0.0%	0
12	6.7%	6
13	0.0%	0
14	0.0%	0
15	5.6%	5
16	1.1%	1
17	0.0%	0
18	1.1%	1
19	0.0%	0
20	5.6%	5
21	1.1%	1
22	0.0%	0

23	0.0%	0
24	0.0%	0
25	2.2%	2
26	0.0%	0
27	1.1%	1
28	0.0%	0
29	0.0%	0
30	0.0%	0
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	0.0%	0
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	0.0%	0
41	0.0%	0
42	0.0%	0
43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0

48	0.0%	0
49	0.0%	0
50	0.0%	0
	answered question	90
	skipped question	0

39. My total years of experience with risk management is:

	Response Percent	Response Count
0	1.1%	1
1	4.4%	4
2	7.8%	7
3	8.9%	8
4	6.7%	6
5	10.0%	9
6	3.3%	3
7	6.7%	6
8	4.4%	4
9	0.0%	0
10	12.2%	11
11	0.0%	0
12	6.7%	6
13	1.1%	1
14	1.1%	1
15	8.9%	8
16	0.0%	0

17	1.1%	1
18	0.0%	0
19	0.0%	0
20	5.6%	5
21	0.0%	0
22	0.0%	0
23	0.0%	0
24	2.2%	2
25	2.2%	2
26	1.1%	1
27	0.0%	0
28	0.0%	0
29	1.1%	1
30	3.3%	3
31	0.0%	0
32	0.0%	0
33	0.0%	0
34	0.0%	0
35	0.0%	0
36	0.0%	0
37	0.0%	0
38	0.0%	0
39	0.0%	0
40	0.0%	0
41	0.0%	0
42	0.0%	0

43	0.0%	0
44	0.0%	0
45	0.0%	0
46	0.0%	0
47	0.0%	0
48	0.0%	0
49	0.0%	0
50	0.0%	0
	answered question	35
	skipped question	6

APPENDIX F

Analysis Data - Normality Plots

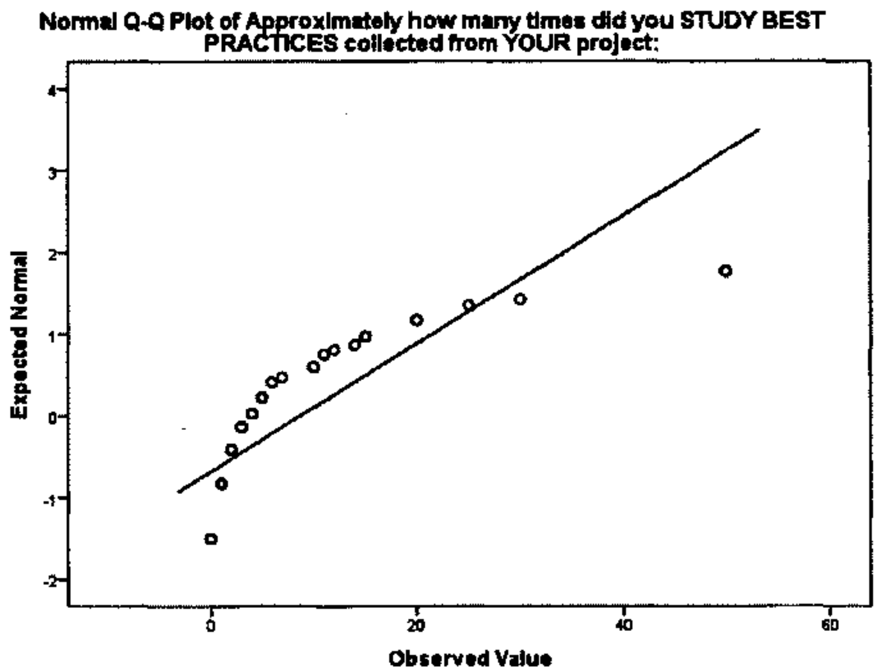

Figure A1. Question 1 - Normal Q-Q- Plot of approximately how many times did you STUDY BEST PRACTICES collected from YOUR project.

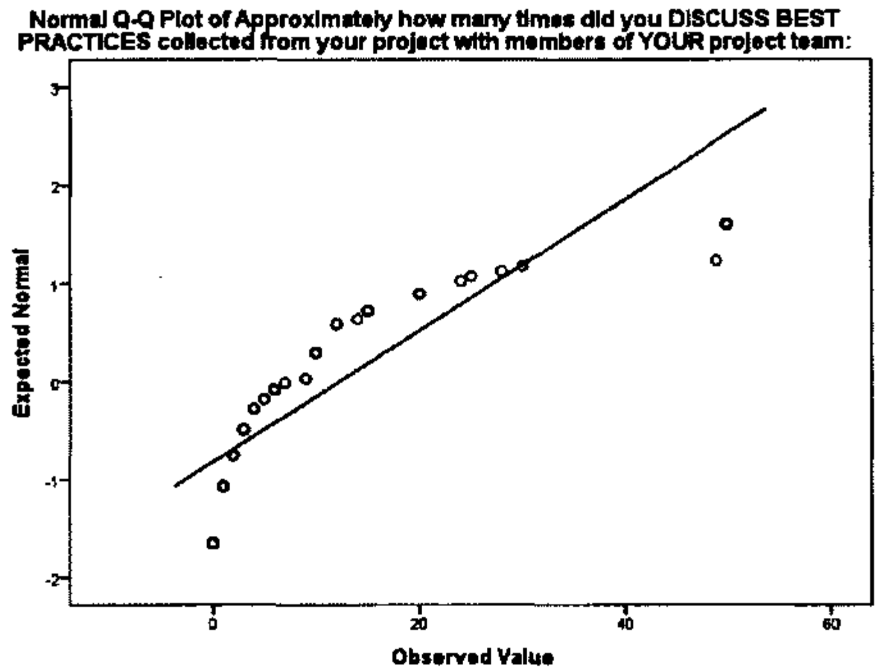

Figure A2. Question 2 – Normal Q-Q plot of approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team.

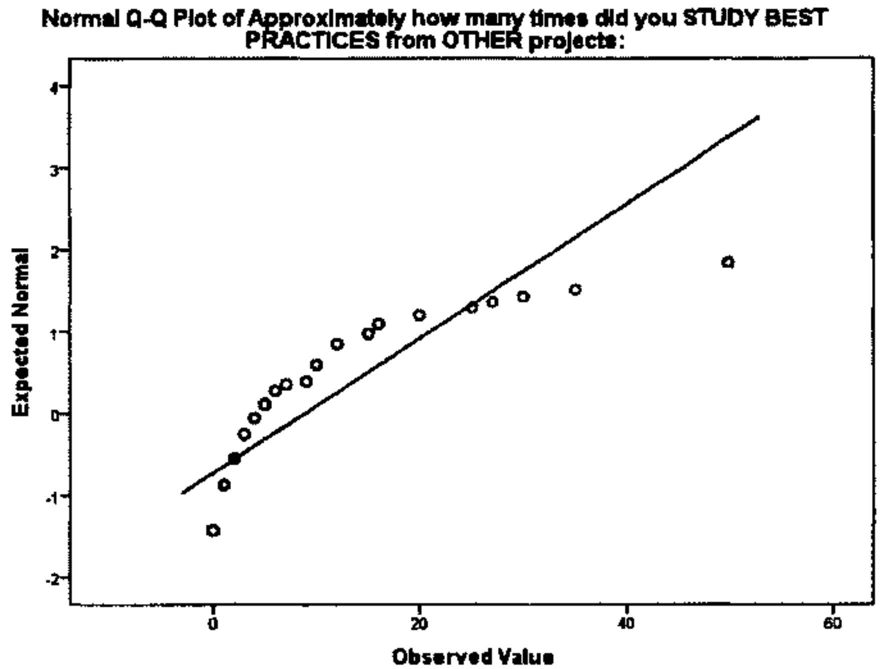

Figure A3. Question 3 – Normal Q-Q plot of approximately how many times did you STUDY BEST PRACTICES from OTHER projects.

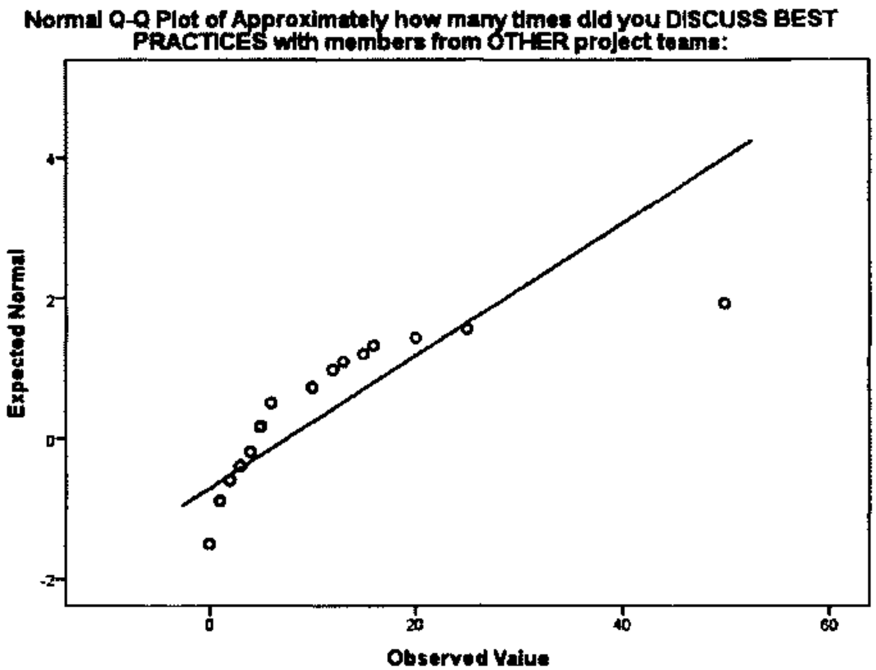

Figure A4. Question 4 – Normal Q-Q plot of approximately how many times did you DISCUSS BEST PRACTICES with member from OTHER project teams.

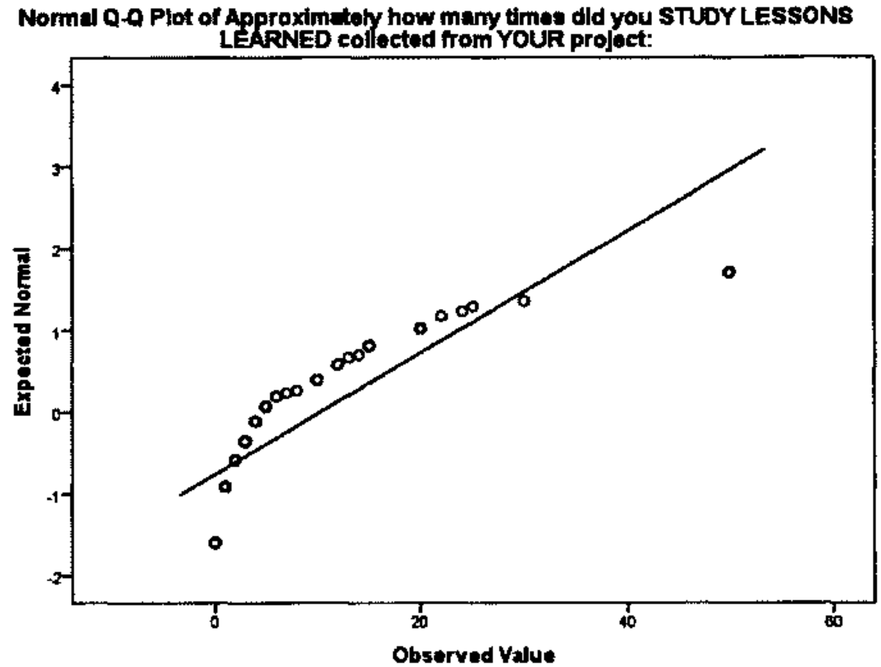

Figure A5. Question 5 – Normal Q-Q plot of approximately how many times did you STUDY LESSONS LEARNED collected from your project.

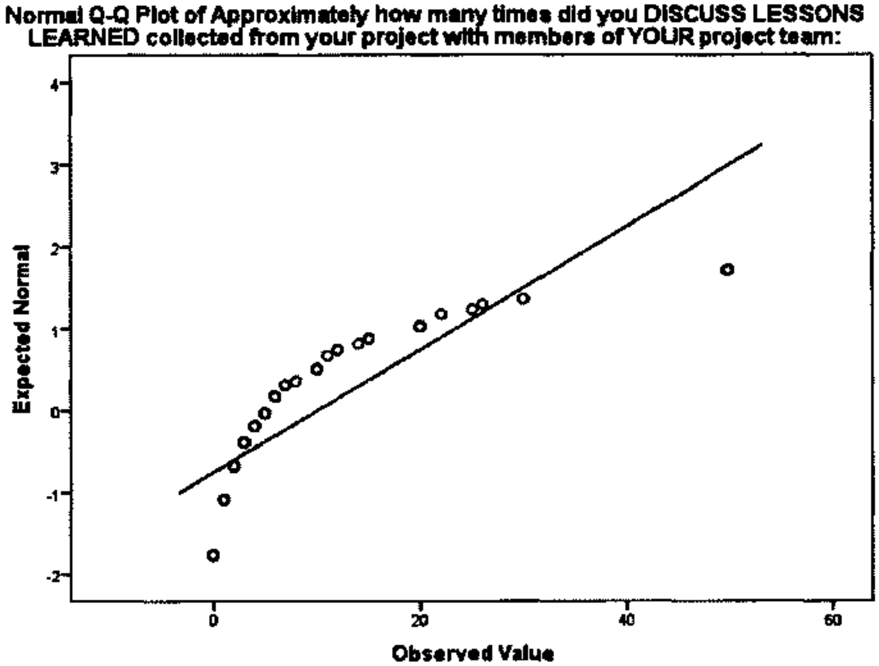

Figure A6. Question 6 – Normal Q-Q plot of approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team.

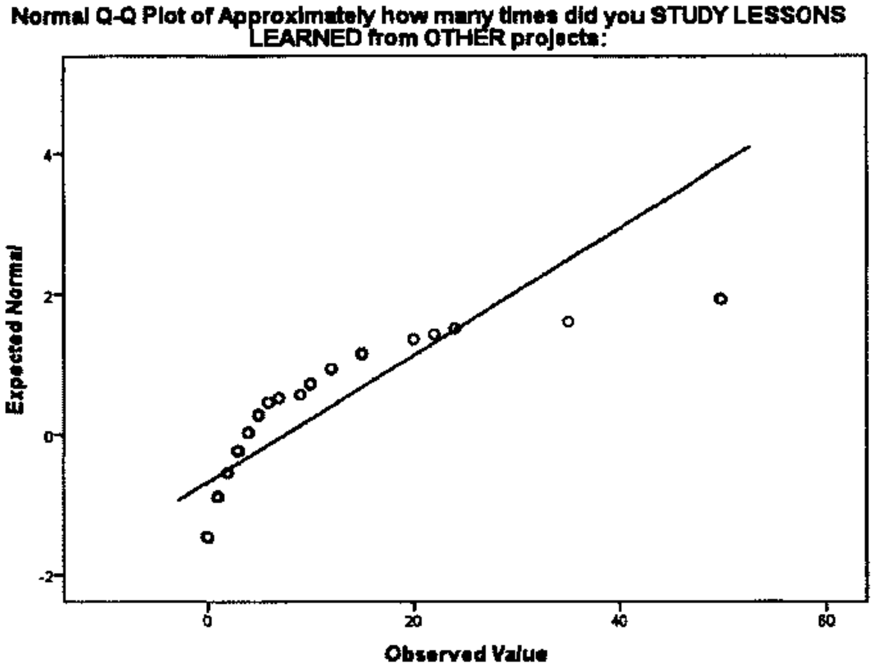

Figure A7. Question 7 – Normal Q-Q plot of approximately how many times did you STUDY LESSONS LEARNED from OTHER projects.

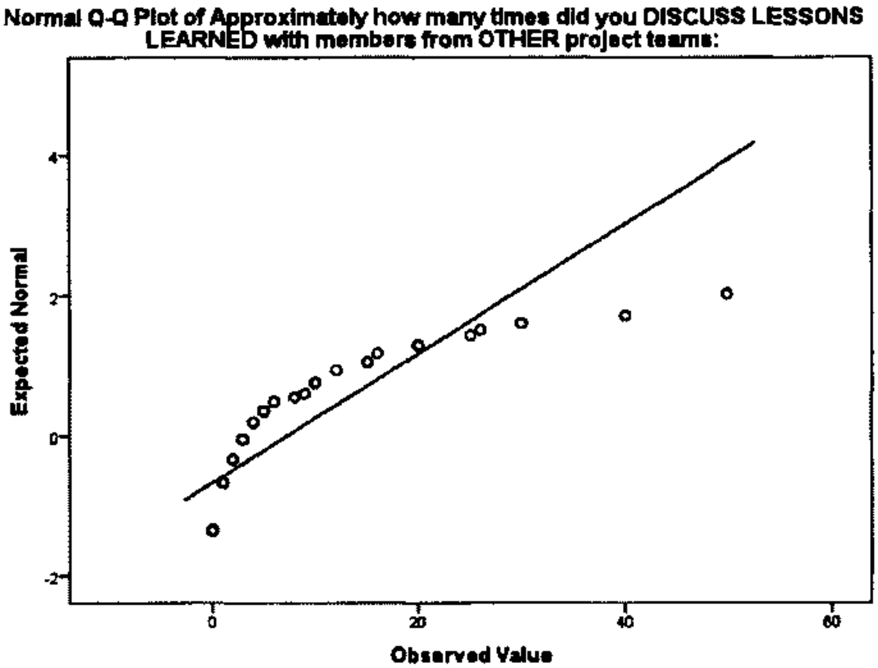

Figure A8. Question 8 – Normal Q-Q plot of approximately how many times did you DISCUSS LESSONS LEARNED with member from OTHER project teams.

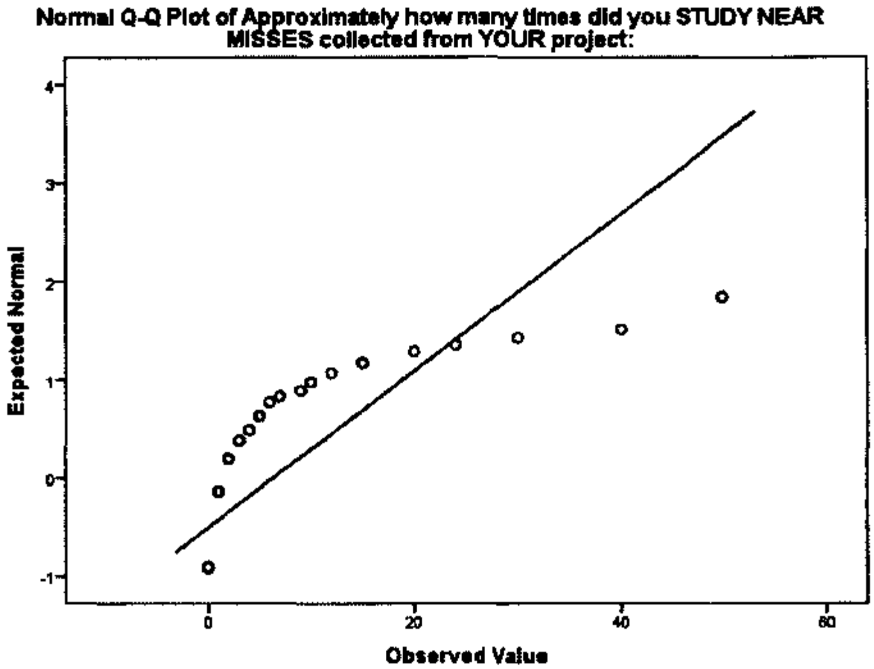

Figure A9. Question 9 – Normal Q-Q plot of approximately how many times did you STUDY NEAR MISSED collected from YOUR project.

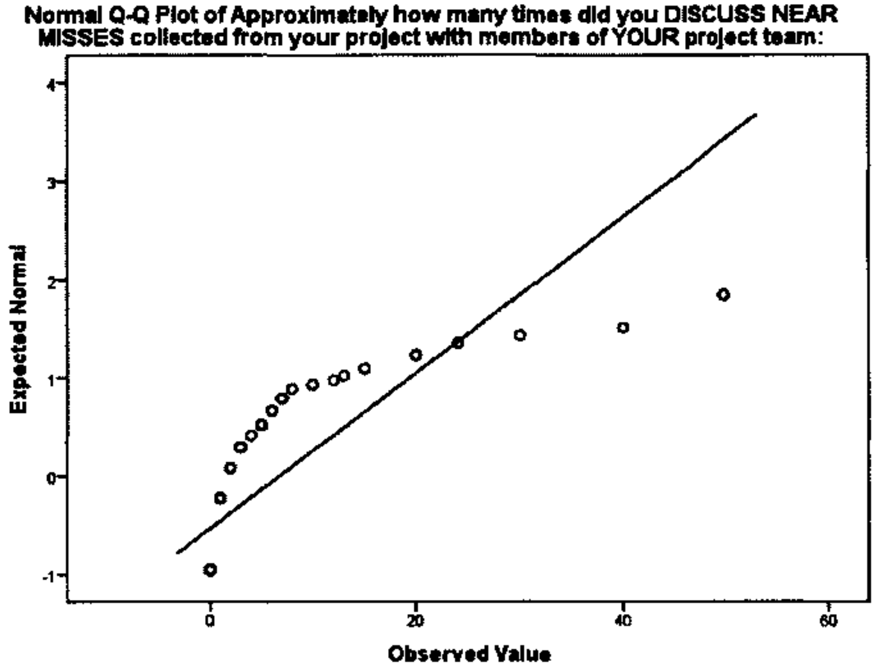

Figure A10. Question 10 – Normal Q-Q plot of approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team.

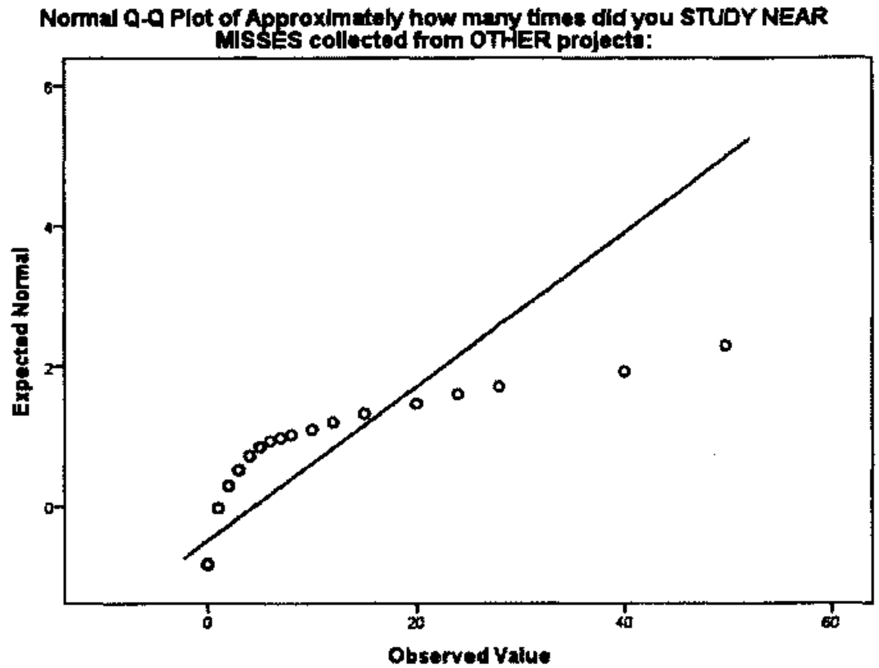

Figure A11. Question 11 – Normal Q-Q plot of approximately how many times did you STUDY NEAR MISSES collected from OTHER projects.

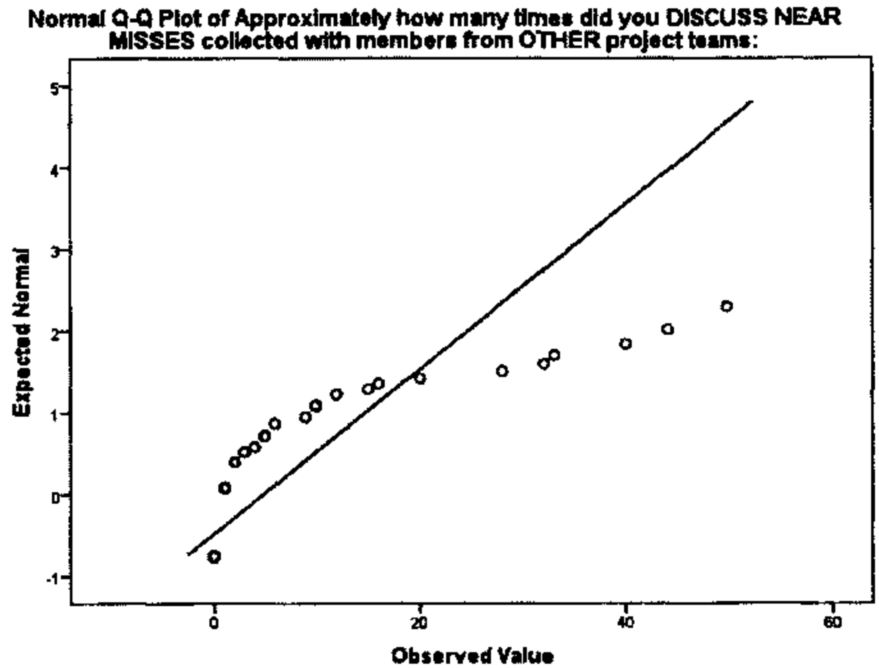

Figure A12. Question 12 – Normal Q-Q plot of approximately how many times did you DISCUSS NEAR MISSES collected with member from OTHER project teams.

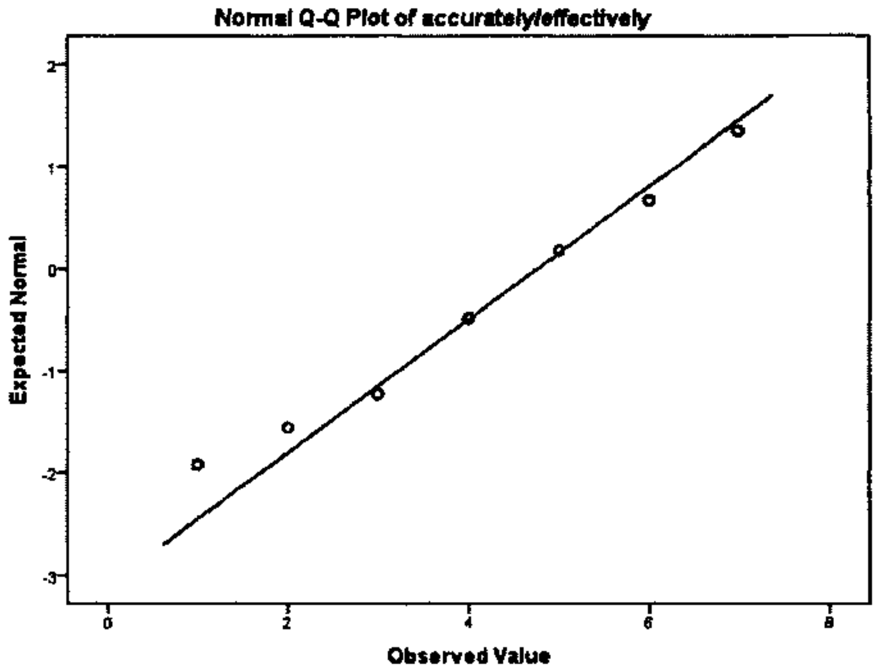

Figure A13. Question 13 – Normal Q-Q plot of we were able to implement project risk plans accurately/effectively.

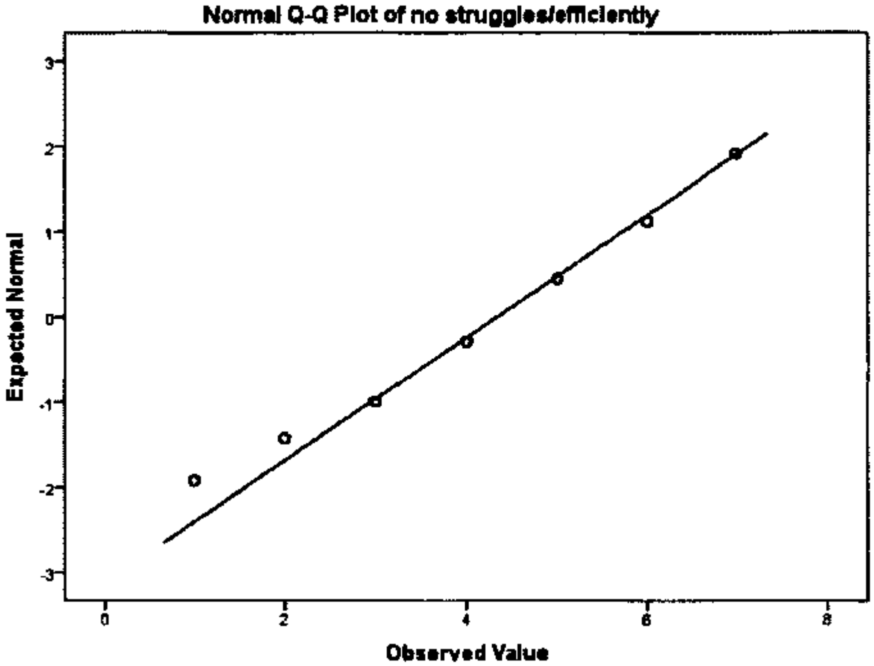

Figure A14. Question 14 – Normal Q-Q plot of we were able to implement project risk plans with no struggles/efficiently.

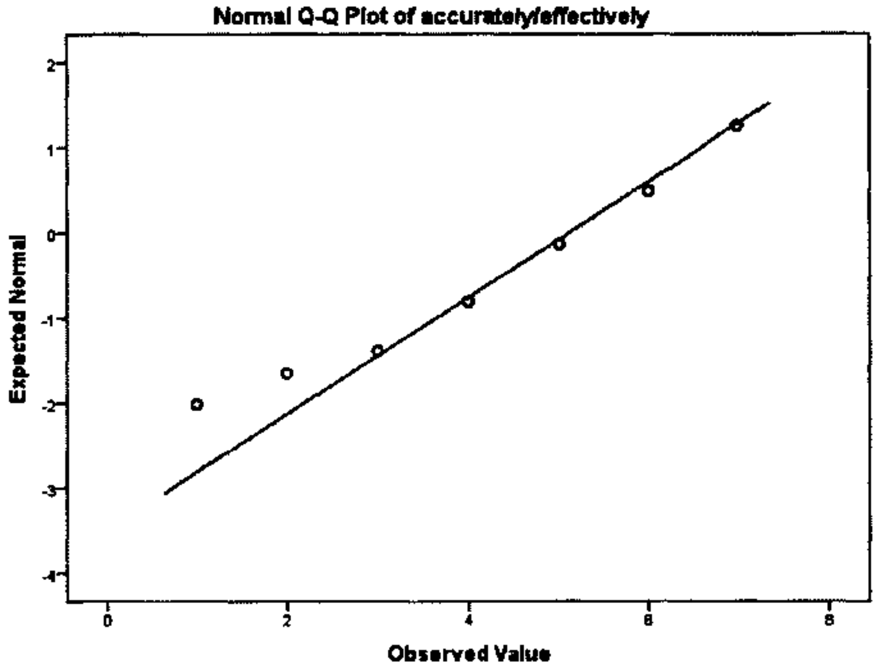

Figure A15. Question 15 – Normal Q-Q plot of we were able to identify project risks accurately/effectively.

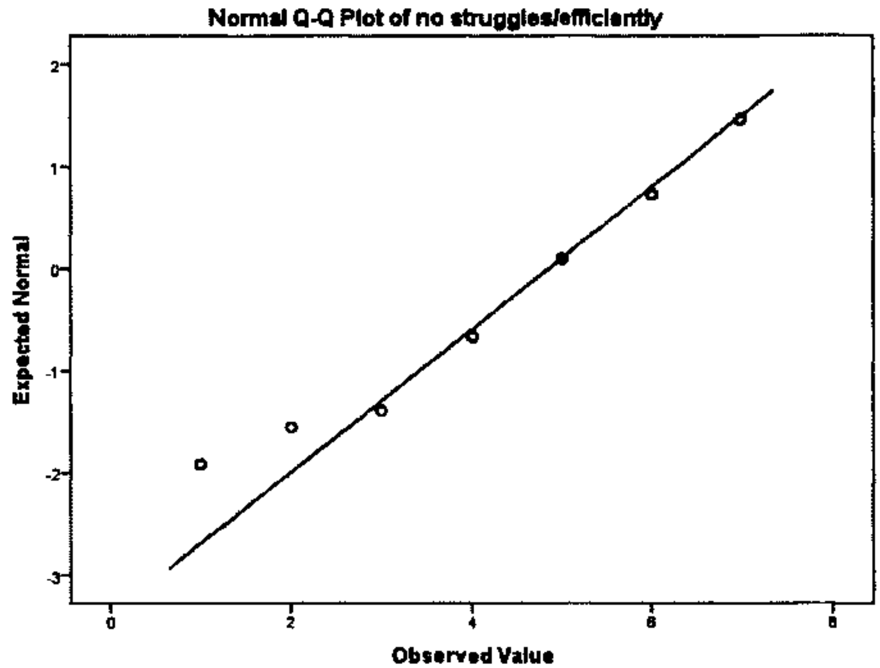

Figure A16. Question 16 – Normal Q-Q plot of we were able to identify project risks with no struggles/efficiently.

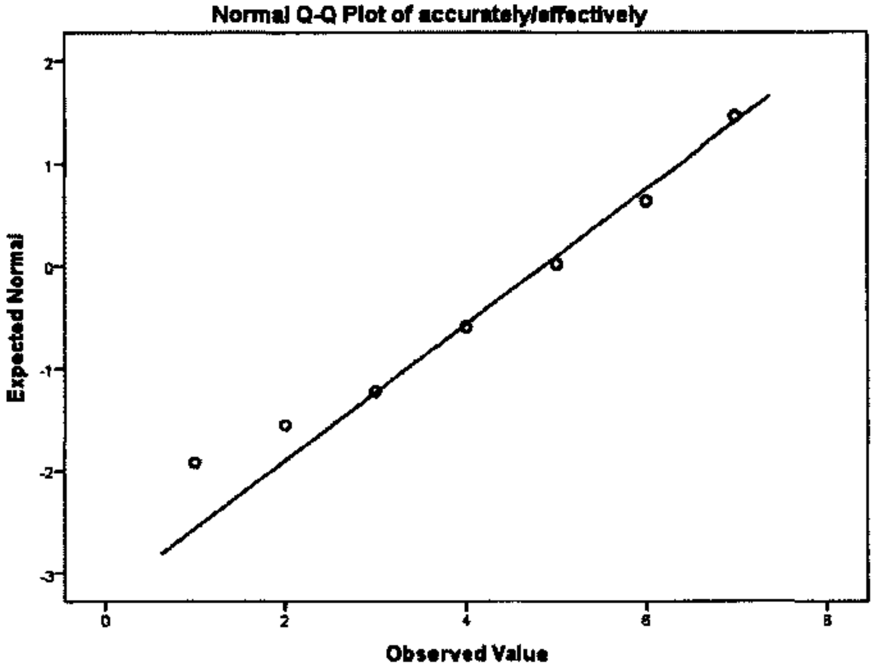

Figure A17. Question 17 – Normal Q-Q plot of we were able to analyze project risks accurately/effectively.

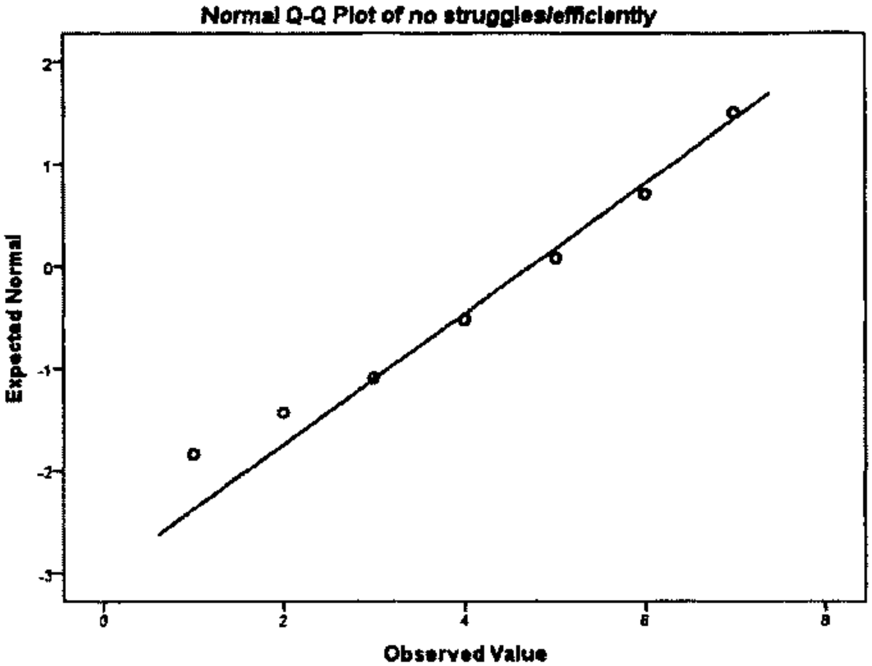

Figure A18. Question 18 – Normal Q-Q plot of we were able to analyze project risks with no struggles/efficiently.

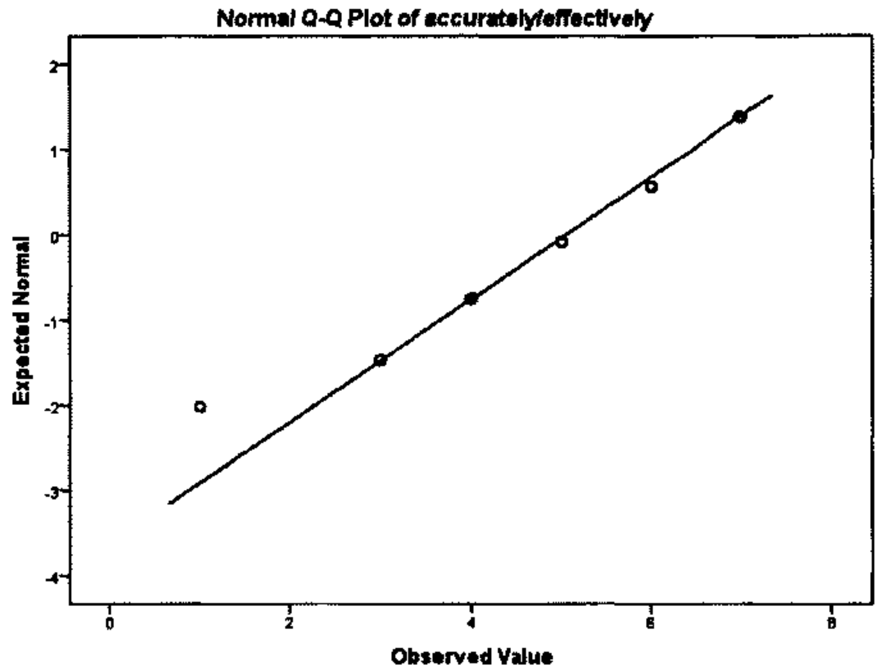

Figure A19. Question 19 – Normal Q-Q plot of we were able to handle project risks accurately/effectively.

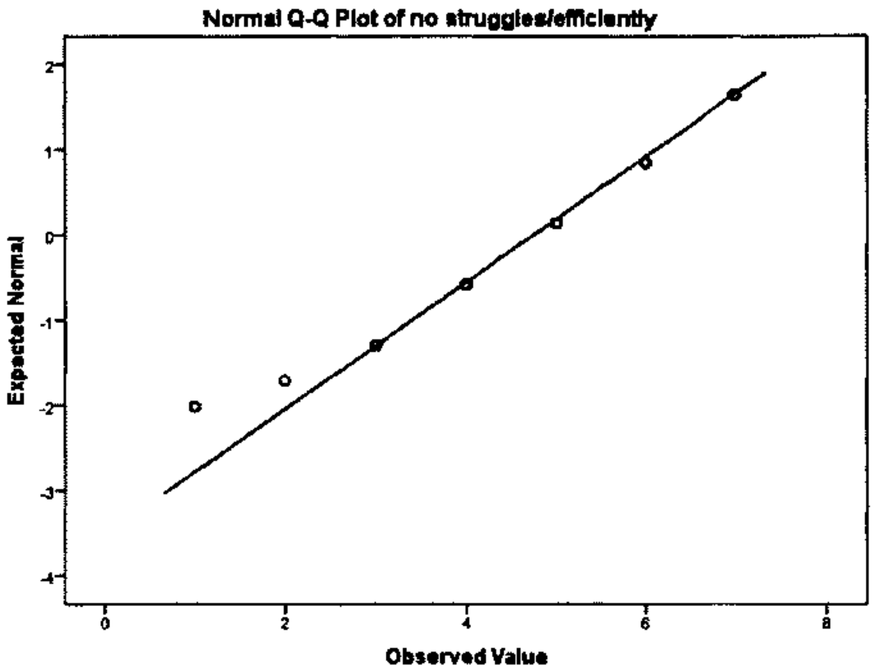

Figure A20. Question 20 – Normal Q-Q plot of we were able to handle project risks with no struggles/efficiently.

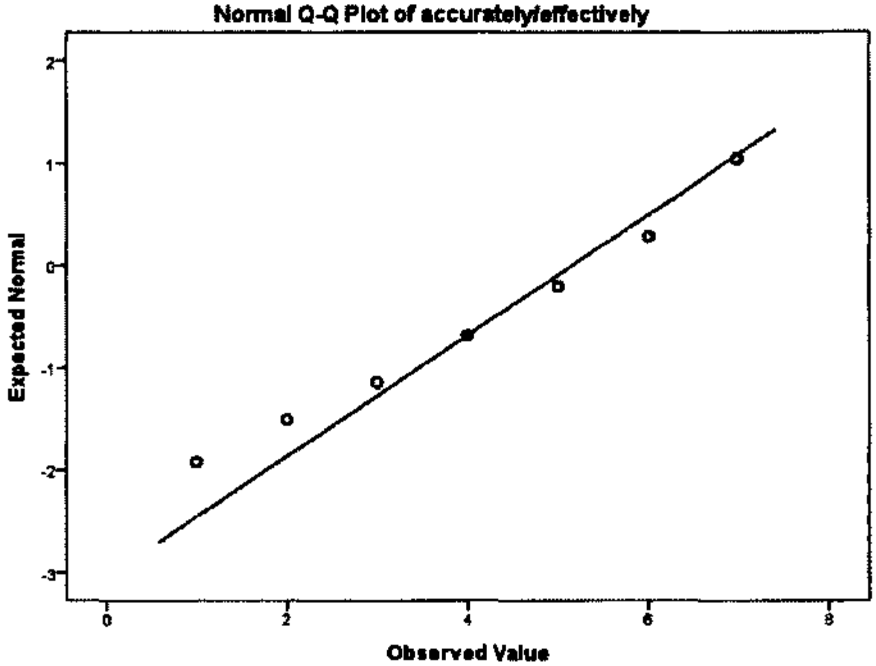

Figure A21. Question 21 – Normal Q-Q plot of we were able to document project risks accurately/effectively.

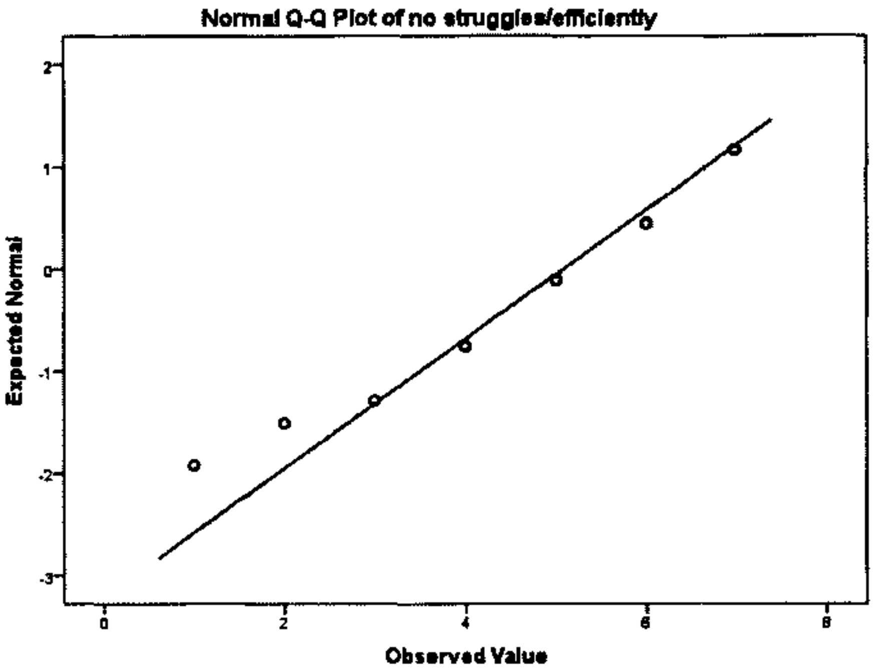

Figure A22. Question 22 – Normal Q-Q plot of we were able to document project risks with no struggles/efficiently.

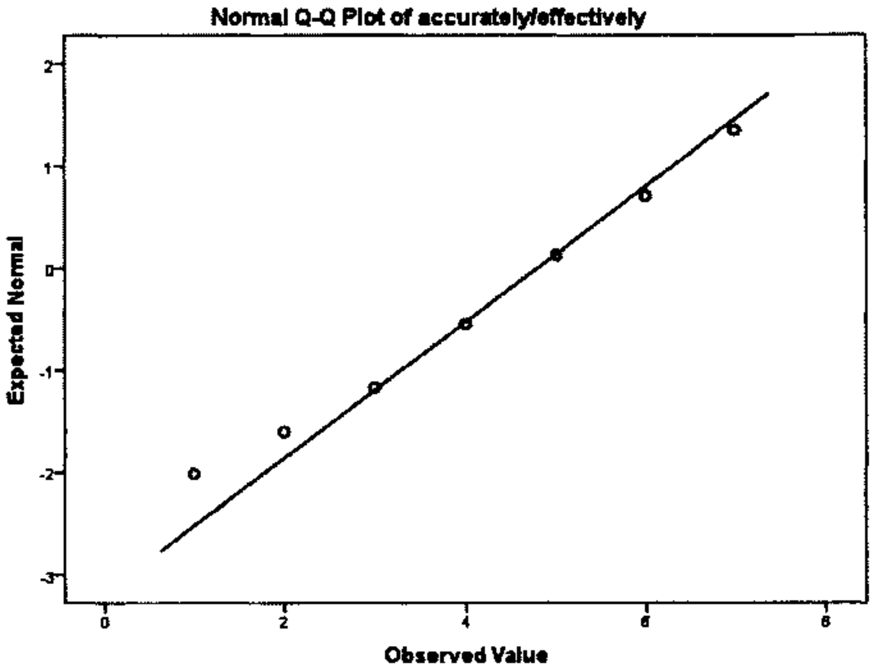

Figure A23. Question 23 – Normal Q-Q plot of we were able to monitor project risks accurately/effectively.

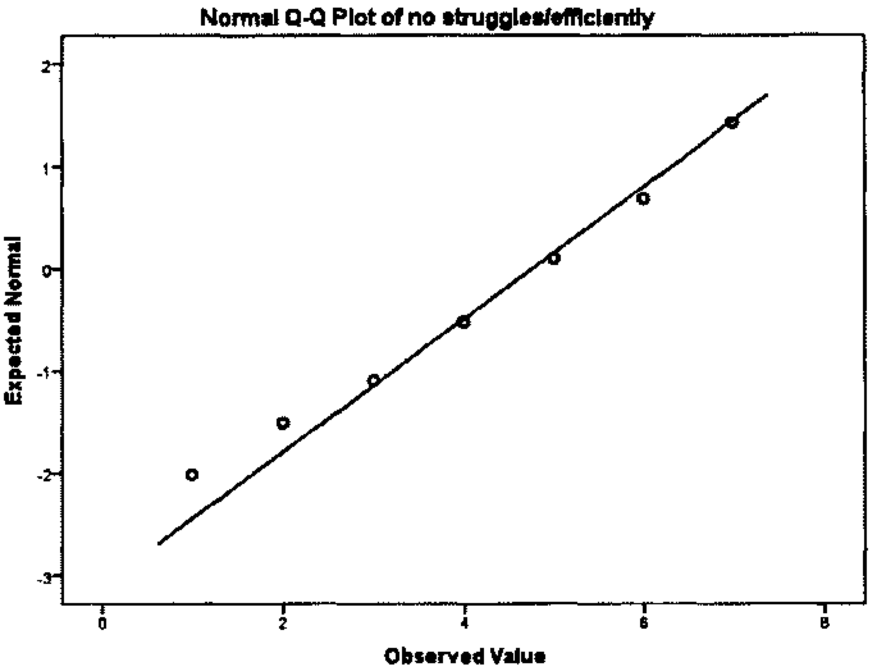

Figure A24. Question 24 – Normal Q-Q plot of we were able to monitor project risks with no struggles/efficiently.

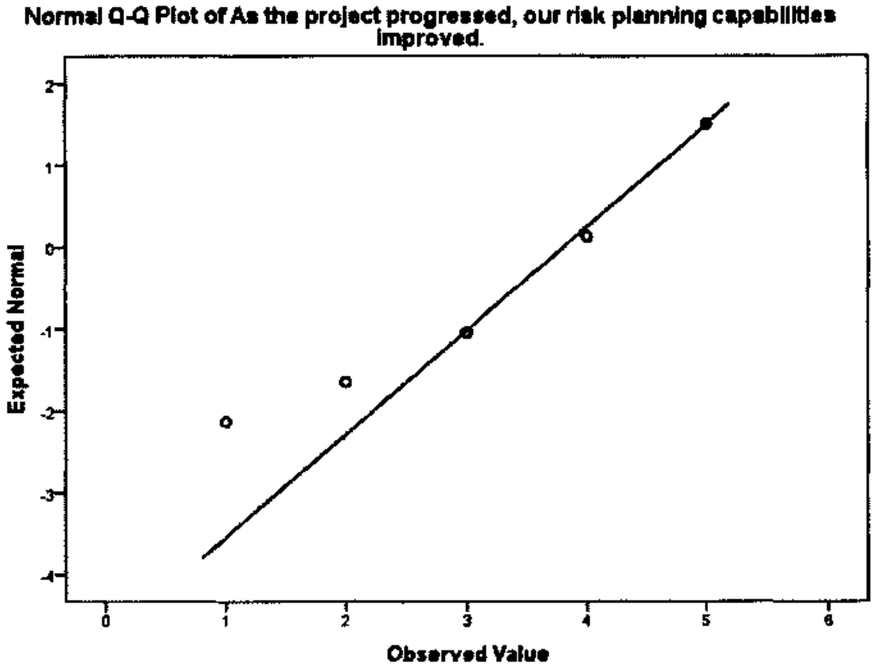

Figure A25. Question 25 – Normal Q-Q plot of as the project progressed, our risk planning capabilities improved.

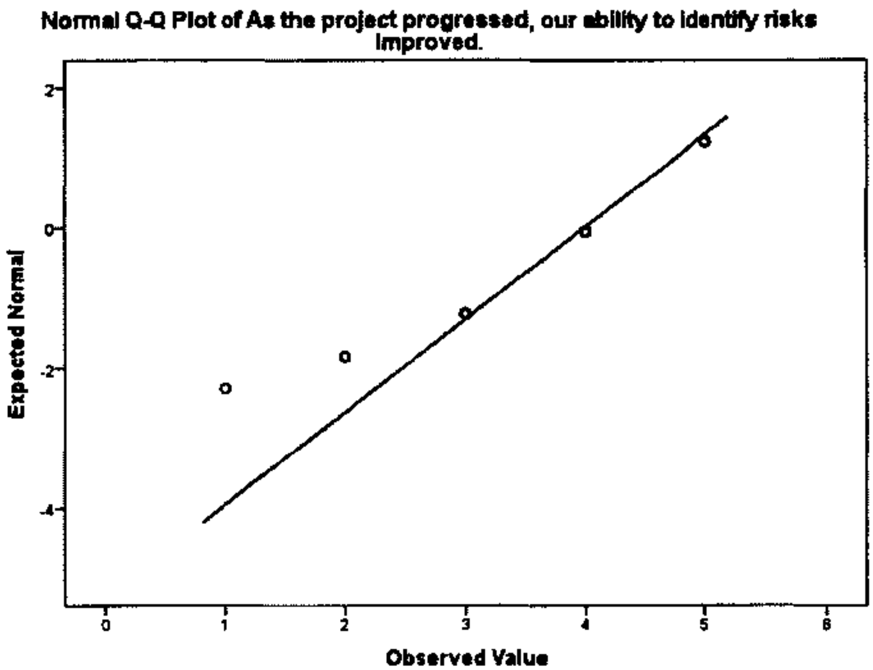

Figure A26. Question 26 – Normal Q-Q plot of as the project progressed, our ability to identify risks improved.

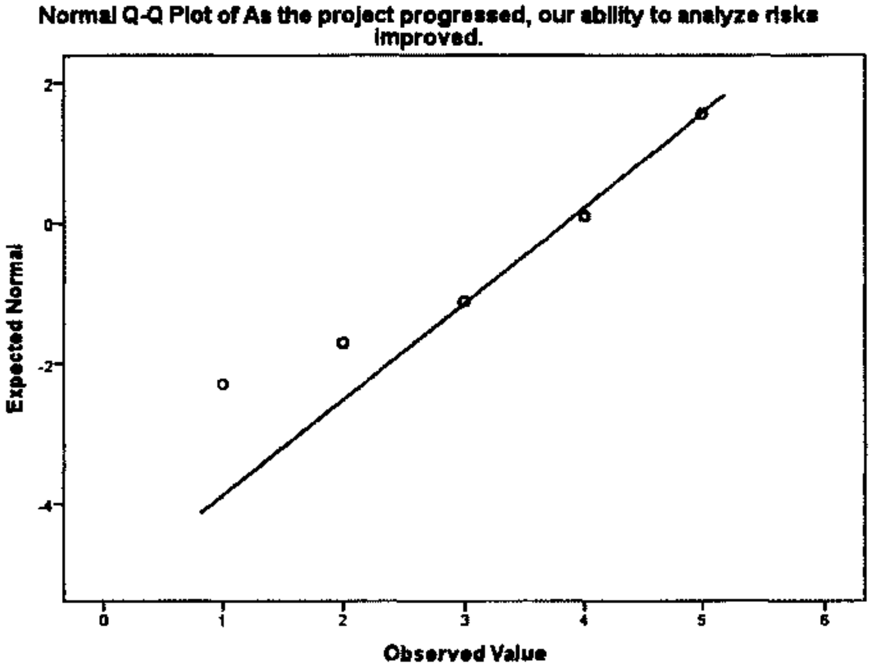

Figure A27. Question 27 – Normal Q-Q plot of as the project progressed, our ability to analyze risks improved.

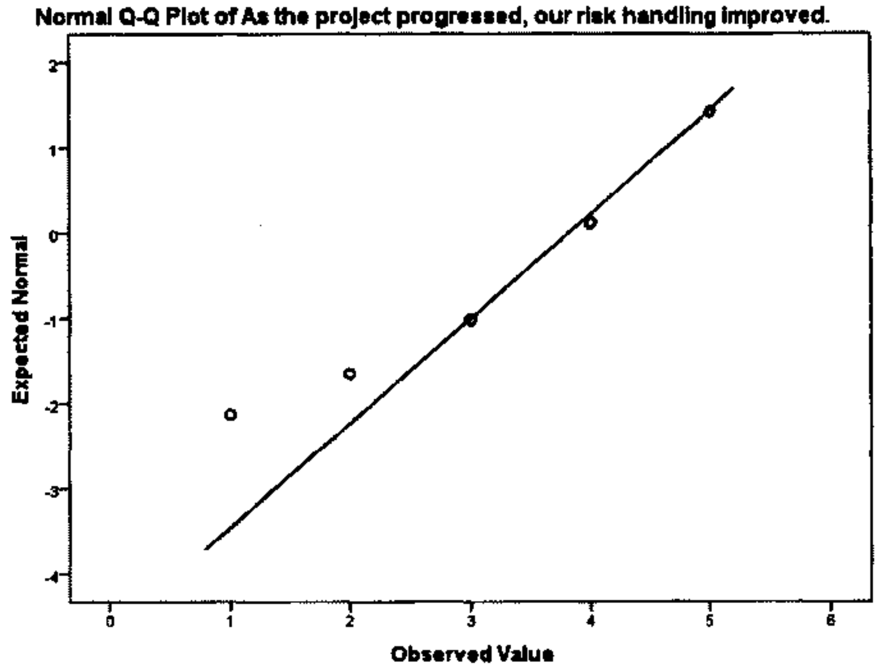

Figure A28. Question 28 – Normal Q-Q plot of as the project progressed, our risk handling improved.

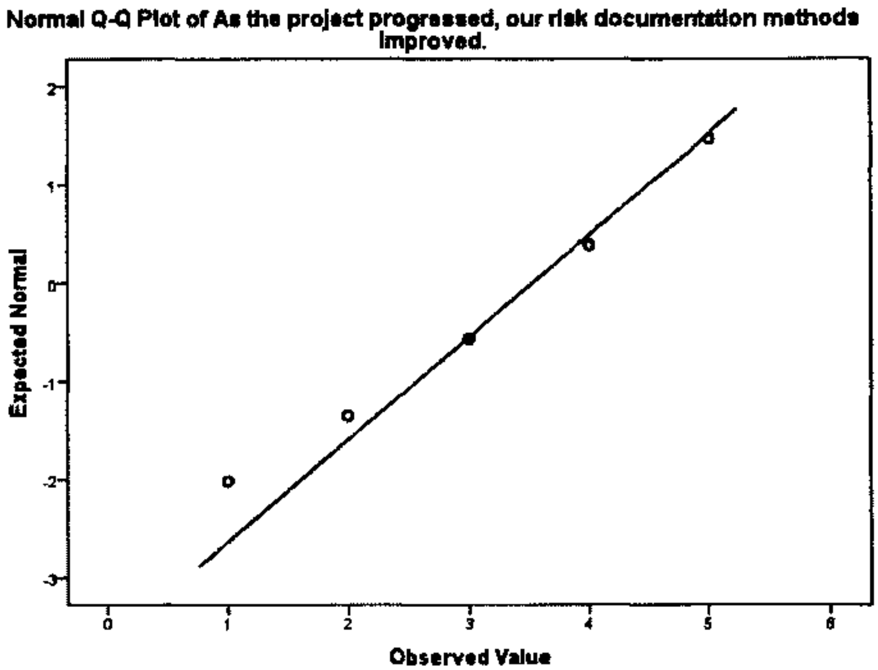

Figure A29. Question 29 – Normal Q-Q plot of as the project progressed, our risk documentation methods improved.

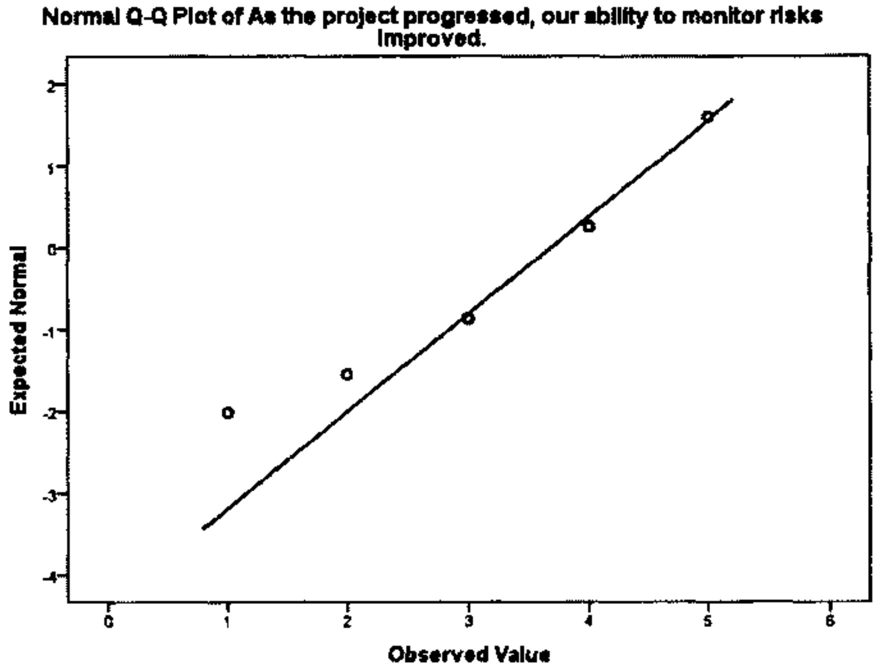

Figure A30. Question 30 – Normal Q-Q plot of as the project progressed, our ability to monitor risks improved.

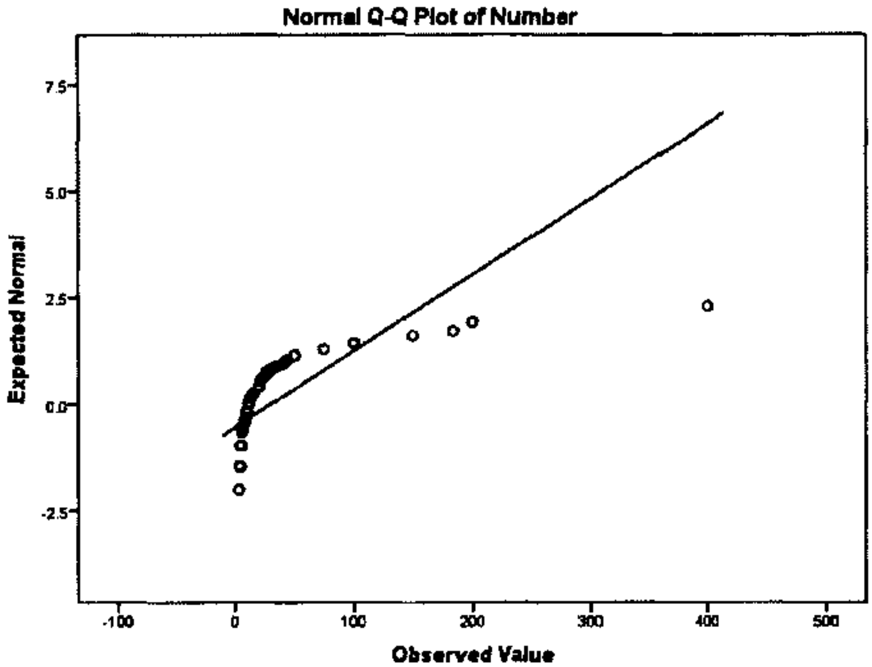

Figure A31. Question 31 – Normal Q-Q plot of the approximate number of team members my project had is.

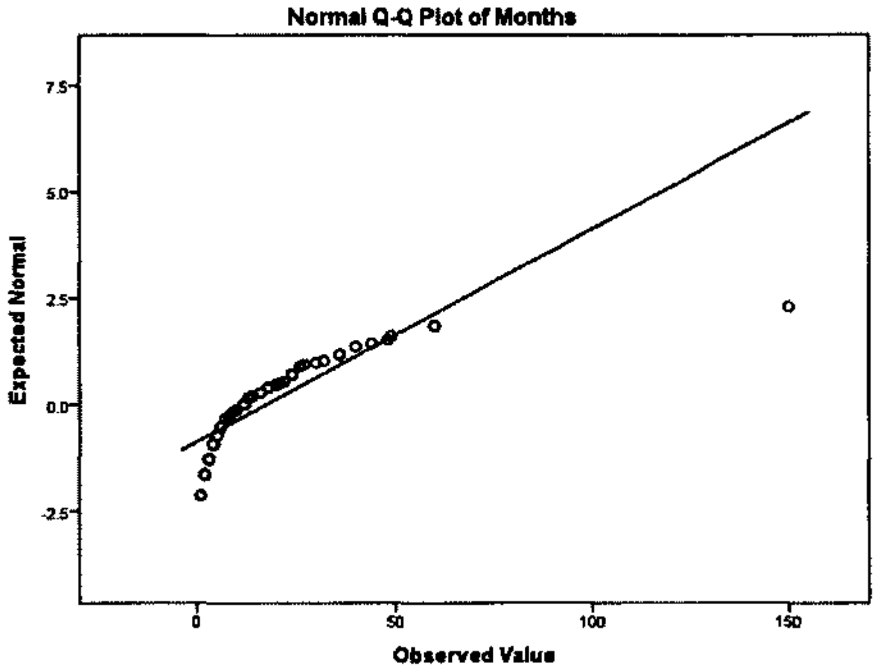

Figure A32. Question 32 – Normal Q-Q plot of the approximate number of months in which my last project was executed.

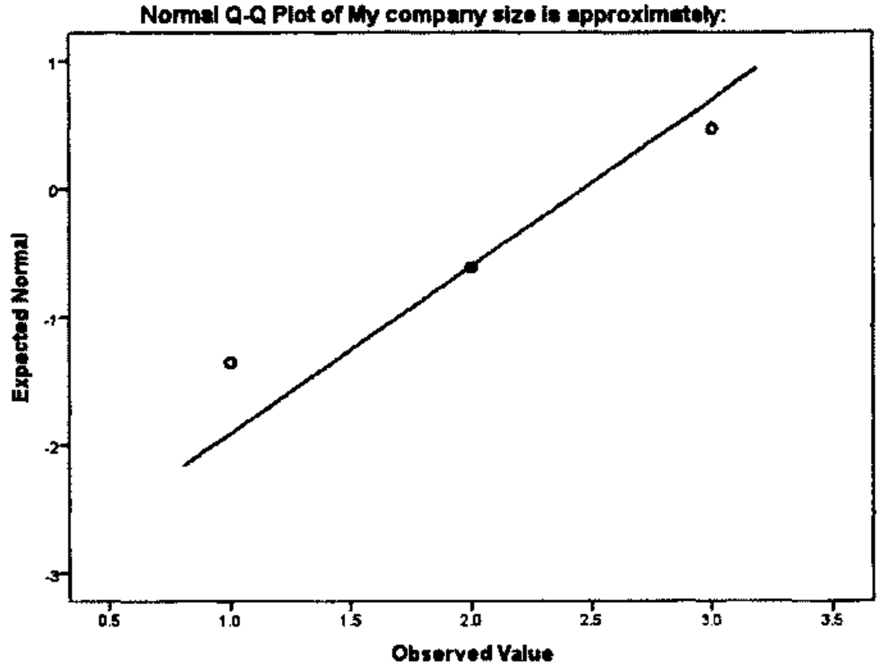

Figure A33. Question 33 – Normal Q-Q plot of my company size is approximately.

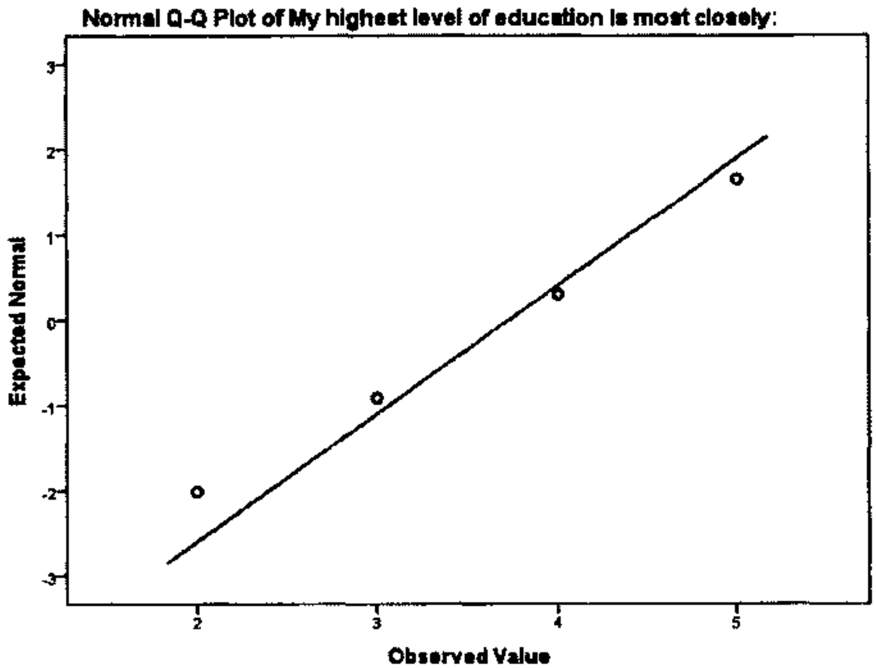

Figure A34. Question 34 – Normal Q-Q plot of my highest level of education is most closely.

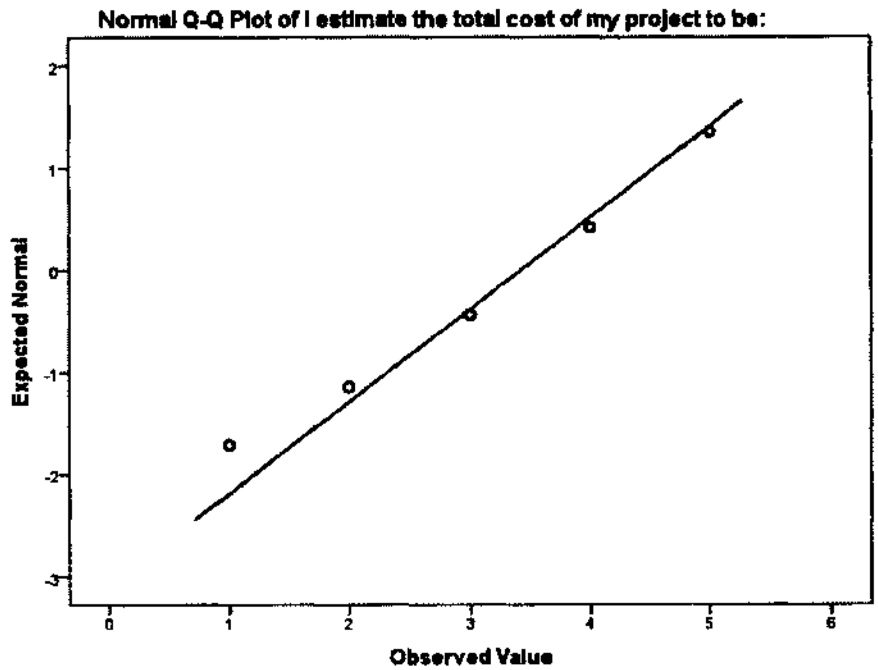

Figure A35. Question 35 – Normal Q-Q plot of I estimate the total cost of my project to be.

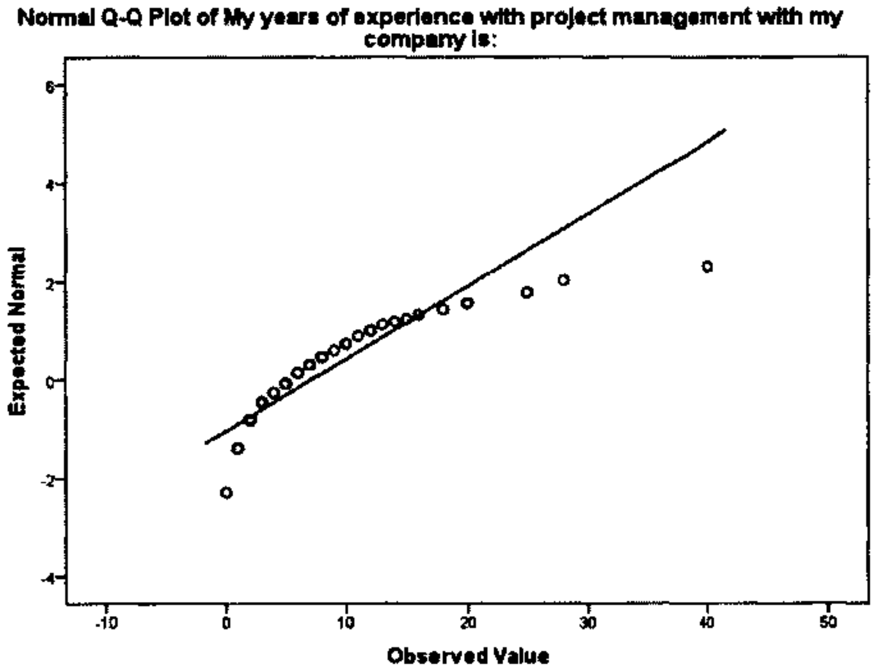

Figure A36. Question 36 – Normal Q-Q plot of my years of experience with project management with my company is.

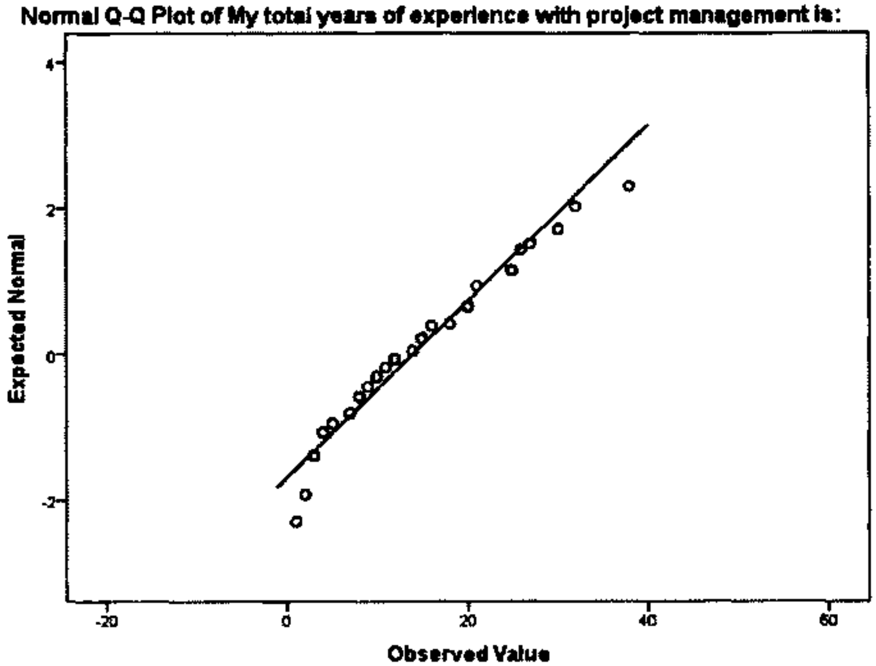

Figure A37. Question 37 – Normal Q-Q plot of my total years of experience with project management is.

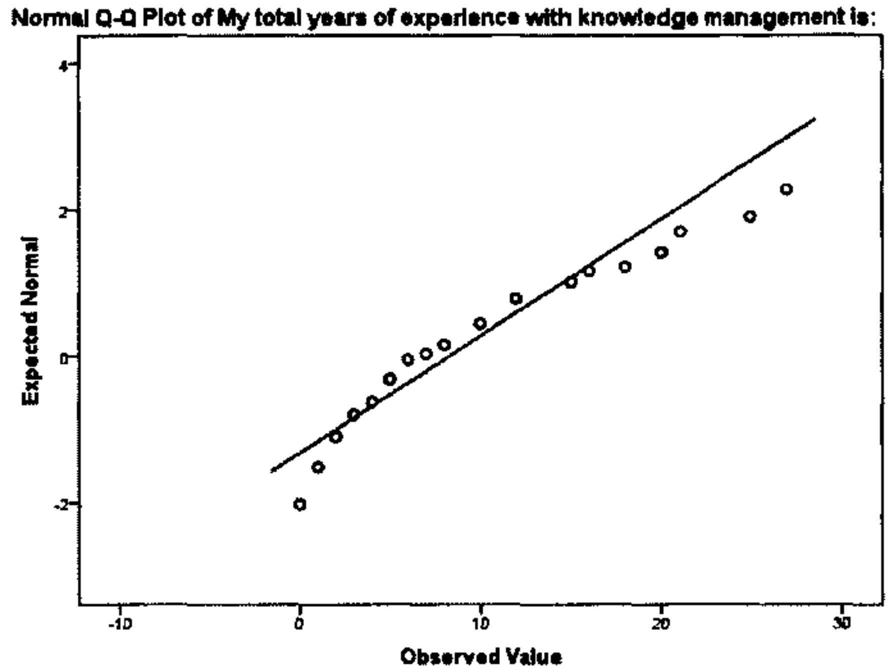

Figure A38. Question 38 – Normal Q-Q plot of my total years of experience with knowledge management is.

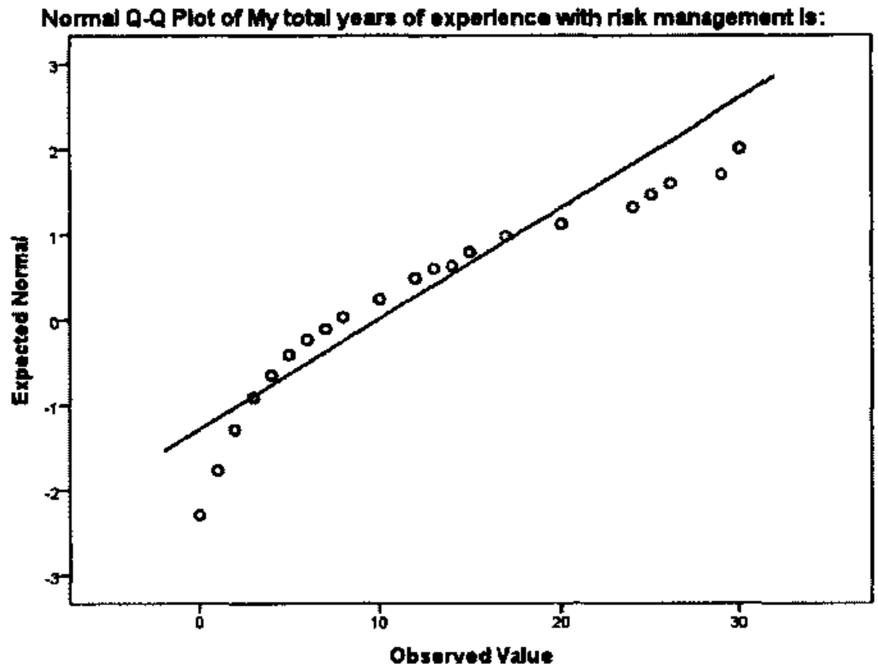

Figure A39. Question 39 – Normal Q-Q plot of my total years of experience with risk management is.

APPENDIX G

Analysis Data - Hypothesis Testing

Table A1

Knowledge Transfer and Risk Management Capabilities

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	KM[b]		Enter

a. Dependent Variable: RM

b. All requested variables entered.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.266	1	5.266	5.534	.021[b]
	Residual	83.734	88	.952		
	Total	89.000	89			

a. Dependent Variable: RM

b. Predictors: (Constant), KM

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.460E-016	.103		.000	1.000
	KM	.243	.103	.243	2.352	.021

a. Dependent Variable: RM

Table A1 (continued).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.243[a]	.059	.048	.97546294

a. Predictors: (Constant), KM

Correlations

		RM	KM
Pearson Correlation	RM	1.000	.243
	KM	.243	1.000
Sig. (1-tailed)	RM	.	.010
	KM	.010	.
N	RM	90	90
	KM	90	90

Table A2

Inter Knowledge Transfer Compare to Intra Knowledge Transfer and Risk Management Capabilities

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Intra Knowledge Transfer, Inter Knowledge Transfer[b]		Enter

a. Dependent Variable: RM

b. All requested variables entered.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.280	2	2.640	2.744	.070[b]
	Residual	83.720	87	.962		
	Total	89.000	89			

a. Dependent Variable: RM

b. Predictors: (Constant), Intra Knowledge Transfer, Inter Knowledge Transfer

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.495E-016	.103		.000	1.000
	Inter Knowledge Transfer	.188	.231	.188	.813	.419
	Intra Knowledge Transfer	.061	.231	.061	.264	.793

a. Dependent Variable: RM

Table A2 (continued).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.244[a]	.059	.038	.98096598

a. Predictors: (Constant), Intra Knowledge Transfer, Inter Knowledge Transfer

Correlations

		RM	Inter Knowledge Transfer	Intra Knowledge Transfer
	RM	1.000	.242	.228
Pearson Correlation	Inter Knowledge Transfer	.242	1.000	.893
	Intra Knowledge Transfer	.228	.893	1.000
	RM	.	.011	.015
Sig. (1-tailed)	Inter Knowledge Transfer	.011	.	.000
	Intra Knowledge Transfer	.015	.000	.
	RM	90	90	90
N	Inter Knowledge Transfer	90	90	90
	Intra Knowledge Transfer	90	90	90

Table A3

Knowledge Transfer and Risk Management Capabilities Factor 1 Static

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	KM[b]	.	Enter

a. Dependent Variable: factor 1 for risk

b. All requested variables entered.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.597	1	3.597	3.707	.057[b]
	Residual	85.403	88	.970		
	Total	89.000	89			

a. Dependent Variable: factor 1 for risk

b. Predictors: (Constant), KM

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.284E-016	.104		.000	1.000
	KM	.201	.104	.201	1.925	.057

a. Dependent Variable: factor 1 for risk

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.201[a]	.040	.030	.98513167

a. Predictors: (Constant), KM

Table A3 (continued).

Correlations

		factor 1 for risk	KM
Pearson Correlation	factor 1 for risk	1.000	.201
	KM	.201	1.000
Sig. (1-tailed)	factor 1 for risk	.	.029
	KM	.029	.
N	factor 1 for risk	90	90
	KM	90	90

Table A4

Knowledge Transfer and Risk Management Capabilities Factor 2-Dynamic

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	KM[b]	.	Enter

a. Dependent Variable: factor 2 for risk

b. All requested variables entered.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.677	1	1.677	1.690	.197[b]
	Residual	87.323	88	.992		
	Total	89.000	89			

a. Dependent Variable: factor 2 for risk

b. Predictors: (Constant), KM

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.287E-016	.105		.000	1.000
	KM	.137	.106	.137	1.300	.197

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.137[a]	.019	.008	.99614637

a. Predictors: (Constant), KM

Table A4 (continued).

Correlations

		factor 2 for risk	KM
Pearson Correlation	factor 2 for risk	1.000	.137
	KM	.137	1.000
Sig. (1-tailed)	factor 2 for risk	.	.099
	KM	.099	.
N	factor 2 for risk	90	90
	KM	90	90

APPENDIX H

Analysis Data - Factor Analysis

Table A5

Knowledge Transfer

Knowledge Transfer Communalities

Knowledge Transfer Communalities	Initial	Extraction
Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	1.000	.759
Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	1.000	.630
Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	1.000	.797
Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:	1.000	.732
Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	1.000	.695
Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	1.000	.732
Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	1.000	.823
Knowledge Transfer Communalities (Continued)	Initial	Extraction
Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:	1.000	.762
Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	1.000	.667
Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	1.000	.589
Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	1.000	.662
Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:	1.000	.705

Extraction Method: Principal Component Analysis.

Table A5 (continued).

Knowledge Transfer Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.551	71.259	71.259	8.551	71.259	71.259
2	1.162	9.686	80.945			
3	.652	5.433	86.378			
4	.500	4.169	90.548			
5	.350	2.918	93.466			
6	.200	1.663	95.129			
7	.170	1.420	96.550			
8	.157	1.310	97.859			
9	.098	.820	98.679			
10	.077	.641	99.321			
11	.048	.397	99.717			
12	.034	.283	100.000			

Extraction Method: Principal Component Analysis.

Table A5 (continued).

Knowledge Transfer Component Matrix

Knowledge Transfer Component Matrix	Component
	1
Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	.871
Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	.794
Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	.893
Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:	.856
Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	.834
Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	.855
Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	.907
Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:	.873
Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	.816
Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	.767
Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	.814
Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:	.839

Extraction Method: Principal Component Analysis.

Table A5 (continued).

Knowledge Transfer KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.860
Bartlett's Test of Sphericity	Approx. Chi-Square	1381.693
	df	66
	Sig.	.000

Knowledge Transfer Case Processing Summary

		N	%
Cases	Valid	90	100.0
	Excluded[a]	0	.0
	Total	90	100.0

a. Listwise deletion based on all variables in the procedure.

Knowledge Transfer Reliability Statistics

Cronbach's Alpha	N of Items
.961	12

Table A6

Intra Knowledge Transfer

Intra Knowledge Transfer Communalities

Intra Knowledge Transfer Communalities	Initial	Extraction
Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	1.000	.712
Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	1.000	.737
Intra Knowledge Transfer Communalities (Continued)	Initial	Extraction
Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	1.000	.788
Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	1.000	.817
Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	1.000	.661
Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	1.000	.605

Extraction Method: Principal Component Analysis.

Table A6 (continued).

Intra Knowledge Transfer Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.321	72.015	72.015	4.321	72.015	72.015
2	.868	14.467	86.482			
3	.365	6.083	92.565			
4	.274	4.565	97.130			
5	.124	2.061	99.191			
6	.049	.809	100.000			

Extraction Method: Principal Component Analysis.

Intra Knowledge Transfer Component Matrix

Intra Knowledge Transfer Component Matrix	Component
	1
Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	.844
Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	.858
Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	.888
Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	.904
Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	.813
Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	.778

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table A6 (continued).

Intra Knowledge Transfer KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.797
Bartlett's Test of Sphericity	Approx. Chi-Square	525.318
	df	15
	Sig.	.000

Intra Knowledge Transfer Case Processing Summary

		N	%
Cases	Valid	90	100.0
	Excluded[a]	0	.0
	Total	90	100.0

a. Listwise deletion based on all variables in the procedure.

Intra Knowledge Transfer Reliability Statistics

Cronbach's Alpha	N of Items
.921	6

Table A7

Inter Knowledge Transfer

Inter Knowledge Transfer Communalities

Inter Knowledge Transfer Communalities	Initial	Extraction
Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	1.000	.785
Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:	1.000	.786
Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	1.000	.825
Inter Knowledge Transfer Communalities (Continued)	Initial	Extraction
Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:	1.000	.829
Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	1.000	.706
Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:	1.000	.773

Extraction Method: Principal Component Analysis.

Inter Knowledge Transfer Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.705	78.410	78.410	4.705	78.410	78.410
2	.641	10.682	89.092			
3	.271	4.512	93.604			
4	.203	3.380	96.984			
5	.102	1.708	98.693			
6	.078	1.307	100.000			

Extraction Method: Principal Component Analysis.

Table A7 (continued).

Inter Knowledge Transfer Component Matrix

Inter Knowledge Transfer Component Matrix	Component
	1
Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	.886
Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:	.887
Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	.908
Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:	.911
Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	.840
Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:	.879

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table A7 (continued).

Inter Knowledge Transfer KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.823
Bartlett's Test of Sphericity	Approx. Chi-Square	570.577
	df	15
	Sig.	.000

Inter Knowledge Transfer Case Processing Summary

		N	%
Cases	Valid	90	100.0
	Excluded[a]	0	.0
	Total	90	100.0

a. Listwise deletion based on all variables in the procedure.

Inter Knowledge Transfer Reliability Statistics

Cronbach's Alpha	N of Items
.944	6

Table A8

Risk Management Capabilities 1 Component

Risk Management Capabilities 1 Communalities

Risk Management Capabilities 1 Component Communalities	Initial	Extraction
We were able to implement project risk plans accurately/effectively	1.000	.524
We were able to implement project risk plans no struggles/efficiently	1.000	.622
We were able to identify project risks accurately/effectively	1.000	.663
We were able to identify project risks no struggles/efficiently	1.000	.579
We were able to analyze project risks accurately/effectively	1.000	.691
We were able to analyze project risks no struggles/efficiently	1.000	.623
Risk Management Capabilities 1 Component Communalities (Continued)	Initial	Extraction
We were able to handle project risks no struggles/efficiently	1.000	.640
We were able to document project risks accurately/effectively	1.000	.720
We were able to document project risks no struggles/efficiently	1.000	.737
We were able to monitor project risks accurately/effectively	1.000	.740
We were able to monitor project risks no struggles/efficiently	1.000	.707
As the project progressed, our risk planning capabilities improved.	1.000	.316
As the project progressed, our ability to identify risks improved.	1.000	.406
As the project progressed, our ability to analyze risks improved.	1.000	.431
As the project progressed, our risk handling improved.	1.000	.463
As the project progressed, our risk documentation methods improved.	1.000	.443
As the project progressed, our ability to monitor risks improved.	1.000	.383

Extraction Method: Principal Component Analysis.

Table A8 (continued).

Risk Management Capabilities 1 Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.402	57.788	57.788	10.402	57.788	57.788
2	2.587	14.373	72.161			
3	.863	4.795	76.956			
4	.727	4.037	80.992			
5	.613	3.408	84.400			
6	.440	2.444	86.844			
7	.379	2.103	88.947			
8	.348	1.931	90.878			
9	.304	1.686	92.564			
10	.275	1.527	94.091			
11	.248	1.375	95.467			
12	.186	1.034	96.501			
13	.164	.912	97.413			
14	.139	.772	98.185			
15	.112	.623	98.808			
16	.086	.476	99.284			
17	.075	.419	99.703			
18	.053	.297	100.000			

Extraction Method: Principal Component Analysis.

Table A8 (continued).

Risk Management Capabilities 1 Component Matrix

Risk Management Capabilities 1 Component Matrix	Component
	1
We were able to implement project risk plans accurately/effectively	.724
We were able to implement project risk plans no struggles/efficiently	.788
We were able to identify project risks accurately/effectively	.814
We were able to identify project risks no struggles/efficiently	.761
Risk Management Capabilities 1 Component Matrix (Continued)	Component
	1
We were able to handle project risks accurately/effectively	.844
We were able to handle project risks no struggles/efficiently	.800
We were able to document project risks accurately/effectively	.849
We were able to document project risks no struggles/efficiently	.858
We were able to monitor project risks accurately/effectively	.860
We were able to monitor project risks no struggles/efficiently	.841
As the project progressed, our risk planning capabilities improved.	.562
As the project progressed, our ability to identify risks improved.	.637
As the project progressed, our ability to analyze risks improved.	.657
As the project progressed, our risk handling improved.	.680
As the project progressed, our risk documentation methods improved.	.666
As the project progressed, our ability to monitor risks improved.	.619

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Table A8 (continued).

Risk Management Capabilities 1 Component KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.895
Bartlett's Test of Sphericity	Approx. Chi-Square	1644.324
	df	153
	Sig.	.000

Risk Management Capabilities 1 Component Case Processing Summary

		N	%
Cases	Valid	90	100.0
	Excluded[a]	0	.0
	Total	90	100.0

a. Listwise deletion based on all variables in the procedure.

Risk Management Capabilities 1 Component Reliability Statistics

Cronbach's Alpha	N of Items
.955	18

Table A9

Risk Management Capabilities -2 Components

Risk Management Capabilities 2 Components Communalities

Risk Management Capabilities 2 Components Communalities	Initial	Extraction
We were able to implement project risk plans accurately/effectively	1.000	.611
We were able to implement project risk plans no struggles/efficiently	1.000	.697
We were able to identify project risks accurately/effectively	1.000	.708
We were able to identify project risks no struggles/efficiently	1.000	.612
We were able to analyze project risks accurately/effectively	1.000	.774
We were able to analyze project risks no struggles/efficiently	1.000	.719
We were able to handle project risks no struggles/efficiently	1.000	.675
We were able to document project risks accurately/effectively	1.000	.740
We were able to document project risks no struggles/efficiently	1.000	.750
We were able to monitor project risks accurately/effectively	1.000	.818
We were able to monitor project risks no struggles/efficiently	1.000	.757
As the project progressed, our risk planning capabilities improved.	1.000	.721
As the project progressed, our ability to identify risks improved.	1.000	.809
As the project progressed, our ability to analyze risks improved.	1.000	.766
As the project progressed, our risk handling improved.	1.000	.787
As the project progressed, our risk documentation methods improved.	1.000	.605
As the project progressed, our ability to monitor risks improved.	1.000	.705

Extraction Method: Principal Component Analysis.

Table A9 (continued).

Risk Management Capabilities 2 Components Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.40	57.78	57.788	10.40	57.788	57.788	8.209	45.605	45.605
2	2.58	14.37	72.161	2.587	14.373	72.161	4.780	26.556	72.161
3	.863	4.795	76.956						
4	.727	4.037	80.992						
5	.613	3.408	84.400						
6	.440	2.444	86.844						
7	.379	2.103	88.947						
8	.348	1.931	90.878						
9	.304	1.686	92.564						
10	.275	1.527	94.091						
11	.248	1.375	95.467						
12	.186	1.034	96.501						
13	.164	.912	97.413						
14	.139	.772	98.185						
15	.112	.623	98.808						
16	.086	.476	99.284						
17	.075	.419	99.703						
18	.053	.297	100.000						

Extraction Method: Principal Component Analysis.

Table A9 (continued).

Risk Management Capabilities 2 Components Rotated Component Matrix

Risk Management Capabilities 2 Components Component Matrix	Component	
	1	2
We were able to implement project risk plans accurately/effectively	.770	.134
Risk Management Capabilities 2 Components Component Matrix (Continued)	Component	
	1	2
We were able to implement project risk plans no struggles/efficiently	.814	.185
We were able to identify project risks accurately/effectively	.803	.251
We were able to identify project risks no struggles/efficiently	.742	.248
We were able to analyze project risks accurately/effectively	.858	.196
We were able to analyze project risks no struggles/efficiently	.833	.155
We were able to handle project risks accurately/effectively	.795	.320
We were able to handle project risks no struggles/efficiently	.777	.266
We were able to document project risks accurately/effectively	.794	.332
We were able to document project risks no struggles/efficiently	.790	.355
We were able to monitor project risks accurately/effectively	.877	.219
We were able to monitor project risks no struggles/efficiently	.832	.256
As the project progressed, our risk planning capabilities improved.	.140	.837
As the project progressed, our ability to identify risks improved.	.204	.876
As the project progressed, our ability to analyze risks improved.	.251	.839
As the project progressed, our risk handling improved.	.275	.844
As the project progressed, our risk documentation methods improved.	.352	.694
As the project progressed, our ability to monitor risks improved.	.225	.809

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Risk Management Capabilities 2 Components KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.895
Bartlett's Test of Sphericity	Approx. Chi-Square	1644.324
	df	153
	Sig.	.000

Table A10

Cronbach's Alpha for Risk Management Capabilities (Static)

Case Processing Summary

		N	%
Cases	Valid	90	100.0
	Excluded[a]	0	.0
	Total	90	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.963	12

Table A11

Cronbach's Alpha for Risk Management Capabilities (Dynamic)

Case Processing Summary

		N	%
Cases	Valid	90	100.0
	Excluded[a]	0	.0
	Total	90	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.921	6

APPENDIX I

Analysis Data - Correlation Analysis

Table A12

Individual Correlations - Best Practices

Spearman's rho		Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:
We were able to implement project risk plans accurately/ effectively	Correlation Coefficient	**.217***	.199	**.222***	.073
	Sig. (2-tailed)	**.040**	.060	**.035**	.493
	N	**90**	90	**90**	90
We were able to implement project risk plans no struggles/ efficiently	Correlation Coefficient	**.235***	**.267***	**.275****	.176
	Sig. (2-tailed)	**.026**	**.011**	**.009**	.098
	N	**90**	**90**	**90**	90
We were able to identify project risks accurately/ effectively	Correlation Coefficient	.173	**.270***	**.409****	**.273****
	Sig. (2-tailed)	.104	**.010**	**.000**	**.009**
	N	90	**90**	**90**	**90**
We were able to identify project risks no struggles/ efficiently	Correlation Coefficient	.007	.157	**.225***	.084
	Sig. (2-tailed)	.949	.139	**.033**	.431
	N	90	90	**90**	90
We were able to analyze project risks accurately/ effectively	Correlation Coefficient	.166	.180	**.241***	**.214***
	Sig. (2-tailed)	.119	.090	**.022**	**.043**
	N	90	90	**90**	**90**

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Table A12 (continued).

Spearman's rho		Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:
We were able to analyze project risks no struggles/ efficiently	Correlation Coefficient	.075	.117	.137	.125
	Sig. (2-tailed)	.482	.271	.199	.239
	N	90	90	90	90
We were able to handle project risks accurately/ effectively	Correlation Coefficient	.092	.154	**.242***	.165
	Sig. (2-tailed)	.387	.147	**.022**	.119
	N	90	90	**90**	90
We were able to handle project risks no struggles/ efficiently	Correlation Coefficient	.059	.150	.185	.140
	Sig. (2-tailed)	.580	.157	.080	.188
	N	90	90	90	90
We were able to document project risks accurately/ effectively	Correlation Coefficient	.120	**.225***	**.304****	.221*
	Sig. (2-tailed)	.261	**.033**	**.004**	.037
	N	90	**90**	**90**	90
We were able to document project risks no struggles/ efficiently	Correlation Coefficient	.081	.196	**.306****	.172
	Sig. (2-tailed)	.449	.064	**.003**	.104
	N	90	90	**90**	90
We were able to monitor project risks accurately/ effectively	Correlation Coefficient	.070	.150	**.239***	**.211***
	Sig. (2-tailed)	.511	.158	**.023**	**.046**
	N	90	90	**90**	**90**

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table A12 (continued).

Spearman's rho		Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:
We were able to monitor project risks no struggles/ efficiently	Correlation Coefficient	.095	.140	**.244***	**.222***
	Sig. (2-tailed)	.372	.188	**.020**	**.036**
	N	90	90	**90**	**90**
As the project progressed, our risk planning capabilities improved.	Correlation Coefficient	.169	.189	**.246***	**.222***
	Sig. (2-tailed)	.112	.075	**.019**	**.036**
	N	90	90	**90**	**90**
As the project progressed, our ability to identify risks improved.	Correlation Coefficient	.105	**.283****	.197	.063
	Sig. (2-tailed)	.325	**.007**	.062	.558
	N	90	**90**	90	90
As the project progressed, our ability to analyze risks improved.	Correlation Coefficient	.158	.161	**.256***	.155
	Sig. (2-tailed)	.137	.129	**.015**	.145
	N	90	90	**90**	90
As the project progressed, our risk handling improved.	Correlation Coefficient	.036	.127	.204	.150
	Sig. (2-tailed)	.736	.234	.054	.158
	N	90	90	90	90
As the project progressed, our risk documentation methods improved.	Correlation Coefficient	**.355****	**.379****	**.392****	**.260***
	Sig. (2-tailed)	**.001**	**.000**	**.000**	**.013**
	N	**90**	**90**	**90**	**90**
As the project progressed, our ability to monitor risks improved.	Correlation Coefficient	**.230***	**.264***	**.238***	**.230***
	Sig. (2-tailed)	**.029**	**.012**	**.024**	**.029**
	N	**90**	**90**	**90**	**90**

Table A13

Individual Correlations - Lessons Learned

Spearman's rho		Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:
We were able to implement project risk plans accurately/ effectively	Correlation Coefficient	.131	.093	.056	-.020
	Sig. (2-tailed)	.219	.381	.600	.855
	N	90	90	90	90
We were able to implement project risk plans no struggles/ efficiently	Correlation Coefficient	**.233***	.130	.140	.061
	Sig. (2-tailed)	**.027**	.221	.189	.570
	N	**90**	90	90	90
We were able to identify project risks accurately/ effectively	Correlation Coefficient	.140	.142	**.219***	.132
	Sig. (2-tailed)	.188	.183	**.038**	.214
	N	90	90	**90**	90
We were able to identify project risks no struggles/ efficiently	Correlation Coefficient	.044	-.005	.083	.051
	Sig. (2-tailed)	.679	.964	.439	.631
	N	90	90	90	90
We were able to analyze project risks accurately /effectively	Correlation Coefficient	.150	.121	.098	.036
	Sig. (2-tailed)	.158	.255	.357	.735
	N	90	90	90	90
We were able to analyze project risks no struggles/ efficiently	Correlation Coefficient	.146	.096	.079	-.015
	Sig. (2-tailed)	.170	.370	.461	.891
	N	90	90	90	90

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Table A13 (continued).

Spearman's rho		Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:
We were able to handle project risks accurately/ effectively	Correlation Coefficient	.021	.078	.097	-.024
	Sig. (2-tailed)	.846	.463	.363	.825
	N	90	90	90	90
We were able to handle project risks no struggles/ efficiently	Correlation Coefficient	.093	.112	.083	-.007
	Sig. (2-tailed)	.381	.295	.435	.945
	N	90	90	90	90
We were able to document project risks accurately/ effectively	Correlation Coefficient	.053	.097	.141	.109
	Sig. (2-tailed)	.622	.364	.184	.307
	N	90	90	90	90
We were able to document project risks no struggles/ efficiently	Correlation Coefficient	.061	.045	.130	.091
	Sig. (2-tailed)	.571	.675	.222	.394
	N	90	90	90	90
We were able to monitor project risks accurately/ effectively	Correlation Coefficient	.151	.191	.109	.084
	Sig. (2-tailed)	.155	.071	.308	.433
	N	90	90	90	90
We were able to monitor project risks no struggles/ efficiently	Correlation Coefficient	.139	.155	.035	.044
	Sig. (2-tailed)	.191	.145	.742	.680
	N	90	90	90	90

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table A13 (continued).

Spearman's rho		Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:
As the project progressed, our risk planning capabilities improved.	Correlation Coefficient	**.242***	.185	.167	.148
	Sig. (2-tailed)	**.022**	.080	.116	.165
	N	**90**	90	90	90
As the project progressed, our ability to identify risks improved.	Correlation Coefficient	.142	.167	.067	.053
	Sig. (2-tailed)	.182	.116	.531	.619
	N	90	90	90	90
As the project progressed, our ability to analyze risks improved.	Correlation Coefficient	.093	.150	.114	.067
	Sig. (2-tailed)	.382	.158	.286	.531
	N	90	90	90	90
As the project progressed, our risk handling improved.	Correlation Coefficient	.051	.058	.043	-.021
	Sig. (2-tailed)	.633	.588	.685	.846
	N	90	90	90	90
As the project progressed, our risk documentation methods improved.	Correlation Coefficient	**.252***	**.216***	.153	.094
	Sig. (2-tailed)	**.017**	**.041**	.150	.376
	N	**90**	**90**	90	90
As the project progressed, our ability to monitor risks improved.	Correlation Coefficient	**.364****	**.323****	**.216***	.138
	Sig. (2-tailed)	**.000**	**.002**	**.040**	.196
	N	**90**	**90**	**90**	90

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table A14

Individual Correlations - Near Misses

Spearman's rho		Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:
We were able to implement project risk plans accurately/ effectively	Correlation Coefficient	.122	.063	.157	.089
	Sig. (2-tailed)	.254	.555	.139	.406
	N	90	90	90	90
We were able to implement project risk plans no struggles/ efficiently	Correlation Coefficient	.026	-.043	.086	.106
	Sig. (2-tailed)	.805	.686	.419	.319
	N	90	90	90	90
We were able to identify project risks accurately/ effectively	Correlation Coefficient	.098	.062	.115	.037
	Sig. (2-tailed)	.357	.564	.282	.729
	N	90	90	90	90
We were able to identify project risks no struggles/ efficiently	Correlation Coefficient	-.037	-.084	-.046	-.044
	Sig. (2-tailed)	.726	.433	.666	.680
	N	90	90	90	90

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table A14 (continued).

Spearman's rho		Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:
We were able to analyze project risks accurately/ effectively	Correlation Coefficient	.105	.051	.120	.146
	Sig. (2-tailed)	.324	.634	.258	.170
	N	90	90	90	90
We were able to analyze project risks no struggles/ efficiently	Correlation Coefficient	.059	-.032	.039	.097
	Sig. (2-tailed)	.584	.768	.718	.363
	N	90	90	90	90
We were able to handle project risks accurately/ effectively	Correlation Coefficient	.082	.007	.096	.052
	Sig. (2-tailed)	.445	.946	.367	.625
	N	90	90	90	90
We were able to handle project risks no struggles/ efficiently	Correlation Coefficient	.096	.033	.078	.120
	Sig. (2-tailed)	.368	.757	.466	.259
	N	90	90	90	90

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table A14 (continued).

Spearman's rho		Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:
We were able to document project risks accurately/ effectively	Correlation Coefficient	.085	.041	.047	.022
	Sig. (2-tailed)	.424	.704	.663	.834
	N	90	90	90	90
We were able to document project risks no struggles/ efficiently	Correlation Coefficient	.068	.025	.060	.019
	Sig. (2-tailed)	.525	.815	.574	.859
	N	90	90	90	90
We were able to monitor project risks accurately/ effectively	Correlation Coefficient	.153	.099	.126	.178
	Sig. (2-tailed)	.150	.354	.238	.093
	N	90	90	90	90
We were able to monitor project risks no struggles/ efficiently	Correlation Coefficient	.143	.072	.093	.131
	Sig. (2-tailed)	.180	.499	.382	.219
	N	90	90	90	90

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table A14 (continued).

Spearman's rho		Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:
As the project progressed, our risk planning capabilities improved.	Correlation Coefficient	.146	.027	.033	-.042
	Sig. (2-tailed)	.169	.798	.758	.694
	N	90	90	90	90
As the project progressed, our ability to identify risks improved.	Correlation Coefficient	.122	-.012	.008	-.021
	Sig. (2-tailed)	.253	.907	.941	.846
	N	90	90	90	90
As the project progressed, our ability to analyze risks improved.	Correlation Coefficient	.200	.066	.052	-.006
	Sig. (2-tailed)	.058	.535	.629	.956
	N	90	90	90	90
As the project progressed, our risk handling improved.	Correlation Coefficient	.166	.104	.082	.057
	Sig. (2-tailed)	.118	.327	.442	.594
	N	90	90	90	90
As the project progressed, our risk documentation methods improved.	Correlation Coefficient	**.262***	.114	**.208***	**.207***
	Sig. (2-tailed)	**.013**	.285	**.049**	**.050**
	N	**90**	90	**90**	**90**
As the project progressed, our ability to monitor risks improved.	Correlation Coefficient	**.292****	.192	.205	**.240***
	Sig. (2-tailed)	**.005**	.071	.053	**.022**
	N	**90**	90	90	**90**

Table A15

Knowledge Correlations with Transfer Risk Management Capabilities

KT Variable	Number of Sig. Correlations at 0.05	Number of Sig. Correlations at 0.01
Approximately how many times did you STUDY BEST PRACTICES collected from YOUR project:	3	1
Approximately how many times did you DISCUSS BEST PRACTICES collected from your project with members of YOUR project team:	4	2
Approximately how many times did you STUDY BEST PRACTICES from OTHER projects:	9	5
Approximately how many times did you DISCUSS BEST PRACTICES with members from OTHER project teams:	6	1
Approximately how many times did you STUDY LESSONS LEARNED collected from YOUR project:	3	1
Approximately how many times did you DISCUSS LESSONS LEARNED collected from your project with members of YOUR project team:	1	1
Approximately how many times did you STUDY LESSONS LEARNED from OTHER projects:	2	0
Approximately how many times did you DISCUSS LESSONS LEARNED with members from OTHER project teams:	0	0
Approximately how many times did you STUDY NEAR MISSES collected from YOUR project:	1	1
Approximately how many times did you DISCUSS NEAR MISSES collected from your project with members of YOUR project team:	0	0
Approximately how many times did you STUDY NEAR MISSES collected from OTHER projects:	1	0
Approximately how many times did you DISCUSS NEAR MISSES collected with members from OTHER project teams:	2	0

Table A16

Risk Management Capabilities Correlations with Knowledge Transfer

RM Variable	Number of Sig. Correlations at 0.05	Number of Sig. Correlations at 0.01
We were able to implement project risk plans accurately/effectively	2	0
We were able to implement project risk plans no struggles/efficiently	3	1
We were able to identify project risks accurately/effectively	2	2
We were able to identify project risks no struggles/efficiently	1	0
We were able to analyze project risks accurately/effectively	2	0
We were able to analyze project risks no struggles/efficiently	0	0
We were able to handle project risks accurately/effectively	1	0
We were able to handle project risks no struggles/efficiently	0	0
We were able to document project risks accurately/effectively	1	1
We were able to document project risks no struggles/efficiently	0	1
We were able to monitor project risks accurately/effectively	2	0
We were able to monitor project risks no struggles/efficiently	2	0
As the project progressed, our risk planning capabilities improved.	3	0
As the project progressed, our ability to identify risks improved.	0	1
As the project progressed, our ability to analyze risks improved.	1	0
As the project progressed, our risk handling improved.	0	0
As the project progressed, our risk documentation methods improved.	6	3
As the project progressed, our ability to monitor risks improved.	6	3

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EDUCATION

- M.E., Mechanical Engineering, Old Dominion University, 2005, Norfolk, VA
- B.S., Engineering Technology, Old Dominion University, 2001, Norfolk, VA

EXPERIENCE

Huntington Ingalls Industries, Inc., Newport News, VA 2009-present
Mechanical Engineer III. Lead engineer for multiple habitability systems for new construction aircraft carriers. Co-ordinate multidisciplinary teams and perform various levels of project management, knowledge management, and risk management for these systems.

Huntington Ingalls Industries, Inc, Newport News, VA 2004-2009
Mechanical Engineer II. Lead engineer for several habitability systems for new construction aircraft carriers. Lead integrated teams for concept development of those systems. Primary point of contact for both internal and external customers.

Huntington Ingalls Industries, Inc, Newport News, VA 2002-2004
Mechanical Engineer I. Back-up lead engineer for plumbing and sewage treatment systems for new construction aircraft carriers. Performed calculations and product review to ensure technical adequacy and quality of the systems.

MEMBERSHIPS, BOARDS, AND PUBLICATIONS

- Mu Epsilon Eta, Engineering Management Honor Society
- Licensed Professional Engineer
- Haltiwanger, G. S., Landaeta, R. E., Pinto, C. A., & Tolk, A. (2010). Understanding the relationship between risk management and knowledge management: A literature review and extension. *International Journal of Knowledge Management Studies, 4*(3), 281-300