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The Interactions Among Information Technology Organizational Learning, Project Learning, and Project Success

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By
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Abstract

An Abstract of a Dissertation Submitted to Nova Southeastern University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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Knowledge gained from completed information technology (IT) projects was not often shared with emerging project teams. Learning lessons from other project teams was not pursued because people lack time, do not see value in learning, fear a potentially painful process, and had concerns that sharing knowledge will hurt their career. Leaders could change the situation; however organizational leaders have not seen value in project learning and have not made it a priority. Yet, if a relationship existed among IT project success variables (PSVs) organizational learning factors (OLFs) and project learning practices (PLPs) then IT leaders may take greater interest in managing knowledge.

The goal of this research was to conduct a correlational study to determine the relationship among OLFs, PLPs, and PSVs within IT organizations. OLFs included those activities at the corporate level that enabled project teams to learn from other projects. PLPs included the activities to learn lessons from a maturing or completed project. PLPs also included activities within an emerging project to harness lessons from prior projects. PSVs described project success.

The research question (RQ) asked; what was the relationship among the OLFs, PLPs, and PSVs? To answer the research question it was necessary to ask four support questions (SQ). First, what elements defined organizational learning, project learning, and project success? Second, how effective was use of organizational learning? Third, how effective was project learning? Fourth, how successful were IT projects?

To answer the first SQ a content analysis was conducted followed by a review with a Delphi team. A survey was then developed based on the content analysis. Finally, a statistical analysis was conducted to answer the remaining SQs and the RQ.

The content analysis and Delphi team review revealed 12 OLFs, 11 PLPs, and 9 PSVs. Answering the second and third support questions the study found that OLFs and PLPs could be used more effectively within IT organizations. However, IT leaders reported that a foundation for organizational and project learning existed. Answering the fourth SQ, IT leaders reported good project success though risk management could be improved. This study found that there was a positive and significant relationship among the OLFs, PLPs, and PSVs. The relationship among the OLFs, PLPs, and PSVs suggests that there is justification to research and develop IT competence in learning.

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Introduction

Background

Information Technology (IT) organizations struggled to deliver successful projects consistently for decades. Projects failed for many of the same reasons that they did 30 years ago (Cerpa & Verner, 2009). The Standish Newsroom (2009) reported that 44% of IT projects were challenged and 24% failed. Rubinstein (2007) reporting on the Standish Group Report for 2006 regarding IT projects said that 19% of projects failed and an additional 46% were challenged. Challenged projects included those that did not fully meet customer needs, had schedule or budget overruns (Rubinstein, 2007). In 2009 68% and in 2006 65% of IT projects had less than satisfactory results. These findings led to economic consequences.

IT project failures caused financial problems. For example, Wu, Ong, and Hsu (2008) cited companies that spent millions of dollars on failed ERP implementations. Gauld (2007) citing Dalcher and Genus, (2003) noted that both public and private organizations in the United States and Europe wasted around US$290 billion per year on information systems failures. Firms invested valuable resources in IT and did not achieve the desired goals (Pan, Hackney, & Pan, 2008). Gauld offered a discouraging assessment suggesting that because IT projects fail so often planners now expect failure. Biehl (2007) indicated that companies experience a wide range of effectiveness in implementing global IT.

Many reasons may explain project failures including lack of top management support (Zqikael, Levin, & Rad, 2008) and project complexity underestimated (Cerpa & Verner, 2009; Shenhar & Dvir, 2007b). IT project failures can also be attributed at least in part to a failure to learn from past IT projects which may have mitigated other reasons for failure cited in the literature. For example, if an organization learned lessons from project failures it may have addressed the root causes for underestimating project complexity. Desouza, Dingsøyr, and Awazu (2005) indicated "that these dismal findings can be traced to poor organizational learning mechanisms in software organizations" (p. 204). Hanisch, Lindner, Mueller, and Wald (2009) theorized that project teams were not learning lessons from other teams and this contributed to higher project costs. Robertson and Williams (2006) opined that IT projects were failing because they do not learn from completed projects. Thus, this research focused on knowledge sharing among IT project teams and the relationship with project success.

Problem Statement

Knowledge gained from completed projects was not effectively shared with emerging project teams (Ajmal & Koskinen, 2008; Newell, Bresnen, Edelman, Scarbrough, & Swan, 2006; Owen, Burstein, & Mitchell, 2004; Petter & Randolph, 2009; von Zedtwitz, 2003). Newell and Edelman (2008) theorized that organizational failures to extract and apply project lessons learned are widespread. Inadequate organizational learning contributed to IT project failures or poor project performance (Desouza, et al., 2005).

Organizations wasted resources when project knowledge was not effectively shared between teams. Newell, et al. (2006) theorized that project teams 'reinvent the wheel' as they begin new projects as opposed to learning from prior projects. Ajmal and Koskinen (2008) added that past errors could be repeated when lessons were not learned from previous projects sometimes for years. Another example of waste was that companies could lose the potential to build employee skills (von Zedtwitz, 2003). When employee skills were lost organizations may lose intellectual capital which led to rework and missed opportunities (Owen, et al., 2004). Thus, if project teams did not learn lessons from the past, poor solutions could be duplicated, mistakes repeated, and knowledge regarding good procedures was lost. (Petter & Randolph, 2009).

The state of organizational learning theory was relevant to the problem. Newell, et al. (2006) theorized that project-based organizations did not use project lessons learned in other projects or in any other manner. Von Zedtwitz (2003), in his survey of 63 R and D managers, reported that 80% of research and development projects did not review project lessons learned upon completion and most of the remaining 20% were ad-hoc reviews that did not follow guidelines. Hanisch, et al. (2009) interviewed 27 project managers and knowledge management (KM) experts in several organizations. Only nine firms reported that lessons learned were incorporated into the project management methodology and of those two firms did not follow the process (Hanisch, et al.). Researchers have cited a number of specific causes for this state of organizational learning in many companies that impeded knowledge sharing between projects.

Researchers have found that several factors explained the state of organizational learning. First, the most common reason cited was lack of time (Ajmal & Koskinen,

2008; Hanisch, et al. 2009; Keegan & Turner, 2001; von Zedtwitz, 2003). Second, centralized control was found to be an impediment (Keegan & Turner, 2001). Third, lessons were often reviewed upon project completion instead of throughout the project (Keegan & Turner, 2001; Newell, et al., 2006). As a result project participants may not have recalled lessons learned early in the project. Fourth, the culture of many organizations did not support knowledge sharing between project teams (Ajmal & Koskinen, 2008). Combined, these factors suggested that knowledge sharing between project teams was a low priority.

Many organizations prioritized short-term business needs over project learning (Keegan & Turner, 2001). Ajmal and Koskinen (2008) indicated that project-based company personnel were overwhelmed with urgent issues and deadlines. These urgent issues and deadlines prevented people from conducting formal project reviews. Hanisch, et al. (2009) theorized in their study that interviewees were pressed for time as new priorities emerged thus preventing project team members from reviewing lessons learned. "When time is a critical resource, retrospection and contemplation are left to others" (von Zedtwitz, 2003, p. 45).

Researchers also noted that centralized control of knowledge sharing between projects was not effective. Keegan and Turner (2001) indicated that centralization promoted learning by the few and in which not all employees are involved. Von Zedtwitz (2003) theorized that post-project reviews were seen by project team members as more bureaucracy. Keegan and Turner (2001) also suggested that deferring lessons learned until the end of projects was an issue. Newell, et al. (2006) indicated that by the

end of the project many of the lessons regarding process had been lost because they were resolved along the way.

Organizational cultures did not support an environment for sharing lessons learned between projects (Ajmal & Koskinen, 2008). Leseure and Brookes (2004) found that project team members were not incentivized to engage in knowledge sharing between projects. Organizational learning mechanisms were not present in many organizations. Yet Rose, Kumar, and Pak (2009) cited several references showing that organizational learning had a positive impact on organizational performance. In a public organization Rose, et al. found that organizational learning contributed to organizational commitment, job satisfaction, and work outcomes.

The state of organizational learning suggested that organization managers were not making it a priority to share lessons learned between project teams. It appeared that organization managers did not understand the value that may be derived from using best practices to share lessons between project teams. Knowledge managers had to justify resources as other managers did. For example, Choy, Yew, and Lin (2006) mentioned that one of the key challenges a knowledge manager faced was convincing senior management of the value of KM. "My bosses want to see how KM implementation improves the ROI [return on investment] of the company, and how am I going to convince them since it is hard to measure KM using dollars and cents?" (Choy, et al., 2006, p. 930). One answer to this question was to understand the relationship between organizational learning, project learning, and their relationship to project success. If a positive relationship existed then organizations may begin to understand the value of

establishing organizational learning initiatives and project learning practices within IT organizations.

Keegan and Turner (2001) theorized that organizational learning related to the systems and processes that facilitated individual learning. Organizational learning also facilitated project learning. Organizations could have impeded or promoted learning (Keegan & Turner, 2001). Haas and Hansen (2005) theorized that organizational policies can cause project teams to focus more on applying historical information rather than first understanding the relevance of the lessons for the emerging project. Karlsen and Gottschalk (2004) theorized that the organization's culture, systems and procedures, as well as IT enabled knowledge transfer between projects. Zqikael, et al. (2008) found that senior management support for an organizational knowledge management system was one of six important processes that enabled project management success. Thus, Organizational Learning Factors (OLFs) such as culture, systems, tools, policies, and leadership impacted for better or worse the relationship between project learning and project success.

Garon (2006) defined lessons learned as knowledge gained from experience that was important and relevant. Garon further indicated that Space Project Management Lessons enabled organizations to plan and manage future projects better. Project lessons came from previous or current projects and support improvement in future project management (Garon, 2006). Newell and Edelman (2008) indicated that most often "project learning practices involve each project undertaking regular project reviews and maintaining project documentation" (p. 569). Anbari, Carayannis, and Voetsch (2008) theorized that the value of post-project reviews came from the flow of lessons learned to

future projects and the organization. Von Zedtwitz (2003) defined post-project reviews as a structured means to capture lessons learned for the benefit of future project teams. Keegan and Turner (2001) discussed project-based learning practices within the context of organizational learning. Keegan and Turner treated project-based learning as a microcosm of organizational learning. The combination of these ideas suggested a concept that can be labeled Project Learning Practices (PLPs). PLPs were the project processes and activities that mature teams conducted to capture, store, and transfer lessons learned, and emerging project teams conduct to access, evaluate, and decide which lessons to apply. PLPs were practices that project managers and project teams can implement on their own.

Projects could be evaluated based on meeting schedule and delivering within budget (Anantatmula & Kanungo, 2008; Anbari, et al., 2008; Karlsen & Gottschalk, 2004; Shenhar & Dvir, 2007b). Anbari, et al. and Karlsen and Gottschalk related project performance to on time delivery within budget. Shenhar and Dvir (2007b) indicated that one may measure project efficiency based on evaluating cost and time performance. Project success may also have been evaluated based on the quality of the product in that it meets stated requirements, contains few defects and it is maintainable (Banker & Kemerer, 1992; Pall, 1987; Project Management Institute (PMI), 2008). Banker and Kemerer identified maintainability as a long term outcome for IT projects. Pall defined quality as conformance to requirements, effective communication of requirements, and delivery without defects. PMI related quality to the degree that the product delivers to specifications. Project Success may also have been gauged based on user satisfaction (Anbari, et al, 2008; Shenhar & Dvir, 2007b). Shenhar and Dvir opined

that customer impact was important. Anbari, et al. referred to the ultimate impact on the customer as a measure of project success. Project success may also have been evaluated based on the business benefits delivered. Shenhar and Dvir (2007b) indicated that business benefits could have referred to financial returns, market position and impact on growth. These project success variables (PSVs) made up project success.

Dissertation Goal

The goal of this research was to conduct a correlational study to determine the relationship among the OLFs, PLPs, and PSVs within IT organizations. OLFs included those activities at the organizational or corporate level that enabled project team members to learn from other projects. PLPs included the activities to learn lessons from a maturing or completed project. Project learning practices also included activities within an emerging project to harness lessons from prior projects. In this research the focus was on the PLPs utilized by emerging IT project teams. PSVs described project success.

The theoretical framework was based on the expected interaction of the OLFs, PLPs, and PSVs. Thus, the theoretical framework was depicted in Figure 1. Henry, McCray, Purvis, and Roberts (2007) used a similar diagramming technique to depict a theoretical framework on project knowledge management (PKM).

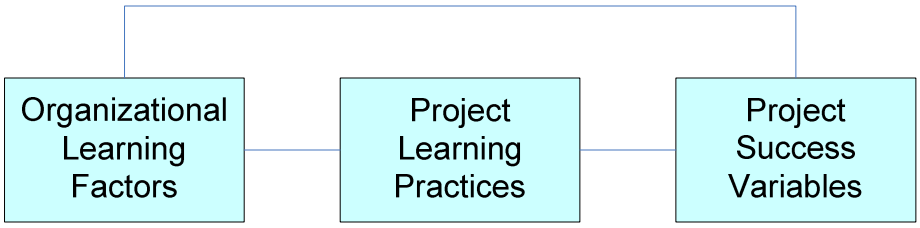


Figure 1: Theoretical Framework – Relationship Among OLFs, PLPs, and PSVs

In addition, the theoretical framework considered time and quality. It was not enough to implement lessons learned practices; they must be effective. Holsapple and Wu (2008) theorized that it was important to measure the different levels of KM performance and specifically to determine the threshold for KM performance excellence. Holsapple and Wu also theorized that there can be a time lag between attaining KM superior performance and organizational success. This study attempted to address degrees of KM performance and time as part of the approach to correlate the OLFs, PLPs, and PSVs.

It was important to execute project learning practices well (Newell & Edelman, 2008). Desouza, et al. (2005) theorized that lessons could be captured after milestones or at project completion but the analysis was only helpful if the insights contribute to future project team endeavors. Von Zedtwitz (2003) identified specific suggestions to ensure that project review meetings were conducted properly and effectively. For example, meetings should be led by a trained facilitator and team members should prepare for the meetings. Von Zedtwitz also established a maturity scale to help managers evaluate how effective their lessons learning program was. Haas and Hansen (2005) concluded from their case study that knowledge that was useful in one situation may not be useful in another. The emerging project team was obligated to evaluate and judge the relevance of lessons learned for the new project. Thus, this research sought to understand the relationship between effective learning and project success as opposed to simply using an OLF or PLP. As Holsapple and Wu (2008) suggested it was important to understand the quality level or effectiveness of KM.

Research Question

The goal and theoretical framework that outlined the relationship between OLFs, PLPs, and PSVs led to the research question. What relationships exist in IT organizations among the following?

a. OLFs and PLPs

b. OLFs and PSVs

c. PLPs and PSVs

In order to support the main research question four support questions (SQ) needed to be answered as follows:

SQ 1: What elements define the following?

a. OLFs

b. PLPs

c. PSVs

SQ 2: How effectively do IT organizations manage OLFs based on the elements that define OLFs (SQ1a)?

SQ 3: How effectively do IT organizations manage PLPs based on the elements that define PLPs (SQ1b)?

SQ 4: How well do projects perform based on the elements that define PSVs (SQ1c)?

Relevance and Significance

Problem Scope

Henry, et al. (2007) citing the Project Management Institute (2001) noted that world-wide organizations spend $10 trillion on IT. The Standish Group's CHAOS 2004 report indicated that 51% of projects failed to meet schedule estimates, costs estimates or functionality requirements (Henry, et al. cites Standing, 2004). Henry, et al. used this data to establish the foundation that poor KM practices were a factor in the low quality of cost and schedule estimates. Gauld (2007) noted in his case study a failed hospital IT implementation cost $13 million and wasted six years of effort. Gauld provided a trail of evidence that lessons were not learned from prior system implementation failures. One interviewee, in Reich (2007) opined that project knowledge issues cost 10% of the total amount of a $60 million IT project. Finally, Cerpa and Verner (2009) theorized with concern that IT organizations have repeated the same mistakes for over 30 years and have not learned to improve project success.

The scope of the problem was significant. The magnitude of IT expenditures, lost benefits during the period of delay (Banker and Kemerer, 1992), forgone value when projects fail or under deliver, and employee impact combined suggested a large problem. Emerging teams were failing to learn lessons from prior teams (Desouza, et al., 2005; Gauld, 2007) in spite of attempts to rectify the problem.

Prior Attempts to Share Knowledge Among Project Teams

Attempts have been made to solve the problem using IT. The United States General Accounting Office (GAO) (2002) empirically found that the National Aeronautics and Space Administration (NASA) project managers did not use the

technology to access lessons learned because many felt the system was too onerous. Newell, et al. (2006) empirically found that even when the information database was easy to use and accessible project managers did not use the system because it detracted from other work.

On the other hand organizations have not implemented cultural changes and processes to share lessons between projects. Ajmal and Koskinen (2008) theorized that culture did not support knowledge sharing between projects. GAO (2002) empirically found that NASA's culture impeded sharing lessons between projects. Keegan and Turner (2001) theorized that increased global competition was eroding social bonds between people and organizations making it difficult to learn lessons and benefit from them in the future. Alavi and Leidner (2001) theorized that KM technology enabled KM processes. Lacking culture and processes IT solutions have been ineffective.

Organizations have not implemented the culture and processes for various reasons. Keegan and Turner (2001) empirically determined that lack of time was a significant barrier because customers demand timely responses to their requests. Organizations thus prioritized new business opportunities over learning lessons from previous projects. Disterer (2002) theorized that lack of time was a barrier to sharing lessons between projects because schedules and budgets do not make room for learning. In addition, teams were quickly redeployed to other IT projects around the globe (Disterer, 2002). Von Zedtwitz (2003) theorized that time constraints were a problem because bureaucracy interfered with true learning. Newell, et al. (2006) conceptualized that time was not set aside to share lessons learned because the project end-dates must be met.

Disterer (2002) theorized that it could be painful to review problems in a prior project. Quoting Boddie (1987) Disterer noted "the postmortem experience is much like a losing football team watching a game film. It's not comfortable, but if the team pays attention to its mistakes, it can perform better the next time it plays" (p. 516). Von Zedtwitz (2003) theorized that team members found it difficult to reflect. Poor communication and a reluctance to blame others also contributed to impede learning lessons from projects (von Zedtwitz, 2003). It would appear that organizations could have over came barriers to implement the foundation for culture and process, but they may not have understood the relationship between project learning and success. One solution entailed helping organizations predict the success of projects based on their effective use of organizational learning factors and project learning practices. Organizations can then assign appropriate resources to solve the problem. Indeed researchers call for work to promote understanding of the impact of KM on project performance (Anbari, 2008; Henry, et al., 2007; Lierni and Ribière, 2008; Newell, et al., 2006).

Proposed Solution and Justification

Researchers called for future research that supports this study. Kotnour (1999) asked for quantitative research to determine the degree of impact that learning had on project management success. This research was a quantitative study to evaluate the relationship between lessons learned in projects and project success. Henry, et al. (2007) called for research to guide project managers to utilize lessons learned from prior experience. The study may act as a guide by helping project managers better understand OLFs and PLPs that used properly could relate to project success. Anbari, et al. (2008)

invited research that encouraged teams to develop lessons learned and emerging teams to use the information. Newell, et al. (2006) suggested that researchers explore how organizations can generate project-level learning. Helping leaders to understand the relationship between OLFs, PLPs and PSVs may result in efforts to promote organizational and project learning. Lierni and Ribière (2008) called for research that related specific KM practices to project success elements such as on time delivery and within budget execution. Hong, Kim, Kim, and Leem (2008) used a single project success variable in their research. Hong, et al. suggested that in the future it would be better to break down project performance into several elements including user satisfaction, budget, schedule, and maintenance complexity. This research included multiple elements of project success which as a whole were correlated with organizational learning and project learning. Newell and Edelman (2008) opined that the majority of KM research has been focused on the supply side or developing lessons learned. Newell and Edelman balanced their research between supply and demand. This research focused on the demand side.

This study responded to calls for further research. Also, this research may ultimately help IT organizations reduce waste and improve project performance through effective knowledge sharing between projects. "Effective KM reduces errors, creates less rework, provides more independence in time and space for knowledge workers, generates fewer questions, produces better decisions, reinvents fewer wheels, advances customer relations, improves service, and develops profitability" (Karlsen & Gottschalk, 2004, p. 4). If this research helps organizational managers understand the correlation among the OLFs, PLPs, and PSVs then this study may facilitate further action to

implement these KM practices in IT organizations. Even a small percentage improvement would be significant.

Barriers and Issues

This study presented challenges. First, there was the possibility that insufficient participants might respond to the survey needed for this research that could cause non-response bias. Much depended on the quality of the research and the design of the tools to facilitate the research to achieve an acceptable survey response rate (surveys received / study population). Obtaining sufficient quality responses could have added to the challenge in the current economy when people were busy. Second, the research design had to resolve the lag between implementation of KM practices and their impact on project management performance (Holsapple & Wu, 2008). Third, the project could have become unusually complicated if there were too many variables. Fourth, IT project managers may have been unwilling to respond if their project failed even when the survey was confidential. Fifth, PLPs may be effective tools but few organizations might have used them. These issues are discussed below.

Fowler (2009) suggested that response rates between 5% and 20% meant that those who respond were "self selecting" which may introduce survey bias. Table 1 lists response rates of research studies in KM. The survey research plans similar to this study were not shaded (white background). These researchers had a large sample frame from many organizations or long lists. For example, Harlow (2008) pulled his sample frame from a list of 68,000 names. In each case the researchers sent at least one reminder to the participants.

Karlsen and Gottschalk (2004) expressed concern about a low response but after reviewing their data they did not believe that their study was biased due to non response. Jugdev (2007) indicated that a 10% response rate from internet survey was very acceptable based on a number of sources. Every attempt in this research was made to maximize the response rate within available resources.

Table 1. KM Study Response Rates

Researchers	Response Rate	Responses and Sample Frame	Description
Ajmal, Helo, Kekale (2010)	10.25%	41/400	Respondents came from Finnish Project Management Association
Harlow (2008)	10.00%	113/1,128	Knowledge manager experts list
Haas (2006)	47.50%	485/1,021	Respondents from one organization
Han & Anantatmula (2007)	36.40%	182/500	Respondents from two organizations
Jugdev (2007)	10.10%	202/2,000	Rented list from Project Management Institute
Karlsen & Gottschalk (2004)	6.50%	68/1,050	From original list of 1,072 companies
Laframboise, Croteau, Beaudry, & Manovas (2007)	5.20%	127/2,425	2,425 IT managers drawn from 3,281 companies.
Lierni and Ribière (2008)	9.90%	99/1,000	Rented list from Project Management Institute
Rose, Kumar, & Pak (2009)	87.00%	435/500	500 questionnaires personally distributed to influential managers in 28 ministries in Malaysia
Tanriverdi (2005)	40.00%	356/890*	Sent to firms. * Estimated denominator 356/.4
U.S. Government Accounting Office (2002)	59.90%	115/192	Respondents from one organization (NASA)

Tanriverdi (2005) achieved a higher net response than other researchers who surveyed a large sample frame. Tanriverdi used a mail order firm to personalize each letter, and sent three follow-ups at 4, 8, and 12 weeks. In addition, respondents could mail the survey back or conduct the survey online. The research was sponsored by Boston University's Systems Research Center. In addition, Tanriverdi stated that CIO Magazine and Darwin Magazine "provided primary data" (p. 330).

Holsapple and Wu (2008) theorized that there was a lag time between implementation of effective KM practices. Lag time proved difficult to completely resolve in a cross-functional study. However, it was important to structure the survey to minimize the distortion that time may result due to the lag time between implementing

effective projects learning practices and project performance. Henry, et al. (2007) addressed the timing problem referenced by Holsapple and Wu (2008) by asking participants to think of a project almost completed or completed. Henry, et al. (2007) studied the relationship traditional project schedule estimating techniques and knowledge supporting practices have with project predictability and ultimately project success surveying 216 respondents in 16 organizations. Jugdev (2007) asked respondents to answer questions thinking of the last work year.

Complexity might have become an issue. One might identify a number of OLFs and PLPs to relate to PSVs. Too many variables could make it too difficult to conduct the study. In addition, the sample size would need to be increased. Thus, it was ultimately decided to summarize variables into OLFs, PLPs, and PSVs.

Respondents may not have wished to answer survey questions about failed projects even if confidentiality was assured. Confidentiality and indeed anonymity was assured. Also, Cerpa and Verner (2009) in a survey regarding the reasons software projects fail did appear to get cooperation from the sample. Respondents provided information on failed projects. Cerpa and Verner asked respondents to report on one successful and unsuccessful project. They received 235 complete responses from software practitioners that included 70 failures that they used for the study.

A project learning practice could be useful but it may not have been used in practice. For example, Desouza, et al. (2005) suggested a new idea to create stories that could be used to share lessons. Use of stories could be impeded because project team members may not have the skills to write stories. Organizations could video team members telling stories, yet organizations may not have invested in equipment yet.

Other PLPs may also not be practiced for various reasons. Desouza, et al., Hanisch, et al. (2009) and Keegan and Turner (2001) noted that organizations did not effectively learn lessons and thus may not have used OLFs and PLPs. However, Jugdev (2007) and Lierni and Ribièri (2008) conducted effective studies surveying members of the Project Management Institute. Thus, it was expected that some organizations were using OLFs and PLPs that could be correlated with project success.

Assumptions, Limitations and Delimitations

Assumptions

This study assumed that participants will accurately reply to the questions. Henry, et al. (2007) theorized that self reporting can be a limitation. Han and Anantatmula (2007) conceptualized that even when participants know their responses will be anonymous they distort answers to look better. However, Cerpa and Verner (2009) obtained survey responses from managers whose projects were not successful. This study assumed IT managers who have led IT projects would fairly report project success. Other stakeholders may have different views of project success (Karlsen & Gottschalk, 2004) yet IT project leaders have an overview of all project success variables.

This study assumed that the database provided by a company known as ZoomInfo represented a good cross-section of IT managers and project team participants across the United States in large companies. The database contained 50,000,000 names of employees in 5,000,000 organizations (ZoomInfo, 2010). Thus, it appeared reasonable that one could randomly draw around 3,000 names for the population frame.

Limitations

A correlational study established the relationship between variables and the strength of their relationship. However, a correlational study could not establish the cause (Sekaran, 2003). Thus, this study could not enable an IT leader to determine if the effective use of OLFs and PLPs caused project success.

This research was also limited because a cross-sectional survey design was implemented which was conducted at one point in time (Creswell, 2005). For example, one of the significant explanations for not learning lessons from prior projects has been due to lack of time (Keegan & Turner, 2001). Yet it will not be clear in this research if organizations have provided more or less time to project teams to learn and share lessons learned as the study of KM has matured.

Delimitations

This research was limited to IT organizations, large firms, and to knowledge sharing between teams and application of lessons learned in emerging teams. These delimitations are in line with previous research. Cerpa and Verner (2009) studied the causes for failure in IT projects. Henry, et al. (2007) focused on the relationship between organizational knowledge and IT schedule and cost predictions. Hartman and Ashrafi (2002) studied project management in the IT industry. Han and Anantatmula (2007) studied knowledge sharing in a large IT organization. Hansen, Nohria, and Tierney (1999) developed their theory of personalization and codification strategies based on experiences with large organizations. Henry, et al. studied Fortune 500 companies. Gauld (2007) studied the impact of an IT failure in a large hospital in New Zealand. Keegan and Turner (2001) while acknowledging the importance of sharing

lessons within a team focused their research on sharing lessons between project teams. Thus, limiting this research to knowledge sharing between project teams in IT divisions of large organizations was consistent with the literature.

The participants in this study were IT managers who had experience leading projects. Henry, et al. (2007) focused on IT managers who led projects in their study that related KM and traditional methods to cost and schedule predictability. In their study on knowledge transfer success in IT projects Laframboise, Croteau, Beaudry, and Manovas (2007) also surveyed IT managers.

Definition of Terms

Ba: A place or means of communication in a reinforcing setting where people may come together to create and share knowledge (Nonaka, Toyama, & Konno, 2000).

Codification Strategy: Knowledge that is coded, stored in a database, and made accessible to authorized people (Hansen, et al., 1999).

Explicit Knowledge: Knowledge that is captured in words, numbers, drawings, and maps that can be communicated readily (Koskinen, Pihlanto, & Vanharanta, 2003; Nonaka, von Krogh, & Voelpel, 2006).

Information System Project Success: Deliver systems that provide business value, satisfied customers, are within schedule, under or equal to budget, and are of high quality. (Anantatmula & Kanungo, 2008; Karlsen & Gottschalk, 2004; Project Management Institute, 2008; Shenhar & Dvir, 2007b).

Knowledge: A state of mind that relates to experiences, facts, figures, processes, visions, values, context, ideas, and judgments (Alavi & Leidner, 2001; Petter & Randolph, 2009).

Knowledge Management (KM): Enables the capture, storage, transfer, and retrieval of knowledge and its effective utilization (Alavi & Leidner, 2001) in order to enable people to understand why, how, and what to accomplish (Ebert & De Man, 2008) to create value out of intangible assets (Liebowitz & Megbolugbe, 2003).

Knowledge Management System (KMS): An IT system that enables knowledge management (Alavi & Leidner, 2001).

Knowledge Reuse: An element of knowledge transfer that is focused on an ability to locate information from the past and apply it (Petter and Randolph, 2009).

Learning: The process to create knowledge enabling improvement (Kotnour, 1999).

Lessons Learned: Important experiences validated by the project team that can benefit future projects (Garon, 2006; Schindler and Eppler, 2003).

Organizational Learning: Capacity to improve based on past experience (Owen, 2006).

Organizational Learning Factors (OLF): The culture, processes, systems, tools, policies, and leadership that impacted for better or worse organizational learning (Haas & Hansen, 2005; Karlsen & Gottschalk, 2004; Keegan & Turner, 2001, Zqikael, 2008).

Personalization Strategy: Knowledge that was shared through direct contact (Hansen, et al., 1999). A personalization strategy is enabled by computers that improve communication and store information about those who have knowledge not the knowledge itself. (Hansen, et al., 1999).

Program: Related projects managed together and coordinated to take advantage of synergies between the projects (Project Management Institute, 2008).

Project: One-time initiative with a beginning and an end to create an improved or new result, service, or product (Project Management Institute, 2008; Shenhar & Dvir, 2007).

Project Knowledge: Related knowledge to the business case, resources, process, schedule, budget, and deliverables for a project (Ebert & De Man, 2008).

Project Knowledge Management (PKM): Knowledge management that pertains to project environments (Hanisch, et al., 2009) at the organizational, project, and individual layers (Ajmal & Koskinen, 2008).

Project Learning Practices (PLP): Project learning processes and activities that maturing project teams conduct to capture and store lessons learned (Anbari, et al., 2008; Garon, 2006; von Zedtwitz, 2003) and emerging project teams conduct to access, evaluate, and apply lessons learned (Goffin, Koners, Baxter, & van der Hoven, 2010; Keegan & Turner, 2001).

Project Management: "The application of knowledge, skills, tools, and techniques to project activities to meet the project requirements" (Project Management Institute, 2008, p. 443) to deliver organizational value (Shenhar & Dvir, 2007b).

Project Postmortem: Team learning actions that occurred after project milestones were completed or at the end of the project (Desouza, et al., 2005) to benefit future projects (von Zedtwitz, 2003).

Post-Project Review: Same as Project Postmortem.

Project Success Variables (PSV): Includes the elements of Information Systems Project Success such as business value, customer satisfaction, schedule performance, budget, and quality.

Quality: Conformance to requirements, communication of requirements to be met, delivering products and services without errors or defects, and maintaining error free products and services even though requirements change over time (Pall, 1987).

Stakeholder(s): A person or group that is actively involved, influences, or is affected by a project (Barclay & Osei-Bryson, 2010; Project Management Institute, 2008).

Tacit Knowledge: Knowledge that is personal related to intuition, deeply embedded, and physical which was difficult to communicate (Koskinen, et al., 2003; Nonaka, et al., 2006).

Summary

IT project teams were not benefitting from lessons learned by previous teams. As a result project teams may not have been as successful as they could otherwise be. Lack of time, fear of sharing failures, bureaucracy, and competitive instincts at the organizational level may have impeded project team learning. It may have been that organizations simply did not see the need to prioritize learning because the value may not be apparent. Thus, the goal of this research was to conduct a correlational study to determine the relationship among the OLFs, PLPs, and PSVs within IT organizations. This research responded to calls in the literature and addressed a problem for which improvements could lead to greater project success.

In Chapter 2 the literature review is reported which provides the foundation for this research. In addition the literature provided the basis for defining the organizational learning factors, project learning practices, and project success variables. This in turn enabled the content and analysis and ultimately the survey. In Chapter 3 the methodology is outlined. In Chapter 4 the results are presented, and in Chapter 5 the conclusions, implications and recommendations are presented.

Chapter 2

Review of the Literature

Introduction

This literature review is divided into six sections. The first section (Project Knowledge Management Foundations) outlines the strategic foundations and broad theories for project knowledge management (PKM) including basis for measuring knowledge management. The second section (Project Failures and Failures to Learn) is a review of the literature that describes project and learning failures. The third section (The Impact of Learning on Organizational and Project Success) reviews literature that relates knowledge management (KM) to organizational and project success. The fourth section (Organizational Learning) focuses on organizational learning and its impact on project learning. The fifth section (Project Learning) reviews project learning practices (PLP) within and between project teams. The sixth section (Project Success) illustrates how research defines project success variables (PSV).

This literature review extracts articles from several domains in addition to information technology (IT) including consulting, construction, manufacturing, new product development, research and development, space exploration, and small business micro-finance. Extracting literature from multiple domains enabled a review of best practices that could benefit IT organizations and project teams. Also, in some cases individual articles inspired multiple variable definitions within the sphere of OLFs, PLPs, and PSVs. Articles were thus assigned to a section based on their research goals.

The first section reviews research that developed and defined knowledge, conceptualized strategies for KM, framed the concept of project knowledge management (PKM), project learning within the organization, suggested future directions for project management research, articulated the role of knowledge management systems, and advocated the need to relate KM to firm performance. The second section relates project failures to a lack of learning providing some evidence that learning and project success are related. Specific projects are identified that failed due in part to a failure to learn from prior projects. This section also amplifies the relevance and significance of PKM. The third section reviews studies that related learning capabilities to organizational and project success. These studies in the third section are similar to the methodology used in this research. The fourth, fifth, and sixth sections build the specific foundations to identify OLFs, PLPs, and PSVs. These sections are also necessary to develop the survey. Appendix A facilitates the literature review (Levy & Ellis, 2006). Articles are assigned to a primary section using Appendix A.

Project Knowledge Management Foundations

This section outlines articles that provide a foundation for PKM. The articles come from the project management and KM disciplines.

Nonaka, et al. (2006) reviewed the theory of organizational knowledge creation over 15 years. The theory indicated that knowledge is defined to include three parts. First knowledge is "justified true belief." (Nonaka, et al., 2006, p. 1181). Second, knowledge is action oriented. Third, building on Polanyi (1966) knowledge falls along a continuum from tacit to explicit knowledge. Knowledge conversion evolves through a

four stage process. Socialization (S) occurs when individuals share tacit knowledge. Externalization (E) occurs when people try to articulate tacit knowledge. Combination (C) occurs when explicit knowledge from different sources are combined. Finally, through Internalization (I) explicit knowledge becomes ingrained so that it becomes tacit. This process is known as the SECI model. Ba, a place where knowledge creation and sharing take place, provided conditions that enable knowledge creation. Nonaka, et al. also briefly touched on knowledge as it relates to projects theorizing that knowledge assets must be used at the organizational and project layers to survive. Relying on Bierly and Chakrabarti (1996) the authors indicated that the relationship between KM and firm performance had been proven. Bierly and Chakrabarti studied the performance of 21 companies in the pharmaceutical industry which showed that those firms who invested more in R and D developed new knowledge earning higher incomes (Nonaka, et al., 2006).

In the emerging discipline of PKM it is a rare article that does not build upon Nonaka and his colleagues. Sometimes an author challenges organizational creation theory as it relates to PKM (Fong, 2003). On the other hand Jugdev (2007) empirically proved the validity of the SECI theory. The challenges associated with managing tacit and explicit knowledge are an important element of PKM research.

Hansen, et al. (1999) introduced two KM strategies namely personalization and codification to support an organization's business model. Using consulting firms Hansen, et al. described when it is best to employ a personalization strategy and when it is best to employ a codification strategy. Consulting firms that developed customer specific solutions utilized the personalization strategy. On the other hand consulting

firms that provided cost effective and repeatable services employed a codification strategy. Hansen, et al. went on to describe other companies in personal computer manufacturing and healthcare related to either the personalization or codification strategy. As long as the KM strategy fit the business model then the company could realize higher profits using the right KM strategy. For example, a firm that had a customer specific strategy would enjoy higher revenues per consulting hour. Another firm saved time when they developed a proposal for a client by relying on codified knowledge from similar projects. Hansen, et al. theorized that a firm should focus its efforts on one strategy or the other. For example, a firm should rely 80% on personalization and 20% on codification.

In order to determine whether to employ a personalization or codification strategy predominantly a firm should look at three issues. First, the company should look at whether it develops standardized or customer specific solutions. Second, the firm should determine whether it offers innovative or mature products. Third, the firm should also look at whether employees solve problems using explicit or tacit knowledge. The concept of personalization and codification strategies helped to explain tacit and explicit knowledge sharing in project environments. Although Hansen, et al. did not address projects specifically their concept was largely based on observations in the consulting industry which were project-based entities. Kasvi, Vartiainen, and Hailikari (2003) and Owen, et al. (2004) reviewed later in this section were among those PKM researchers that built upon Hansen, et al. (1999).

Kasvi, et al. (2003) conducted three case studies in order to study KM competencies in project environments. The framework for conducting the case studies

was based on the codification and personalization strategies (Hansen, et al., 1999). Kasvi, et al. defined two concepts; namely project memory and project memory system. Project memory comes from knowledge of the project's history that may be applied to current issues. A project memory system is the way that project memory was developed. Project memory and project memory system both enabled codification and personalization. Project memory included explicit knowledge including requirements and instructions as well as tacit knowledge that involved values and skills. A project memory system entailed databases and e-mail to support codification and through models and personal interaction the personalization strategy. Kasvi, et al. theorized that lessons learned need to be appended with meta-knowledge to put specific lessons learned into context.

Two of the three cases involved three year programs in heavy industry costing EUR 2.5 million and EUR 17.6 million. The third case involved a research institute. During the research 24 participants were interviewed and 25 people were surveyed. The interviews consisted of 80 questions and interviewers could adjust the questions as needed. In addition, Kasvi, et al. (2003) conducted a survey using a four point scale from one "I/they do not know the competence area at all" (p.574) to "I/they know this competence area very well" (p. 574). In addition, respondents could indicate that the competence was either not needed (0) or the respondent did not know (9). Information was collected about several competencies that involved collecting, combining, improving, creating, storing, distributing, and efficiently using knowledge (Kasvi, et al., 2003). In addition Kasvi, et al. collected information about an individual's KM skills

including “knowledge sharing between project managers, knowledge dissemination outside the project, and knowledge productisation and dissemination” (p. 574).

Of those interviewed 19 people suggested that KM competencies could be improved. Reports were most commonly used to accumulate and store knowledge but were not accessible later. Benchmarking and seminars were held to exchange information but notes were not retained. The study empirically found that KM was an unsystematic process overall. Both personalization and codification strategies were used but not well. Yet when participants were asked which area was vital to project success only three interviewees mentioned KM. A major cause for problems with KM related to the belief that KM was not critical to project success. Kasvi, et al. (2003) also theorized that KM must be extremely well done in order to be effective.

Owen, et al. (2004) undertook a case study in an engineering management company to understand how knowledge is created, shared, and reused in project environments. The investigators sought to understand intra-project learning, knowledge sharing and reuse across projects, and the relationship between organizational learning and individual knowledge. Owen, et al. used the case study to test a project-based knowledge model developed earlier. The framework of the model was supported by strategic cycle and a tactical cycle. The strategic cycle was built on a framework known as the OODA (Observe, Orient, Decide, and Act) loop. The tactical cycle was built on the PDSA (Plan, Do, Study, Act) cycle developed by Walter A. Shewart. Owen, et al. slightly renamed the PDSA to PDSO (Plan, Do, Study, and Orient). The orient phase was the intersection between the PDSO and the OODA loop.

The case study findings suggested that the personalization strategy was used most often. Knowledge gained at the project level was reviewed at the corporate level in face-to-face meetings three times a year. Knowledge was shared across project teams on a personal level. The process was informal and depended on relationships that employees have developed within the organization. Knowledge was linked to the OODA loop primarily by the project director who served as a way to help retain organizational knowledge and share across the organization. Knowledge reuse also was dependent on informal relations and individual project management decisions. The company had two systems that did not interact. It was difficult to use technology to support knowledge sharing. In the organization culture that was studied Owen, et al. (2004) recommended that an expert locator may be more useful than a lessons learned repository. Lessons were learned throughout the PDSO cycle. During the study phase lessons were captured and formally transferred using a formal process which occurred normally at the end of the project. Owen, et al. (2004) found that after a project was completed team members moved on and there was not a "conscious orientation to the next project they unconsciously reorient themselves" (p. 31). Owen, et al. improved the idea of PKM by theorizing the relationship of the OODA and PDSO loops. The success of projects depended not only on project learning but was enabled by the organization's support for learning.

Keegan and Turner (2001) evaluated the barriers in organizations that impeded learning at the project level. The authors evaluated 19 firms in several European countries interviewing 44 executives to understand the practices they had in place to promote learning through projects. This was done by evaluating variation, selection,

and retention. In this context "variation" was related to an organization's effort to learn. For example, Pillsbury conducted bakeoffs to gain new knowledge about how their products may be used in new recipes. Selection related to those ideas developed in variation that were retained. Retention sought to exploit existing knowledge. Projects related to retention were the most common. The authors focused on knowledge sharing between teams and processes common to all projects in an organization.

Keegan and Turner (2001) found that few firms engaged in projects related to variation and exploratory learning was limited. During selection organizational learning was not a high priority. Projects were selected based on written proposals that were written to 'expected ideals' that were not often attainable. On the other hand most organizations focused on exploiting existing knowledge. The objective was to leverage existing learning. Keegan and Turner found that organizations actively employed retention practices including lessons learned databases and after-action reviews. However, while managers could describe the ideal processes they were often not followed. This was because once a project was concluded managers would be immediately transferred and did not have time to capture lessons learned. All of the managers mentioned that insufficient time was the major reason cited for inadequate project learning. The second reason was centralization of learning which encouraged retentive learning over variation. In addition, centralization promoted the idea that learning is the responsibility of a few not the entire organization. The third reason was that learning was deferred beyond which a team member's memory recalls accurately the lesson. None of the interviewees expressed satisfaction with the project learning processes.

Shenhar and Dvir (2007a) outlined future directions for project management research. The authors also empirically illustrated that some projects fail even when they are well managed. Other projects succeed even when they were not well planned. For example, the Sydney Opera House was expected to cost seven million dollars and take five years to build. The project was plagued with problems and ended up costing $100 million and 15 years to complete. Yet the Sydney Opera House was a success bringing income and global fame. Perhaps tacit knowledge both impeded the project and at the same time enabled eventual success. Frustration may have set in because people could not articulate certain ideas and yet the leaders some-how retained a level of confidence and tolerance for ambiguity. Shenhar and Dvir noted that project research has not led to a common underlying theme. Much must to be done to develop a theoretical foundation for project management. It was suggested that other fields such as technology, innovation management, and operations management could offer a foundation for further research in project management. Project management was described as an interdisciplinary field yet few such studies have been applied to project management. Shenhar and Dvir suggested that theories of knowledge could contribute to the development of project management as a discipline.

Holsapple and Wu (2008) formulated a theory that related KM to firm performance. From the theory three hypotheses were developed. First, excellence in KM was related to high profits. Second, excellence in KM was related to lower costs. Third, excellence in KM was related to a higher Tobin's Q ratio. Tobin's Q is a single index relates that value of common and preferred stock as well as debt to total asset or book value (Chung & Pruitt, 1994 as cited in Holsapple & Wu, 2008). In addition,

researchers needed to resolve key issues in order to relate KM to firm performance. The theory indicated that divisions of KM related to the customer, products, and management. Having unique knowledge to develop products, understand customer needs, and manage more effectively enabled a firm to achieve a competitive advantage. A company that was able to effectively leverage this knowledge could achieve a competitive advantage. Thus, Holsapple and Wu hypothesized that excellence in KM led to higher profits, improved cost ratios, and an increased Tobin's q (market value: value of total assets).

Holsapple and Wu (2008) outlined five issues that must be addressed to relate KM to firm performance. First, a firm must be able to acquire financial data to measure criterion variables. Second, it was important to understand relative degrees of KM excellence. Third, one must understand that there can be time lags between achieving KM excellence and firm performance. Fourth, one must be able to select a sample of firms that have practiced KM excellence. Finally, there may be a financial halo effect that could impact validity of a study if financial performance caused the perception of superior KM. Of these five issues the second and third can be addressed in a correlational study. In conclusion Holsapple and Wu suggested that if the hypotheses could be proven then this may help organizations to justify resources for KM.

Holsapple and Wu (2008) called for further research that would enable an organization to measure KM and its impact on organizational success. Two of the barriers can be overcome. First, an interval scale can be used to measure responses survey questions in an attempt to understand the degree of effectiveness of a KM element. Second, the time lag between implementing a KM program and performance

can partially be addressed by using an approach similar to Henry, et al. (2007) that would ask respondents to think about the last project they completed. KM practices would need to have been implemented sometime prior to a respondent's last project to have had an effect.

Hanisch, et al. (2009) conducted an exploratory study to understand the enablers and impediments to success of KM in projects and the impact to project success. The study entailed interviewing 27 people in German speaking companies within nine industries. Five of the interviewees were in the software/IT business. The team used semi-structured interviews and used software to conduct content analysis.

Hanisch, et al. (2009) empirically found that managers believed that PKM could enable improved project success. One interviewee in the construction sector indicated that excellent PKM could drive down costs from three to five percent. In addition, PKM could help reduce mistakes, avoid duplicate work, enable standardization, promote continuous process improvement, enhance project staffing, and lead to innovation. Most of the respondents used a personalization strategy to share knowledge. Some respondents also reported that they used both personalization and codification. Yet in spite of the benefits Hanisch, et al. reported that a number of respondents indicated that they could not successfully implement PKM because of time pressures, weak IT support, lack of leadership, and unsupportive culture. IT was generally used to provide information on prior projects, to support multi-directional information exchange, a means to store and organize data, and to provide templates. On the other hand the respondents favored action that would improve PKM.

Alavi and Leidner (2001) reviewed the literature and developed concepts for KM and KM systems. KM processes were divided into four categories including knowledge creation, knowledge storage and retrieval, knowledge transfer, and application of knowledge. Each of these categories could be supported by a variety of KM systems. For example, knowledge creation could be enabled by data mining, learning tools, knowledge storage and retrieval by knowledge repositories and support for organizational memory, knowledge transfer by discussion forums, knowledge directories, and knowledge application by expert systems and workflow systems (Alavi and Liedner, 2001, p. 125 – Table 3). Moreover, communication technologies and intranets enabled all of the knowledge categories.

Alavi and Leidner (2001) emphasized that the knowledge management systems (KMS) solutions must be developed in a manner that related to the way a firm defined knowledge and its business model. This article provided a framework for considering the role of KM systems in an IT organization. Specifically, the framework may be used to understand how KM systems support knowledge storage and retrieval, knowledge transfer, and knowledge application.

The articles in this section set the stage for research in project knowledge management (PKM). Nonaka, et al. (2006) and Hansen, et al. (1999) established the KM strategies that could be applied in project-based organizations and within the individual projects. Keegan and Turner (2001) specifically addressed the deficiencies of learning in project environments while Kasvi, et al. (2003) and Owen, et al. (2004) related personalization and codification to project management research. Shenhar and Dvir (2007a) suggested that interdisciplinary research in project management was

necessary to advance the discipline of project management. Keegan and Turner highlighted the problem that project teams did not share knowledge while Shenhar and Dvir spoke to the number of project failures that continue to occur. Holsapple and Wu (2008) provided a framework to further research in measuring KM and organizational performance including consideration for the degree of excellence in implementation and timing. Hanisch, et al. (2009) through their exploratory study found evidence that the emerging study of PKM could lead to improvements in project management and project outcomes. Alavi and Leidner (2001) provided a foundation to understand how KM processes are enabled by different knowledge management systems. The researchers in this section theorized that learning was important and may contribute to organizational and project success with proper incentives and removal of impediments.

Project Failures and Failure to Learn

This section reviews studies that explored the relationship between project failure and failure to learn from prior projects. The insights in these studies suggest that implementation of effective organizational and project learning programs could have reduced project failures.

Lyytinen and Robey (1999) conducted a conceptual analysis drawing from the literature to understand the failure of IT projects. The study also evaluated two published case studies (Markus & Keil, 1994; Keil, 1995; Robey & Newman, 1996). Lyytinen and Robey theorized that organizations experienced two learning issues. First, organizations did not learn appropriate lessons over time and thus learned to fail. Second, IT organizations experienced high project failures because they depended too

much on outdated organizational concepts. These concepts grew in a company over time from recruiting practices, consultants, various external influences, organizational structure, and management policies that were often not scientifically proven to work.

Lyytinen and Robey (1999) diagnosed four barriers to learning in IT organizations and theorized solutions. First, organizations have limits on how much knowledge can be absorbed (March & Simon, 1958 as cited in Lyytinen & Robey, 1999). Second, organizations have implicit disincentives for learning as success was rewarded and failure was punished. Third, organizational design was a barrier because departmental boundaries may discourage communication. Fourth, IT personnel were trained in engineering not organizational strategy. In addition systems development methodologies may have impeded learning because requirements and design must be established up front. Lyytinen and Robey concluded that the solutions should include implementation of KM processes that were integrated into the core of IT work, learning incentives, and restructuring to promote learning, and improved IT education. The programs could correct old concepts leading to a smart IT team.

Cerpa and Verner (2009) studied the causes for IT project failures. The authors theorized that although software has been developed since the 1960s a high proportion of software projects continue to fail. A survey was developed consisting of 88 questions based on the literature and discussions with over 90 software developers. The survey was distributed to companies in the north east of the United States, Australia, and Chile. Respondents were asked to fill out the survey twice once for a successful project and once for a failed project. Of 235 projects surveyed 70 were considered failures.

Cerpa and Verner (2009) realized, as their research progressed, that in view of the culture in many organizations that project managers would not concede that their project failed. This was true even if none of the benefits were realized. Cerpa and Verner theorized that the political climate was a key reason for a lack of postmortem reviews. Projects failed for multiple reasons. The top four causes for project failure were management issues including focus on delivering to a date, project scope was underestimated, risks were not managed, and staff were not rewarded for working hard and for long hours. Indeed, 46% of the projects experienced all four of the top four failure factors. Many of the project failure causes were beyond the control of the project manager. Inadequate user requirements were an underlying reason for many project failures. Cerpa and Verner noted with concern that their findings agreed with prior studies going back 30 years. Organizations have not been learning from their mistakes. Finally, Cerpa and Verner theorized that if project teams did not conduct post-project reviews they would not understand the reasons for project failure.

Gauld (2007) conducted a case study to evaluate the failure of a New Zealand IT hospital project. Gauld used the freedom of information act to review thousands of pages in the national archives. The hospital provided services to a population of 300,000 people. The government made a top down decision to implement a 'buy' solution and discouraged modifications. In addition, the hospital acquired an application that another hospital had tried to implement. The other hospital experienced significant problems with its implementation. For example, the implemented model was not the same as the one demonstrated to the staff. The purchasing specifications were not

detailed enough. Yet the board of the hospital in the case wanted to use a system that had been implemented previously.

After spending $13 million the hospital had to discontinue the project. The project began in 1997 and was terminated in 2003. Many failures were identified including ill defined requirements, unclear project goals, staff resistance, and lack of senior management leadership. The board and staff did not learn from their own experiences nor learn from earlier implementations. Gauld (2007) opined that in political environments it was even more important to learn lessons because public IT projects have more organizational and political complexities to address than private sector projects.

GAO (2002) conducted a review of lessons learned programs at National Aeronautics and Space Administration (NASA). The audit was initiated because of the loss of the Mars Polar Lander and Climate Orbiter spacecraft costing taxpayers $188 million. The U.S. Congress believed that these losses occurred because past experiences had not been applied to current programs and projects. For example, NASA's decision regarding inclusion of down-link telemetry on the Mars Polar Lander was a lesson that NASA should have learned seven years earlier with the Mars Observer. GAO conducted its investigation through a review of documents, interviews with staff, site visits, and a survey of NASA's program and project managers. The survey was self administered and enabled GAO to understand how NASA utilized lessons learned, the positives and negatives of NASA's lessons learned program, challenges or impediments to sharing lessons, and suggestions to improve use of lessons learned. GAO surveyed a population of 192 managers and received 115 responses that could be used.

GAO (2002) found that NASA had a system in place to store lessons learned, train staff through its academy of program and project learning, made stories available through a website, and conducted activities that enabled lessons learned to be diffused throughout the organization. NASA was also working at the time to strengthen its lessons learned policies. Yet program and project management claimed to lack awareness of the various lessons learning capabilities in the survey. Managers also claimed that it was difficult to use the Lessons Learned Information System. The survey results also showed that there were several cultural barriers including lack of time, a perception that lessons were not valuable, lack of trust, and an intolerance for mistakes.

GAO (2002) spoke to KM practitioners to understand best practices and develop recommendations. Several recommendations were suggested. KM should be contained within the business plan including a KM vision and goals. Senior managers must set an example and support KM. In addition, a central function should be established to facilitate KM in NASA. GAO also encouraged management to invest in Lessons Learned Information System. Finally, GAO suggested that NASA needed to make changes in the corporate culture to ensure success of a lessons learned program. This included providing sufficient time, establishing formal and informal mechanisms to share lessons learned, and incentives. GAO also noted that a KMS was important but should not be the focus of the KM initiative.

Robertson and Williams (2006) utilized cognitive mapping to study a large IT project within the insurance industry that was delayed several times. Four barriers to project learning were reviewed. First, project leaders and their teams did not see value in learning and thus did not put time into the effort. Second, project teams considered

that their situation was unique and others could not learn from the experience. Third, people were under considerable time pressure. Finally, people may have used time as an excuse to avoid discussing failures. In addition, current learning methods did not help to explain the complex issues that arose in projects. There was a complex web of relationships that were not readily apparent within and outside the teams. Thus, modeling may have helped management work through lessons learned.

The model defined key outcomes, events external to the project, management decisions during the project, and other important concepts or activities. The model depicted a situation in which the agreement was not reached on the final design. This left the contractor's team idle and since they were on a fixed price contract they began work with an incomplete design. This in-turn led to rework including re-design, re-coding, and re-testing impacting other software code. In addition, the contractor and the client negotiated new contract terms that encouraged parallel work which aggravated the problem further. The loops in the model surfaced these issues. Using the model experience Robertson and Williams (2006) developed general recommendations for organizational learning. First, the means of learning should suit the nature of the project. It was not necessary to use a cognitive model for all projects. Second, learning should continue throughout the project. Third, cognitive maps could be developed by an analyst based on a meeting or an interview. Fourth, when a cognitive map was used it was important to identify the management decisions and actions that were taken as the result of a given situation. Fifth, teams should consider human oriented factors as well as hard issues such as a late deliverable when developing lessons learned. Finally, the team should look for loops that caused issues.

Robertson and Williamson (2006) concluded that cognitive maps offer an effective tool to analyze complex projects. One can establish chains of activities that led to certain outcomes. In addition, cognitive maps could be a means to address issues in a relatively impartial way. Perhaps the model may help to address a key barrier to learning in which people do not want to discuss difficult issues. Finally, the maps may help future learners understand the context in which outcomes came about and thus understand why a lesson is important.

The research in this section linked project failures in IT and the space program with failure to learn lessons from prior projects. Lyytinen and Robey (1999) theorized that IT teams were learning to fail because the organization did not have a structure to enable learning. Cerpa and Verner (2009) theorized that a failure to learn has been an issue for three decades in software development. GAO (2002), Gauld (2007), and Robertson and Williams (2006) discussed specific projects that failed because lessons were not learned and in two cases led to total project failure and in another project severe cost overruns. In addition common causes included lack of time, an unwillingness to discuss hard lessons, and senior management's approach. Cerpa and Verner also theorized a general unwillingness to concede that projects were failures. Failure to learn led to project failures. Understanding the relationship between learning and project success may help leaders make better decisions. For example, leadership may provide more time and resources to enable staff to participate in knowledge sharing.

The Impact of Learning on Organizational and Project Success

Love, Edum-Fotwe, and Irani (2003) opined that project success could be improved by effective KM. The researchers in this section studied the relationship

between effective KM and organizational or project success. This section is divided into two sub-sections. The first sub-section (Learning and Organizational Success) discusses research that related KM and organizational success. The second sub-section (Learning and Project Success) relates KM and project success.

Learning and Organizational Success

Tanriverdi (2005) evaluated how the IT resources of a firm should be organized and managed to improve KM and the impact of the firm's KM capability on firm performance. The research focused on firms that have multiple products in many markets. Tanriverdi addressed cross unit KM capabilities which contained three first order constructs including product KM capability, customer KM capability, and managerial KM capability. Within each of the capabilities there were four KM processes related to knowledge across the enterprise including knowledge creation, knowledge transfer, knowledge integration, and leveraging knowledge. Tanriverdi hypothesized that complementary product, customer, and managerial KM capabilities should have a positive effect on firm performance namely market performance and accounting performance. Tobin's q was used to assess market performance and return on assets was used to determine accounting performance. Tanriverdi introduced the concept of 'IT relatedness' to conceptualize the balance between the conflicting objectives and needs between the divisions or business units and the corporation. IT relatedness consisted of four elements including the IT infrastructure, strategy development, human resource management, and vendor management. Tanriverdi proposed that the corporation should establish the processes but allow business units to manage the common process. This enabled the organization to balance the needs of the

corporation and the business units. Tanriverdi hypothesized that the complementary nature of the four elements IT relatedness were positively associated with cross-functional KM capability. Tanriverdi tested the two hypotheses using a sample of multi-business firms from the Fortune 1000 list. Data was developed along multiple lines. IT relatedness was based on a survey of senior IT executives. KM capability was determined from a separate survey of business executives in the same firms. Financial data was developed using data from COMPUSTAT. In addition, Tanriverdi computed control variables such as "industry profitability, firm size, relatedness of firm's businesses, and risk levels" (p. 321) with objective data from COMPUSTAT. Tanriverdi pretested the survey with 10 academic experts and 25 managers in Fortune 1000 companies in meetings. A direct mailing company was used to mail the questionnaires with four follow-ups every two weeks thereafter. Tanriverdi achieved net response rates of 38% for the business survey and 40% for the IT survey after deducting mergers and firms that declined to participate. As a result 250 firms provided matching results. Tanriverdi used structural equation modeling to assess the effect of KM capability on performance and IT relatedness on KM capability

Tanriverdi found empirical support for both hypotheses. IT relatedness was correlated with KM capability and KM capability impacted market-based and financial performance. KM capability also acted as a mediator to positively influence market-based and accounting performance. The structural link for KM capability and Tobin's q was 0.15 and ROA was 0.17. The structural link between IT relatedness and KM capability was found to equal 0.36 for both Tobin's q and ROA. Tanriverdi empirically found that both results support the hypothesis.

Rose, et al. (2009) evaluated the relationship between organizational learning, organizational commitment, job satisfaction, and work performance based on a survey of managers in Malaysian government agencies. Rose, et al. developed a self administered questionnaire using previous questions in the literature. Organizational learning questions were based on Gomes (2005), questions related to organizational commitment were based on Porter, Steers, Mowday, and Boulian (1974), questions regarding job satisfaction came from Hackman and Oldham (1975), and work performance was supported by Sullivan (2001). The authors personally delivered the surveys to 500 people in 28 different ministries supporting the territory of Kuala Lumpur and Putrajaya. As a result 435 respondents fully answered the survey.

Rose, et al. (2009) found a positive relationship between organizational learning and work performance where r=.484. The authors characterized this as moderately positive. Increasing organizational learning improved knowledge, capabilities, and skills which led to better performance. In addition, the authors found that there was a high positive relationship between organizational learning and organizational commitment where r=.561. Employee commitment increased with improvements in organizational learning. Organizational learning and job satisfaction also had a high correlation where r=.551. Overall, Rose, et al. concluded that a learning organization was a significant factor that drives organizational commitment, job satisfaction, and work performance.

Goh and Ryan (2008) undertook a study to determine the relationship between organizations that make learning an integral part of their strategy and their competitive position relative to the overall capital market and direct competitors. A team of three

independent reviewers found at least two articles that outlined the work that 16 companies did to become learning companies. The learning companies were compared to 21 companies who were also successful but focused on other strategies to compete. The companies were compared based on their performance in the stock market over 20 years and traditional financial metrics such as return on equity. In addition, the performance of the 16 companies that included learning in their strategy as a group were compared to S&P 500 index.

Goh and Ryan (2008) found that in 159 months out of 264 months of data that the 16 learning companies, firms that had a strategy to promote organizational learning, performed better than the S&P 500 index. In addition, the 16 companies outperformed their direct competitors in terms of share price and growth. The 16 companies also outperformed their competitors in six of eight accounting measures. Return on Assets and Return on Equity were higher but not statistically significant. In short, Goh and Ryan found a relationship between learning companies that focus and financial performance.

Yang (2010) correlated KM strategies in 190 Chinese high technology firms with organizational performance. A survey was sent to 500 senior executives and a follow-up call was made after four weeks. Yang developed five hypotheses that indicated a firm's KM strategy and strategic performance relationship were moderated favorably by:

1. An incentive system.
2. Process innovation. Process innovation interacts with KM and tends to reflect KM strategies.
3. R and D projects learning from past projects.

4. Market intelligence, and
5. Interorganizational knowledge sharing

Yang (2010) found that an incentive system, process innovation, and interorganizational knowledge sharing positively moderated the relationship between a firm's KM strategy and performance. However, the results did not show that learning from prior R and D projects had a significant impact on performance while market intelligence had a negative impact on performance.

The researchers used different approaches to relate KM to organizational success. Tanriverdi found a positive relationship between a firm's KM capability and financial and market performance. Rose, et al. found a positive relationship between organizational learning and work performance, employee commitment, and job satisfaction. Goh and Ryan found that firms with a strategy to promote organizational learning outperformed the S&P 500 index and their competitors on six out of eight financial metrics. Yang (2010) found that inter-organizational knowledge sharing positively moderated a KM strategy and organizational performance yet R and D learning from prior projects was not statistically significant. Overall, these studies showed a positive relationship between effective organizational learning and organizational outcomes using different methods in different settings.

Learning and Project Success

Dingsøyr and Conradi (2002) conducted a literature review of eight case studies to determine if KM led to improved software quality, lower costs, or improved the work environment for employees. The organizations studied included the NASA Software Engineering Lab, Daimler Chrysler, Telenor Telecom Software, Ericsson Software

Technology, an Australian telecom company, ICL High Performance Systems, ICL Finland, and sd&m a German software company. The literature review evaluated KM strategies, processes, and tools. The authors looked at whether the strategy included a codification or a personalization strategy or the organization used both strategies. The analysis was also framed by the Experience Factory concept that Dingsøyr (2000) developed previously. The Experience Factory was integrated into Total Quality Management (TQM) which provided feedback to managers seeking to continuously improve.

Dingsøyr and Conradi (2002) had difficulty reaching conclusions because many of the case studies were written by the teams that implemented the programs. In addition, quantitative data was not always available. Nonetheless, six of the eight organizations employed both personalization and codification strategies. In addition, three of the organizations reported that they reduced software development costs. In one organization it was suggested that quality may have improved and another organization claimed that fewer mistakes were repeated. Finally, in four of the organizations employee satisfaction improved.

Haas and Hansen (2005) conducted a study within a single consulting firm to determine under what circumstances using knowledge from other parts of the firm enhanced or hindered competitive performance. Competitive performance was based on whether or not the firm won bids. Haas and Hansen hypothesized that the more codified and personalized knowledge was used the higher the chances of winning a bid. However, experience and opportunity costs must also be considered. Thus, it was also hypothesized that the greater the experience of the team an increase in the amount of

codified and personalized information used reduces the likelihood of winning a bid. In addition the more competitors the company faced in a bid the less likely codified knowledge would benefit the firm. However, the more competitors a firm faced the more valuable personalized knowledge was. The consulting firm had over 10,000 consultants in 100 offices across the United States. Bid results were extracted from the company's database. The ultimate bid sample included 112 wins and 70 losses.

Haas and Hansen (2005) empirically found that teams were less likely to win when they used codified knowledge and advice from colleagues had no impact on the bid results. In addition both experienced and inexperienced managers did not benefit from using codified knowledge. However, the research indicated that if inexperienced managers obtained and used personalized knowledge it helped the team to win. Yet the result was not statistically significant. On the other hand if experienced managers utilized personalized knowledge the team was less likely to win. Finally as competition increased the use of codified knowledge would decrease the chances of winning the bid. Yet if the team used personalized information the team was more likely to win the bid. Thus, the key finding of the study was that use of previous knowledge in some situations impeded project performance. As team experience and competitors increased the use of codified information proved an impediment for winning a bid. Moreover, even personalized information could detract from winning if the team was experienced. Haas and Hansen theorized that use of too much codified information may have caused a team to use less customization and innovation. Also codified knowledge may have been out of date.

Haas and Hansen (2005) suggested that more attention be paid to the net effects of using knowledge for future efforts. Both the benefits and the costs of knowledge flows should be evaluated. Leadership was also important and worthy of further study. If teams questioned the knowledge they used and related it carefully to their project task then the information may be more helpful. Haas and Hansen theorized that knowledge valuable in one situation may not be valuable in another. Haas and Hansen studied the impact on sales teams. IT project teams may behave somewhat differently. For example, reusing standard templates may be beneficial over time to different IT teams (Petter, Mathiassen, and Vaisnavi, 2007) unless there was a major change in over-arching policy or process.

Henry, et al. (2007) conducted a correlational study to determine the impact of traditional project estimating techniques and KM supporting practices on IT project costs and schedule predictability and consequent impact on IT project success. Henry, et al. hypothesized that traditional estimating techniques and KM practices would improve predictability of schedules and costs which in turn favorably impact project success. KM practices included three elements. Organizations should rely on teams for estimates, senior managers to set realistic targets, and project managers for experience. Traditional project management practices suggest that project managers should evaluate similar projects, utilize formal scheduling and cost models, and build the schedule and cost estimates based on specific tasks. Henry, et al. surveyed 216 IT professionals. The respondents came from 16 organizations in financial services, manufacturing, healthcare, and telecommunications.

The research results indicated that KM variables were significant; namely reliance on teams for estimates, senior management expectations, and project management experience. However, development of schedules or budgets based on prior projects was not found to significantly contribute to predictability. Henry, et al. suggested that IT projects may appear similar but could be different. Another explanation may be that project managers did not look for similar projects that could be used to enable scheduling. Overall, the study indicated that when traditional project management estimating practices and KM practices were combined they improved predictability where $R^2 = 0.355$ (p. 606 – Figure 2). In turn improved predictability contributed to project success where $R^2=0.135$. The research empirically concluded that using both traditional techniques and KM was better than using either traditional project management or KM alone to develop accurate cost and schedule estimates.

Newell and Edelman (2008) conducted a hybrid study that entailed qualitative and quantitative research to understand learning within teams and knowledge transfer between project teams. The studies were accomplished within a single utility company in the United Kingdom. The qualitative research included interviews with participants in two typical projects. In addition 144 people responded to a survey. The study built upon Zollo and Winter (2002) who developed a hierarchy of learning including experience accumulation, knowledge articulation, and codification. Experience was the most basic form of learning, articulation of lessons learned through analysis was a higher form, and codifying knowledge was the highest level. The survey correlated the learning variables with team learning, cross-project learning, and project success. Newell and Edelman found experience accumulation correlated with cross-team learning

but not project learning. Knowledge articulation did not correlate with team learning or cross-project learning. Yet knowledge codification correlated significantly with both project learning and cross-team learning. Knowledge articulation also was proven to predict knowledge codification. Finally, project learning and cross-team learning both were strongly correlated with project success.

The survey results suggested that having meetings alone to learn lessons were insufficient to enable learning. Newell and Edelman theorized that when people took the time to write down the lessons this helped them internalize lessons learned and it helped future teams. The meetings were necessary input to the codification efforts. The qualitative research found that staff members did not always realize the value of project learning practices in spite of the impact to project success. Newell and Edelman recommended processes should be mandated and that rewards should be put in place to encourage effective review of lessons learned and documentation. Moreover, there should be a system of rewards for effective learning practices. In addition, it would be useful to provide illustrations of the value of learning to project teams. Finally, a supporting structure would enable review of lessons learned and could approve them for future use.

Hong, et al. (2008) studied the relationship between system integrator (SI) team member knowledge and project performance in a systems integration firm. Specifically, the study evaluated the effect of product tacit knowledge, process tacit knowledge, and explicit product knowledge on project performance. Hong, et al. used a customer satisfaction index to represent project success. The index included schedule, maintainability, budget, and overall satisfaction. Hong, et al. collected project

performance data from an SI service firm. Knowledge information was gathered from 34 project leaders and 192 team members using a survey that was hand-delivered when possible. Between the knowledge data gathered from the firm's employees and performance data directly from the firm Hong, et al. were able to study 49 projects.

Hong, et al. (2008) found that tacit product knowledge had a significant positive effect on project success. In addition, tacit process knowledge including leadership and communication skills had a significant impact on project success. Explicit product knowledge did not affect project performance. Hong, et al. theorized that documentation was not sufficient to influence project performance. Tacit project knowledge also significantly influenced tacit process knowledge. However, tacit product knowledge did not affect explicit product knowledge. Hong, et al. theorized that managers with tacit knowledge did not document their expertise. This implied that the lessons learned process may be weak. Hong, et al. recommended that firms employ both a personalization and a codification strategy. In addition, because tacit information was so important an expert locator database should be established.

Lierni and Ribière (2008) conducted a correlational study to determine whether KM led to improved project management practices. The authors sent out 1,000 surveys to members from the Project Management Institute in various business domains. Of the 99 responses 22% of respondents came from the IT industry (Lierni & Ribière, 2008). Lierni and Ribière developed several hypotheses. First, there was a correlation between key project performance areas and KM. Specifically, the authors posited that there was a positive correlation between meeting user expectations, schedule performance, and cost control and use of KM. Second, project deliverables, project communication, and

reduced project risks were associated with the use of KM. Third, the institutionalization of lessons learned enabled the use of KM. The survey results showed that all hypotheses were accepted with a confidence level of 95% or greater. All the hypotheses were accepted with r falling in the range of 0.273 to 0.532 which the authors stipulated was not strong.

Landaeta (2008) evaluated the correlation between knowledge transfer across projects, the project body of knowledge, and project performance. The method used involved surveying 14 organizations in the Americas with whom contacts were available. Landaeta invited 116 individuals to respond of which 71 respondents began the survey and 46 completed the survey. The unit of analysis was a completed project. Landaeta drew questions from three previous researchers to improve the validity of this survey. The level of effort to transfer knowledge across projects was defined by the number of times a team member evaluated previous projects and the number of times a team member mentored people in other projects. The body of knowledge was evaluated based on how the team member relied on experiences from other projects and how that knowledge helped the team to resolve problems. Landaeta defined project performance based on budget, schedule performance and quality.

Landaeta (2008) empirically found that the greater the level of effort expended on knowledge transfer helped improve the body of knowledge related to projects ($r = .329$). However, the regression analysis (R^2) came out to 6% which suggested that other factors also contributed to project performance. Landaeta also found that the higher the level of the body of project knowledge the better the performance ($r=.320$). R^2 at 10% also indicated that a significant portion of the variability was determined by factors other

than the body of knowledge from other projects. Landaeta originally hypothesized that there would be a negative correlation between a project team's efforts to transfer knowledge and project success. Yet there was a positive relationship between the effort exerted in transferring knowledge and project performance (r=.248). In addition R^2 explained about 10% of the variability. Landaeta suggested that the finding for the last hypothesis may not have been valid because it was unlikely that diverting resources from the project's mission would benefit a project. Overall, the research concluded that certain strategies could be implemented that minimized the cost of knowledge transfer across projects and maximized the value. One strategy was to select motivated team members to perform knowledge transfer functions. Second senior management enabled knowledge transfer and consequent benefits. Finally, select a few individuals on a team to focus on knowledge transfer thereby reducing the costs of knowledge transfer. Overall, the analysis suggested that the cost of knowledge transfer was justified by an improvement in project success though other factors also contributed to project performance.

Jugdev (2007) conducted an empirical study on the relationship between project management and achieving competitive advantage. This study was part of a larger study that looked at the relationships within the knowledge-sharing spiral (Nonaka, et al., 2000). A survey of 202 project managers from the Project Management Institute that was undertaken was premised on a theoretical model. A company's competitive advantage could be evaluated based on how valuable, rare, and inimitable its resources are and how well the organization supports a project which was labeled the VRIO (Valuable, Rare, Inimitable, and Organizational support) model. To have ongoing

competitive advantage the resources must also be inimitable. Ongoing support was also indicative of competitive advantage. Jugdev's empirical results indicated that intangible knowledge provided a temporary competitive advantage, however, tangible knowledge sharing did not. Jugdev also found that the knowledge sharing spiral conformed to its theoretical foundations.

The relationship between KM and project success appeared to be positive, however, results conflicted. Moreover, it appears that tacit knowledge enabled by personalization strategy was often a better predictor of project success. Haas and Hansen (2005) and Jugdev (2007) empirically found that tacit or intangible knowledge could lead to project success in competitive situations. Yet Haas and Hansen and Jugdev also found that explicit knowledge or tangible knowledge was not correlated with success in a competitive environment. Hong, et al. in a systems integration consulting environment also empirically found that tacit project knowledge enabled tacit product knowledge and in turn project success in a systems integration environment, but explicit product knowledge did not correlate with project success. Henry, et al. (2007) concluded that reliance on team for estimates, senior management guidance, and project management experience correlated with improved project scheduling and budgeting but not learning from similar projects. Dingsøyr and Conradi (2002) concluded that three of eight organizations reduced software development costs, quality improved in one, and fewer mistakes were repeated in another organization. All of the companies that showed better results utilized both a personalization and codification strategy. However, Newell and Edelman (2008) in a survey found within a utility company that codifying lessons learned correlated with project success in their survey even though employees

did not recognize the value. Lierni and Ribière (2008) found a mildly strong relationship between KM and project management success. Landaeta (2008) found that the cost of knowledge transfer was justified by project performance improvements but other factors may have contributed more.

Organizational Learning

The articles in this section focus on the elements that drive organizational learning and their relationship to project learning. In addition, many of the studies are conducted in relation to project-based organizations such as IT and construction. This section is divided into three sub-sections. The first sub-section (The Effect of Organization and Culture on Organizational Learning) describes how organizational learning was shaped by the organization and cultural factors. The second sub-section (The Effect of Process and IT on Organizational Learning) focuses on how organizational learning was shaped by process and technology. The third sub-section (Organizational Learning Summary) summarizes, evaluates, and synthesizes the literature from both sub-sections and helps establish the OLF variables.

Effect of Organization and Culture on Organizational Learning

Ayas (1996) conducted action research at a major aircraft manufacturer where she developed a concept to network projects to achieve program objectives and enhance learning. A program may initially consist of a single team. As work increased a second layer of teams may form around the core team and a third layer of teams around the second layer teams. Teams came and went as required to meet the requirements of the program. Within the project network structure (PNS) members of the core team were leaders on the level two teams and members of the level two teams were leaders on the

level three teams. Thus, many core team members served on two teams. The link team member understood the big picture requirements and constraints of the upper level team as well as the specific issues of the subordinate level teams. This allowed information to move quickly through the teams. In addition, lessons learned from one team flowed between teams rapidly. Moreover, Ayas empirically found that learning must be integrated into the project management process to enable project learning.

Ayas (1996) theorized that the project network structure could work in any organization structure and promote continuous improvement. Ayas and Zeniuk (2001) indicated that the project network structure led to a project was delivered on time, within budget, and of high quality. The project network structure successfully increased the velocity of knowledge sharing between teams.

Bresnen, Edelman, Newell, Scarbrough, and Swan (2003) reviewed a single case of process innovation in the construction industry to understand the part that social interaction had in sharing knowledge between project teams. The £370 million British company employing 1,200 people introduced new positions known as Regional Engineering Managers (REMs). The REMs were responsible to improve the means for transferring knowledge between project teams. The REMs established bi-annual gatherings for engineers to exchange lessons learned, the REMs frequently inter-acted with one another, and there was a champion for the process. The case indicated that the REMs relied extensively on their personal networks to interact with each other and the engineers. In addition, knowledge was transferred largely by word of mouth. While a database was available there were no incentives to keep the system up-to-date and accurate.

Bresnen, et al. (2003) concluded that KM in project-based organizations depended heavily on social settings and a community approach. This social network was an important element within which the REMs operated. The case study indicated that the process innovation cost £0.5 million, yet it was unclear how the new KM process in the project-based organization impacted organizational learning or project performance.

Koskinen (2004) theorized that project-based organizations may not have a complete understanding of the differences between tacit and explicit knowledge. Koskinen conducted a conceptual study based on epistemological assumptions to establish the foundation for a PKM framework. Epistemology was divided into two major groups namely cognitive and autopoietic. Under the cognitive approach knowledge represents pre-established reality and this knowledge could readily be shared. Under the autopoietic approach knowledge was created based on observation and it was context sensitive. Autopoietic knowledge was difficult to share. Koskinen chose the autopoietic approach for application in a project environment. He then set the foundation for a two-by-two matrix that on one side consisted of tacit and explicit knowledge. Substitutive and additive knowledge identified the other dimension of the matrix. At the outset of a project new knowledge must be developed which may be additive or substitutive. Substitutive knowledge involved the substitution of new knowledge for old knowledge. For projects with clear goals additive knowledge is used. One is building on the base of the knowledge that existed. Thus, the two-by-two matrix enabled project classification. For example, house construction required additive and

explicit knowledge and a research and development project required substitutive and tacit knowledge.

Koskinen (2004) enabled organizational leaders to classify projects and better develop a KM strategy. For example, a contractor building homes may conclude that a codification strategy was most appropriate (Hansen, et al., 1999). It may also suggest that the firm should organize its KM program to focus on sharing explicit knowledge. Koskinen's approach enabled an organization to simultaneously plan commercial and KM strategies.

Leseure and Brookes (2004) evaluated knowledge transfer between projects by interviewing 19 individuals who worked in 14 organizations. Most of the individuals were in aerospace and construction. Based on the interviews Leseure and Brookes developed a theoretical framework that explained the nature of different KM systems. Respondents outlined a number of external barriers to the effective implementation of PKM including company down-sizing, long-term supplier termination, high organizational and project turn-over, and company growth. The respondents also indicated that it was important to put in place programs to incentivize employee contribution to knowledge sharing, to make clear ownership of knowledge, and to reach a balance between innovation and stability. Knowledge that substituted existing knowledge could be disruptive. Respondents also felt it was a challenge to transfer tacit knowledge. The authors determined that respondents were often talking of gradients of knowledge. Kernel knowledge enabled an organization to reuse knowledge in future projects and could be treated as an intangible asset. Organizations strived to improve kernel knowledge. Ephemeral knowledge was active only during the project.

In order to enable effective management of kernel knowledge the authors used concept originally developed by Buckman Laboratories that included three layers namely the infrastructure (hardware and software that facilitates communication), infostructure (organization and processes that facilitate knowledge sharing), and infoculture (background knowledge that organizational members may not be fully conscious of). Best in-practice infrastructure included specific organizational structures to facilitate learning, dedicated IT including expert systems, libraries, and organizational awareness. Infostructure was enabled by templates, processes, incentives, and project controls as well as effective management of the balance between innovation and stability. Infoculture was enabled by post-project reviews, a supportive culture for knowledge sharing, training, and recruiting.

Owen (2006) reviewed how KM was integrated into program management. Program management involved coordinating multiple projects to achieve a common purpose (Project Management Institute, 2008). Owen interviewed nine people within an engineering firm in Australia. Project teams benefited from the program office because it provided a means to network the project teams in various ways. The program office set standards for processes, templates, post-project reviews, and documentation. These processes also ensured that project teams looked at all of the issues such as risk management. In addition, the program office helped to standardize performance reporting. The program director mentored his staff and this was one way that helped project teams reuse knowledge. Finally, the program office acted as a means to resolve conflicts that could not be resolved at the project level. Thus, the use of program knowledge enabled the firm to set up a network for knowledge transfer and reuse. The

networks enabled informal and formal exchange of information. The networks also helped people develop relationships to foster tacit knowledge transfer.

Pretorius and Steyn (2005) studied the dissemination of tacit knowledge within and between project teams PKM within four groups of a large commercial bank in South Africa. The authors selected the case study methodology interviewing 13 participants using open-ended questions derived from the literature. The bank utilized project teams to implement strategies, optimize operations, and enhance efficiency. The interviews were focused on individual team member roles and tasks, project team structure and locations, and the means to manage knowledge. The interviews were also used to understand participant perceptions about culture and staff support.

Pretorius and Steyn (2005) found that the physical environment was an important factor in encouraging or discouraging knowledge sharing. If people were co-located and had a good place to meet then the team more readily gathered to share lessons learned. Staff tenure was also important. The longer people had worked together the higher the level of trust which enabled knowledge sharing. In addition, the size of the project teams impacted knowledge sharing. It was easier for staff to share knowledge when teams were small. The research also found that it was difficult to share lessons learned between project teams. Information was posted on the intranet but it was not easy to use. Physical limitations and tight schedules also impeded knowledge sharing between teams. It also appeared that the culture was individualistic. Pretorius and Steyn suggested that management allow people more time to participate in PKM processes and provide resources to enable the process. Also, the authors suggested that project managers should use performance appraisals to motivate people to use organizational

learning processes. In addition, management should bring project managers together on a regular basis and form communities of practice.

Desouza and Evaristo (2006) outlined the major project management office (PMO) types through interviews with project leaders in 32 IT organizations. Problems with projects resulted from poor PKM including ineffective budget estimating, scheduling, ineffective communications, and failure to learn lessons and apply them. A PMO could enable an organization to integrate lessons learned from all projects and pro-actively share key lessons with other teams. A PMO could also provide experts to facilitate the flow of information between project teams. Desouza and Evaristo indicated that according to CIO magazine and the Project Management Institute a survey of 450 project managers showed that 67% of the organizations the managers worked in had a PMO. Desouza and Evaristo defined a PMO as a group that integrated lessons learned, encouraged knowledge sharing, established project processes, trained project teams, managed resources, coordinated multiple projects, or oversaw project finances.

Four archetypes were discovered during the interviews. First, some PMOs provided administrative support to projects but did not influence projects directly. Second, some PMOs managed information including score cards and project tracking. This PMO integrated knowledge but could not enforce policies. Third, some PMOs acted in the capacity of knowledge managers. They acted as central stores for knowledge and worked with teams to share best practices. Finally, Desouza and Evaristo defined a PMO they labeled the coach. The coach acted as a center of excellence and had responsibility to ensure that projects performed well. Knowledge

intensive PMOs were found to be more suitable for organizations with more sophisticated project management practices.

Haas (2006) studied KM and project performance in dynamic and difficult work environments. He conducted a field study using multiple methods at an international development agency. First, Haas conducted 70 interviews to define the organizational character which was project oriented. Organizational traits included over worked staff, politics, and ambiguity. Second, a survey was conducted that related knowledge gathering to project success when slack time was high or low, when work experience was high or low, and when a team had high or low decision-making autonomy. Within the agency 485 project team members completed valid surveys related to 96 projects. The respondents were asked about knowledge gathering, slack time, work experience, and decision-making autonomy. Project quality had previously been determined by an independent quality team.

The results showed that if slack time was high, organizational experience was high, and decision-making autonomy was high then high knowledge gathering in each case reduced the likelihood for the project to perform below expectations. For all three cases the reverse was also true. For example, if slack time was low and knowledge gathering high then the likelihood of a low project success rating was high. Haas (2006) concluded that it was important to recognize that KM occurs within the realities of the organization which may or may not constrain KM effectiveness. The research also implied that if senior managers worked to change the culture they could bring about project success. For example, managers could increase slack time.

Reich (2007) over a three year period conducted research that identified risks and their impact on project processes and project outcomes. The methodology entailed five steps. First, a literature review was conducted. Second the research was integrated into a conceptual model. Third, the model was presented to IT professionals in Canada, New Zealand, and the United States. Fourth, 15 interviews were held with senior IT professionals to obtain feedback. Finally, Reich qualitatively evaluated the data.

Reich (2007) theorized that organizational learning translated individual learning to the organization and groups as well as recognizing that projects process a great deal of knowledge. Since IT project management was a complex knowledge based endeavor firms should promote team learning and that there were risks if they did not. Reich's concept included 10 knowledge-based risks in IT projects. At the outset of the project two risks were identified. First, projects create risk if they do not learn from prior projects. Second, risk was generated if knowledge requirements were not considered in selecting the team. Several other risks in project governance, project operations, and project closure were also identified. The risk at project closure is that project lessons were not captured. Many participants in the study indicated that not capturing lessons learned at the close of the project was the most serious risk.

Reich (2007) offered five suggestions to reduce risks associated with project learning. First, organizations needed to create a climate where team members can learn. Second, project managers should ensure that the team was staffed with people who have the knowledge to perform. Third, the organization should promote ways and means to transfer knowledge. Fourth, teams should implement practices to retain memory of

lessons learned. Fifth, the team should establish a risk register to enable managers to address knowledge issues.

Zqikael, et al. (2008) theorized that top management support was vital to project success and needed to be measured. The study related 17 top management processes such as use of a knowledge warehouse to four project success variables including schedule overrun, cost overrun, project performance, and customer satisfaction. From several industries 290 project managers including software development, engineering, construction, services, and manufacturing within Israel were surveyed.

Zqikael, et al. (2008) found that senior management support was highly correlated with project success where $R^2 = 0.11$ for cost overrun, .15 for schedule overrun, .17 for project performance, and .16 for customer satisfaction. Six of the 17 top management processes had the highest impact on project success including "communication between the project manager and the organization, organizational project quality management, use of new tools and techniques, appropriate project management assignment, project success measurement, and use of organizational project data warehouse" (Zqikael, et al., p. 26 – Table 4). The last process related is broader than the name suggests. The concept refers to an organizational KM system in which each project is valued for learning. The learning system included personalization and codification strategies. Based on the findings Zqikael, et al. developed a maturity model for each of the six processes that may be used by executives to gauge their support for projects. The maturity model allows executives to rate their performance on a scale from one (initial) to five (leader) for each of the six categories. Within the matrix is a description of what a senior manager should be doing to be at that maturity level.

Zqikael, et al. empirically established the importance of senior management's role in establishing and maintaining and organizational KMS.

Ajmal and Koskinen (2008) conducted a conceptual study regarding the impact of culture on organizational learning in project-based organizations. KM failed in organizations because the culture was unsupportive. Project-based organizations were those which deliver value to customers based on one-time designs. The organizations could be a division within a firm, a company, or a consortium. Project management was viewed as a complex process integrated amongst other organizational processes. As a result knowledge transfer was more complex as well. Even organizations that capture lessons learned have difficulty transferring knowledge to emerging projects. There was too much information that was not accessible and there was insufficient time to go through the files to find relevant knowledge. Several barriers were identified to transfer knowledge within project based organizations. Most projects have strict budgets and timelines that did not allow for KM activities. Employees did not wish to openly address failures. Many employees were not motivated and did not see the value. These barriers related to the organization's culture. "Culture is to the organization what personality is to the individual" (Ajmal & Koskinen, 2008, p. 11). Culture could impede or strengthen KM. Ajmal and Koskinen identified four culture types including control, competence, collaboration, and cultivation. A control culture sought to ensure certainty and reduce risks. A competence culture related to achievement. A collaborative culture stressed that people working together to make decisions. A culture of cultivation may be considered one of ideals and beliefs. Leaders should understand where an

organization tends to fit within these cultures in order to enable one to better integrate KM into the organization and overcome barriers to open communication.

Ajmal and Koskinen (2008) theorized that there were three levels of knowledge creation including the individual who originated the knowledge, the group that provided an opportunity to exchange ideas, and the organization that consumed knowledge from the groups and ultimately transformed the culture. IT was identified as an enabler supporting KM. The change agent should ask questions related to the way in which communications were conducted, understand elements that have improved projects, the types of knowledge that could be forwarded, and so forth. For example, an understanding of the culture may help a change agent to include enough time in processes to learn lessons. Finally, the change agents needed to understand that organizations were social organisms and to evoke change one must assess the culture, align projects with the culture, and work within the core culture. Yet there were also common problems and questions suggesting that some organizational learning factors appear to cross cultures. For example, Ajmal and Koskinen theorized that leadership and making time for KM were key elements of any successful KM initiative. These organizational learning factors spanned cultures though the path to reach an effective state may be different.

Petter and Randolph (2009) based on the literature and 24 semi-structured interviews with IT project managers within a single consulting firm that employed 95,000 people developed themes for knowledge reuse. The focus was on soft skills. In order to explore the topic Petter and Randolph focused on managing user expectations. Four themes emerged from the study. First, if knowledge was considered novel then it

was more likely to be transferred. Yet if knowledge was considered routine people would not think to transfer it to others. Second, knowledge transfer depended on the organization's enablers. The social norms should support knowledge transfer. Third, project knowledge was explicit and tacit and thus the categories were the same as those of organizational KM. Fourth, knowledge reuse could be categorized into three methods including using verbatim, synthesis, and creation. Verbatim occurs when knowledge is reused without modification. Synthesis occurs when managers integrate knowledge from several sources to solve a problem. Synthesis was the most common category of reuse. Creation occurred when a group brainstormed a new solution to a difficult problem. This method was used when the past did not provide an adequate model. Experienced managers used a KM database to obtain knowledge yet inexperienced managers would seek guidance from within the social network. Petter and Randolph theorized that this happened because inexperienced managers sought knowledge dealing with soft skills.

Petter and Randolph (2009) developed recommendations to improve knowledge reuse for all managers. Employees should be provided with incentives to formally obtain knowledge. Mentoring programs may help to develop inexperienced managers more quickly. Training should also be instituted to help people understand how to reuse knowledge and to encourage the practice. Finally, the KM System should be structured to include knowledge relevant to all employee levels whether they were new or experienced.

Christensen and Bukh (2009) studied KM in two project-based organizations. Knowledge perspectives were associated with explicit and tacit knowledge. The explicit

dimension focused on artifacts while the tacit dimension was process oriented. Christensen and Bukh sought to understand PKM based on a company's business model delivering mass produced products or custom tailored solutions. One company Bang and Olufsen (B&O) produced electronic consumer products. The study focused on the product development division within B&O which was project oriented. The other company FKI Logistex Crisplant A/S (Crisplant) produced and installed automated transport systems that were developed in close concert with each customer. Five people in each company were interviewed at the same organizational levels including senior management, project management, and engineers. Data was gathered using semi-structured interviews aimed at understanding why the company worked with KM, how the companies worked with KM, how knowledge was created, stored, retrieved, and shared, and does knowledge interact with project management.

At the outset of projects B&O emphasized the need for personal interaction. In addition, the company promoted an environment where everyone walked around and spoke to others about their projects and shared knowledge. B&O established a number of internal courses where employees taught each other. B&O also had a strong program to capture and codify knowledge. At each milestone the project managers captured lessons learned and documented them. Crisplant focused their KM activities on face-to-face meetings and informal exchanges. The company established communities of practice to promote knowledge sharing. At the start of each project there was a "seeing phase" and at the end of the project a "seeing again phase" (Christensen & Bukh, 2009, p. 12). Crisplant also used IT tools to support knowledge capture which project managers must contribute to each month. Christensen and Bukh empirically found that

both companies used personalization and codification strategies. However, Crisplant tended to emphasize informal knowledge transfer and this may be due to their focus on customized solutions where as B&O focused on both personalization and codification. B&O stressed personalization during the initial project phases yet the company placed significant emphasis on documenting knowledge for use in future projects. Christensen and Bukh confirmed Hansen, et al. (1999) in that organizations should adapt personalization or codification to their business model. Yet deeper within the organization divisions may also need to tailor KM to their activities.

Kampf and Longo (2009) illustrated how KM and project processes were integrated and interwoven using a case study. The case related to knowledge exchange using cell phone and Web 2.0 between a non-governmental organization (NGO) in the Democratic Republic of Congo (DRC), and students with expertise in Denmark. The NGO provided micro loans from $50 to $300 to women entrepreneurs. The project was in the initial stages to obtain grants for students, NGO staff, and women entrepreneurs in the DRC to exchange knowledge by phone and web 2.0. Normally the NGO trained the women in business practices such as bookkeeping. Using KM principles it was planned to shift the focus from pure training to a knowledge exchange between the NGO trainers and the women entrepreneurs respecting that the women have knowledge specific to their business and communities. Using communities of practice the women and trainers could exchange information instead of the trainers merely transmitting information to the women. The authors described that project initiation was related to the SECI process of externalization. The project planning process was related to combining explicit knowledge from different sources. During project execution the

team (students, NGO, and women entrepreneurs) would work together to internalize the results. The authors illustrated this with a project to help microloan recipients articulate their issues with business practices such as advertising and bookkeeping. For example, ba (a communication means and reinforcing environment for people to come together) enabled a virtual workshop that might be set up to facilitate discussion of using computers to track expenditures (Kampf & Longo, 2009; Nonaka, et al. 2000).

Kampf and Longo (2009) concluded that the integration of KM and project management affected the nature of the projects that the students proposed. The project titles, goals, and descriptions reflected respect for the NGO and customers. The use of KM was expected to lead to an environment that created greater respect for the loan recipients and would encourage more two-way communication and interaction. Integrating KM into project management may change the culture of the organization. Further, the approach could lead to a more positive atmosphere. It would be interesting to see a follow-up article on how the new approach impacted business success using the new way of working between the trainers and the women entrepreneurs.

Caldas, Gibson, Weerasooriya, and Yohe (2009) evaluated lessons learned programs (LLPs) within 70 construction firms who were members of the Construction Industry Institute (CII). The evaluation determined what organizations were doing in the area of LLPs, what benefits they were experiencing, and described the issues construction firms are facing. The data was collected using three separate surveys and from case studies. First, preliminary surveys were sent to the CII membership eliciting preliminary information about LLPS. Second, another in-depth survey was sent out regarding potential legal barriers. Third, another general survey was sent to the

membership to learn in more detail about the lessons learned processes and to understand maturity of the processes. Finally, the authors conducted interviews with 10 firms including eight who had responded to the surveys and two known to have quality LLP programs.

Caldas, et al. (2009) during phase one found that 73% of lessons learned were obtained in meetings and interviews. Many of the meetings were technology enabled. People in 61% of the accessed lessons learned from databases. Only 6% of the firms did not have a lessons learned program. Organizations normally collected lessons at the conclusion of a project. Before publishing many companies used subject matter experts to validate lessons before they were published. Firms that employed informal lessons learned programs evaluated lessons in various staff meetings. Most organizations counted on the emerging project teams to utilize lessons at their discretion. The analysis indicated that seven factors were critical to success including leadership, lesson collection (lessons must be collected), lesson analysis (lessons need to be evaluated), lesson implementation (lessons need to be used), resources (resources must support LLP), maintenance and improvement (continuously improve LLP), and culture (needs to support LLP). The first questionnaire cited that 16% of the firms expressed liability risks. Thus, a survey was sent out addressing legal issues to legal experts. Legal experts agreed that during discovery lessons learned documentation could lead to legal consequences if there was a failure to implement standard processes or ironically to learn from past mistakes. However, the authors concluded that if steps were taken to mitigate the legal risks LLPs can benefit the organization.

The second general survey probed into the benefits firms realized using LLPs. Benefits included process improvements, better communication, leverage of best practices, and lower costs. Leadership was a key ingredient to ensure success of an LLP. Some companies made use of artificial intelligence and other advanced technology solutions to enhance their LLP. However, there were issues too. The survey indicated that 49% of respondents did not believe that their organization was giving them enough time to implement the program. LLPs were not always a priority for individuals in organizations. Moreover, it was often difficult to quantify the benefits for LLPs. The case studies revealed that none of the companies used full time employees to manage the LLP. The authors also concluded that many of the benefits of LLPs occur during the planning stages of future projects. Some firms employed creative technology solutions. For example, one company developed a subscription service that proactively notified teams of lessons that could be relevant to a project. Caldas, et al. (2009) concluded that the benefits of LLPs were significant and abundant. Moreover, LLPs would become more valuable as globalization expanded and employees approach retirement.

Swan, Scarbrough, and Newell (2010) qualitatively evaluated factors that enable learning from projects through a review of 13 projects across six organizations. The study was based on the framework of Zollo and Winter (2002) who described 'experience accumulation, knowledge articulation, and codification.' The study related organizational learning to three organizational structures including secondment, overlay, and coordination. Secondment included a structure in which a central team prepared the bids and broad-based cross-functional teams and sub-contractors execute the project.

Overlay described a matrix structure where project team members report to a functional and project manager. Finally, the coordination style represented functional groupings in which project team members worked on projects as a special assignment.

Swan, et al. (2010) empirically found that secondment organizations learned through experience accumulation primarily. As employees built their experience they brought it with them from project to project. Although secondment and overlay firms had access to more formal learning mechanisms they were not used because people lacked time or were skeptical of the value of the mechanisms. Secondment organizations had a strong emphasis on timely delivery which impeded use of formal learning mechanisms. There was also evidence that project teams kept knowledge to themselves even from similar projects down-stream. On the other hand overlay and coordination organizations rarely transferred knowledge from projects to the wider organization. In coordination organizations people were focused on their functional work and did not have strong ties to the project. Overall, Swan, et al. concluded, regardless of organization type, that often knowledge does not transfer from the project to the organization and that if knowledge was transferred it was by the person or through personal networking. Thus, the situation may improve by helping individuals to balance their allegiance between the organization and projects using incentives and reducing time-pressures.

Effect of Process and IT on Organizational Learning

Liebowitz and Megbolugbe (2003) developed a conceptual framework to enable project managers to implement KM. The framework included a number of KM solutions many of which involved technology and a questionnaire that enabled senior

managers to grade the organization's PKM capabilities. The solutions included get-togethers to exchange tacit knowledge using chat rooms, electronic libraries, communities of practice, expert locator system, knowledge repository, expert systems, data and text mining, and use of intelligent agents. The framework also included a questionnaire that enabled a company to assess communications, the KM environment, organizational facilitation of KM, and KM measurement. There was a scale to grade an organization's KM proficiency from A to F based on the survey. Von Zedtwitz (2003) also suggested a maturity model to gauge project learning proficiency.

Von Zedtwitz (2003) conducted a study on use of lessons learned practices by research and development teams. Von Zedtwitz found that 80% were not sharing lessons and the remaining 20% were not effectively using lessons learned practices. Von Zedtwitz then followed up with a conceptual study of barriers to learning lessons. In addition, von Zedtwitz developed a lessons learned maturity model based on Carnegie-Mellon University's (1995) Capability Maturity Model (CMM) for software engineering. Von Zedtwitz used the CMM as a basis to establish a theoretical five step framework for achieving maturity in the post-project review processes. The first step involved unstructured reviews. The second step introduced guidelines for post-project reviews. The third step called for the implementation of a standard process. The fourth step established goals and focused on corrective action not blame. During the fifth step post-project processes were optimized, reviewed, and improved. Lessons would be widely distributed and used. In conclusion a maturity model helped an organization focus on good practices and enhance communication.

Abdel-Hamid and Madnick (1990) conducted a case study of a software project within NASA. Initially the project team estimated that the project required 16,000 delivered source instructions that cost 1,100 work days and required 320 business days to complete. The project missed the schedule by 20% and over ran the budget by 100%. On the surface the issues appeared to be that the project was under budgeted, recovery staff was hired too late, and the budget for quality assurance was well above industry averages. Another project team may be tempted to conclude that a similar project in the future should be budgeted at 2,200 man days to be completed within 380 calendar business days. Abdel-Hamid and Madnick developed a simulation model to help decision-makers find the optimum number of days to schedule. The model helped the researchers to run a number of trials to determine at which point lowering the staff levels would under-size the project. They accomplished this by slowly removing slack time activities in the original project.

Abdel-Hamid and Madnick (1990) found that the optimum schedule in their case study was 1,900 hours. Had a team simply doubled the schedule work would have filled the vacuum and resources would have been wasted. This case also suggested that there was value in assigning an experienced analyst to review lessons learned before storing them. A single analyst could mitigate the need for multiple teams to do the same analysis. The analyst and the system could make it easier for a team to understand to what extent lessons learned apply to their project.

Weiser and Morrison (1998) theorized that project information was rarely available to future teams in a coherent manner. In order to resolve the problem they developed an information system prototype that was tested in the field and in the lab.

The system included features to index the knowledge to make retrieval easier. Weiser and Morrison developed a data model that consisted of "projects, users, events, meetings, and documents" (p. 149). The system was designed to make it easy to input knowledge while the focus was on enabling users to access information without perfect recall of what the user sought. Users benefitted from the design that enabled work in an environment familiar to users, enabled standard keyword search, secured storage, access paths but with constraints, and offered context for the data. The focus was on providing a platform to develop project memory. The field test provided information regarding system usability with a real project. The experiment compared management of project memory using manual paper-based techniques and the system.

The field study showed that the system was useful to team members because it enabled communication. The field study did not confirm the usefulness of the system to future project teams. The lab study indicated that the system worked better for structured tasks than unstructured tasks. However, Weiser and Morrison (1998) opined that as users gained more experience and used the system for larger projects the system would have enabled improvements in managing unstructured tasks as well. Weiser and Morrison illustrated that a well designed KMS may lead to KM excellence.

Fong (2003) conceptualized a model of knowledge creation based on the literature and two case studies for projects in the construction industry. Fong's model was an alternative to Nonaka and Takeuchi (1995). Fong argued that Nonaka and Takeuchi did not address issues of knowledge creation within multi-disciplinary teams. Fong found it problematic that tacit knowledge which was unarticulated was always a precondition for explicit knowledge. In addition, multi-disciplinary teams may not

always share a common language. In order to define a new model Fong explored the knowledge sharing processes of multi-disciplinary teams in a real estate development project and an infrastructure project.

Fong (2003) observed five knowledge sharing processes in the two companies. The first process related to boundary crossing which was essential for project success. One boundary was between different disciplines and the second between organizations such as the client, consultant, and contractor. Personal communications and drawings were most effective in crossing these boundaries. In addition, project managers enabled boundary crossing by setting a good example. The second process addressed knowledge sharing. When a project team had diverse membership then team members were more likely to discuss and share information. For tacit knowledge to be shared it was important to have interpersonal communication. The third process related to knowledge generation which was created through social networks, reports, and customer feedback. Social networks were considered to be the most important vehicles to create knowledge. The fourth process to integrate knowledge was more formal which was accomplished by considering the diverse views of all team members using project documentation, drawings, and other documentation. The fifth process related to collective learning in which the team engaged in self-directed learning utilizing lessons learned from failures. Individuals would then form their own strategies for using the lessons learned. The fifth process also involved inter-project learning from concurrent projects or from completed projects. Fong also theorized that some repetition of processes was important to enable learning among projects. It was emphasized that the five processes were inter-related. Boundary crossing was an important element of the model to enable knowledge transfer.

Desouza and Evaristo (2004) theorized a model for a KMS based on a number of case studies. Project knowledge was classified in three segments. Desouza and Evaristo indicated "knowledge in projects" (p. 87) related to management of project schedules, milestones, meetings, and training; "knowledge about projects" (p. 87) helped project managers to manage financial and personnel resources as well as user expectations; and "knowledge from projects" (p. 87) contained insights and lessons learned that may benefit future projects. In addition, the personalization and codification strategies were related to different architectures for a KMS. Personalization was related to a peer-to-peer architecture because the nodes could act as a client or a server whereas a client-server architecture that was more centralized related to a codified strategy. Using a centralized approach helped make lessons learned available to the organization at large. The U.S. Army used a centralized system effectively to manage knowledge. However, centralized solutions posed problems because those with the least to gain have to put the most effort into updating the systems. In addition, people may fear they will become less valuable to the organization. Also, a centralized solution may be inefficient since a lot of information regarding schedules and other project specific data is valuable only to a team. John Deere used a Peer-to-Peer model and set up 65 communities of practice with information shared by video conference, e-mail, and discussions. Yet since data structures varied it was difficult to share knowledge.

Desouza and Evaristo (2004) conceptualized a hybrid approach that utilized the best features of a centralized and peer-to-peer architecture. Knowledge about and from projects would be stored in a central repository because it could be valuable to the entire organization. It would enable ease of maintenance and access and an appropriate level

of standardization and context for the organization. Knowledge in projects would be stored in a peer-to-peer system. Motorola used a hybrid approach. White papers, requirements documents, and test reports were available to all employees. Information that was customized for a specific project was stored in the peer-to-peer systems. Desouza and Evaristo demonstrated how the architecture of a KMS enabled knowledge sharing between project teams. Project teams would access centralized information to obtain lessons learned and utilize the P2P environment to analyze and apply those lessons within the context of a project.

Falbo, Borges, and Valente (2004) developed a process and KMS to improve software project performance for a CMM level 3 organization in Brazil. This organization had in place a software engineering process group (SEPG) that was responsible for process management. SEPG was also responsible to develop tools to support the organization's processes. The team concluded that KM could enable the organization to continuously improve at the project and organizational levels. Thus, the team established two goals to establish a KMS and to use that system to support project planning. The system known as ProKnowHow was built to support formal and informal knowledge, to support well defined structure for memory in the organization, support knowledge filtering, support the software development process in real-time, and measure progress against objectives. Total Quality Management was applied to the process and system. The database containing project information was used to support projects and to enable analysis and synthesis of knowledge. The project managers submitted lessons learned which were filtered by the SEPG and then entered into the system. This information was considered informal knowledge. Goals, metrics, and standard process

updates made up the formal knowledge part of the system. Project managers played a key role to ensure the knowledge was distributed to team members. Each lesson included key information about the problem and its source as well a description of the context.

Falbo, et al. (2004) had recently implemented the model and believed it would enable process improvement, simplify process and project feedback, and enable improvements in project scheduling. This article illustrated how a process and a KMS were developed in concert. In addition, the system showed how a team considered carefully what lessons were entered into the system to enable downstream use. The act of evaluating the lessons learned provided a way to share tacit information.

Van Donk and Riezebos (2005) developed a method to measure the knowledge inventory in a project-based organization and tested it using a case study and survey within the organization. Domain knowledge was divided into three areas namely entrepreneurial, technical, and project management. The range of users or knowledge interests included employees, markets, and project phases. Understanding the domain and the range was the first step towards developing a knowledge inventory. The second step involved developing the metrics and a means to validate the inventory. The final step included detail and summary level reporting. Working with a Dutch engineering company consisting of 250 employees that developed pre-design and detailed designs for piping, logistics, mechanical, civil, and electrical engineering van Donk and Riezebos developed the questionnaire and scale. The scales measured the three areas of knowledge by market (Dairy, Food processing, and Chemical) and project lifecycle stage (“Acquisition, Initiation, Pre-design, Design, Plan of Specifications, Realisation,

and Utilization & Maintenance" (van Donk, Riezebos, p81, Figure 3)). The scales consisted of yes or no or interval scales ranging from 0 to 2 with 0 being no experience, 1 indicating junior experience, and 2 indicating senior level experience. The survey was issued and 163 employees responded.

Van Donk and Riezebos (2005) indicated that management used the inventory to plan strategy and determine which markets to focus on. The study also enabled management to determine where investments should be made in new personnel and training. Management also used the inventory to analyze risks of knowledge losses. Department managers used the inventory to help plan career paths for their employees. Finally, project managers used the inventory to staff projects and as an expert locator. The biggest issue with the inventory was maintenance of the information. This was resolved by assigning one person within each department to maintain the inventory. This alone indicated that the company thought it was cost effective to maintain the inventory. The knowledge inventory could enable a firm to develop business strategies. For example, the firm could determine where its core competencies lie and focus on those areas. Alternatively, the organization could determine to develop a competency. The knowledge inventory could also help management determine which projects to undertake.

Newell, et al. (2006) theorized that organizations employed a strategy to share knowledge between project teams using IT and that this approach was largely unsuccessful. Thus, Newell, et al. evaluated 13 projects across six organizations interviewing 137 people over a two year period to better understand how knowledge sharing between project teams worked. The team coded the data and used an

information system to help manage the analysis. If the team discovered inconsistent statements third parties were consulted to help resolve the issues.

Newell, et al. (2006) empirically found that informal mechanisms were often used to share knowledge. Personalization was the primary means of sharing knowledge. Moreover, mostly product knowledge was shared between teams. Senior managers often played a key role in facilitating knowledge between teams. IT was rarely used to share knowledge even though systems might be well designed containing documents and project review notes. Databases were effective in capturing what was done but not how or why. Moreover, Newell, et al. found that process knowledge was rarely captured. Participants did not recognize that process knowledge could be valuable. In many cases knowledge was not shared among teams. People did not know how or where to share information, did not have time to reflect on lessons learned, or did not understand the value of process knowledge gained. Lack of systems and tools to capture and share lessons was also given as a reason for failure to share knowledge. Intermediaries or experts in knowledge sharing were not available to teams to facilitate knowledge transfer between teams. Newell, et al. offered three recommendations. First, teams should be encouraged to capture process knowledge as the project proceeded. Second, intermediaries should be assigned to help teams learn and share their learning. Third, organizations should encourage development of personal networks.

Newell, et al. (2006) illustrated that for an IT solution to be effective it needed to enable a management process. In this case the organization needed to establish the KM process and supporting infrastructure. Then an ICT solution could prove useful as Hirai, Uchida, and Fujinami (2007) illustrated.

Hirai, et al. (2007) described an IT system that enabled research and development project teams to store and reuse knowledge. At the time the system was described it had been in use for six years supporting research and development laboratories. Two methods were used to manage projects namely a work break down structure (WBS) and work-flow or process management. A WBS enabled project managers to outline all of the detail tasks to be performed in a hierarchical structure (Project Management Institute, 2008) resembling an organization chart. Documents were associated with each work task. Work-flow addressed the steps or process necessary to accomplish a series of tasks. Utilizing documents in a WBS format and processes enabled knowledge to flow using the system. The system was programmed to notify team members of up-coming tasks and provided necessary information to enable accomplishment of the task. Another feature of the system was that after a project team had entered documents into the system an e-mail was sent to the team members suggesting a meeting be held to accept or reject the knowledge. This meeting similar in nature to Falbo, et al. (2004) was an important means to exchange tacit information and share lessons learned. As a result of the process and system the group enjoyed shorter time-frames to realize process improvements.

Laframboise, et al. (2007) evaluated the relationship between IT organizational KM capabilities and the success of knowledge transfer between IT and its users during the conduct of IT projects. The authors theorized that knowledge capability enabled an organization to improve performance or gain competitive advantage and that knowledge transfer success was an important aspect of knowledge capability. Thus, it was important to study the impact of knowledge transfer infrastructure and knowledge

process on knowledge transfer success. LaFramboise, et al. established two hypotheses. First, knowledge transfer infrastructure enabled knowledge transfer success. Knowledge infrastructure consisted of the structure including technology that encouraged communication and provided reward for communication, and an environment that fostered collaboration. In addition, the knowledge infrastructure included standardized IT systems. Second, knowledge process capabilities were related to knowledge transfer success. Process capabilities included the ability to maintain data integrity, secure knowledge, convert knowledge to appropriate formats, distribute knowledge to those who need it, and make knowledge readily accessible. Knowledge transfer success was divided into effectiveness and efficiency. An effective knowledge transfer occurred when knowledge was successfully absorbed. An efficient knowledge transfer was successful if it was transmitted in a timely and cost effective manner. In order to test the hypotheses Laframboise, et al. developed a survey and sent it to 2,425 IT managers sourced from the Canadian Capabilities Directory. Managers were selected from medium to large companies. The survey resulted in a useable sample of 127 responses.

The results of the study indicated that knowledge infrastructure contributed to knowledge transfer effectiveness but not knowledge transfer efficiency. On the other hand knowledge processes positively contributed to knowledge transfer efficiency but not effectiveness. Laframboise (2007) found that it was important to have a strong technological infrastructure in order to enable knowledge transfer. The article illustrated the importance of having both a knowledge transfer infrastructure and processes to ensure the success of knowledge transfer.

Ebert and De Man (2008) conducted a case study at Alcatel-Lucent. The IT management team integrated project, product, and process knowledge into a single lifecycle software engineering management concept. Project knowledge related to the project budget, schedule, resources, and milestones. Product knowledge related to the requirements and features of the product. Process related to workflows and other technologies. The lifecycle concept was named PLM and supported by an enabling KMS. At the outset of each project the system the management group asked teams to develop knowledge objectives as well product development objectives. These objectives were recorded in the PLM KMS. The team used PLM as the governing process from inception to project close. A key feature of the system was that it enabled the workflow. The system pushed the knowledge to a team member at the required time for that team member to execute the process step. In addition, as each document was entered into the system meta-data was captured to enable retrieval later. Employees were rewarded for following the process and sharing knowledge using the system. Engineers were also encouraged to network and share knowledge. Internal customers also used the system to follow projects. In addition, Ebert and De Man indicated that training was an important element to ensure success of the processes and system.

Ebert and De Man (2008) reported that 89% of the marketing and sales forces considered the PLM important for their jobs and the knowledge valuable. Also, 60% of the respondents used the IT tool supporting the PLM process, 70% exchanged information with product managers, and 80% would prefer to have information in the portal. In addition, 40% of defects were discovered earlier in the process leading to a cost savings of 30% in rework. Based on internal surveys Ebert and De Man recognized

that it was important to expand the KMS features to enable a personalized KM strategy. For example, the system could be used to enable employees to locate experts as needed for strategic, tactical, and operational matters. Ebert and De Man illustrated the importance of integrating the KMS and KM process into a comprehensive strategy. Moreover, the system illustrated how a KMS could enable workflow.

Ribeiro and Ferreira (2010) developed a KM system prototype to enable construction firms to better prepare for construction projects. Before developing the KMS prototype five case studies were conducted in the construction field from 2007 to 2008. The case studies revealed that all of the participants indicated that they did not use past experiences for planning new projects. A key reason was that people lacked the time. In addition, the case revealed that the participants did not have a tool to enable knowledge sharing. Thus a system was designed that provided a means to store knowledge from past projects, in-progress projects, and new projects. The knowledge was stored in a server that was connected to a knowledge base application serve which in turn users accessed. System use was enabled by a diagram and graphic representations. Based on a real-life test it was found that all of the forms and programs worked correctly which indicated that the program was successful. The authors acknowledged that they need to further develop the model. The article did not stipulate whether or not the system helped construction managers use and apply knowledge to future projects.

Ajmal, Helo, and Kekäle (2010) studied the contributors to the success of KM initiatives in project-based organizations. From a literature review the authors defined six elements that influence KM initiatives. The authors then sent the survey to 400

members of the Finnish Project Management Association and received 41 replies. The six elements included familiarity, coordination, incentive, authority, system, and culture. Familiarity related to the understanding within the organization about KM concepts and practices. Coordination related to the willingness of team members to communicate and share knowledge with one another. Incentives related to the management practices that an organization used to encourage participation in KM. Authority related to whether or not employees were empowered and authorized to share knowledge. A system referred to the IT that enables collection, transfer, and use of knowledge. Culture was unique to the organization and was believed to be a key factor in knowledge sharing. The survey evaluated which of the six elements were the most significant barriers in the adoption of KM initiatives.

Ajmal, et al. (2010) found that inadequate incentives and either the absence of or an ineffective information system were the two most significant barriers for KM initiatives. In this study culture and authority were the least significant barriers. However, all six elements proved to be barriers. Indeed the range between the highest barrier's weight (incentive) and the lowest barrier's weight (authority) was a spread of 0.048 on a scale of 0 to 1 or roughly 5%. The authors noted that the results needed to be viewed with caution in view of the sample size.

Organizational Learning Summary

Researchers focused investigations on organizational and cultural issues as well as processes and information technology that impact learning. In order to promote learning organizational structures have been modified. Ayas (1996) encouraged learning by networking teams. Bresnen, et al. (2003) studied a project team that co-

located and organized itself around the project. Owen (2006) through integrated organizational learning loops and project learning loops provided another structure that encouraged knowledge sharing. Desouza and Evaristo (2006) illustrated how project management offices can enable knowledge transfer between project teams. Zquikael, et al. (2007) demonstrated that top management could avoid project failures in part through KM techniques. Organizational structure that complements the traditional hierarchical structure as well as leadership can create a learning environment.

Researchers also studied the role of process and information technology in organizational learning. Von Zedtwitz (2003) and Liebowitz and Megbolugbe (2003) discussed the use of maturity frameworks to enable firms to continuously improve management of knowledge sharing. Several researchers developed processes and information systems to enable KM. In all cases the information systems either enabled a specific process or were integrated into process. For example, Van Donk (2005) developed a KMS that helped the organization and its employees understand their skill levels. Falbo, et al. (2004) and Hirai, et al. (2007) included meetings in their design in order that tacit knowledge could be exchanged as part of the process of managing lessons learned which likely accounts for the success of these knowledge management systems. Processes and systems can play an important role to complement organizational and cultural facets to support a learning company.

Project Learning

This section provides a review of the literature that focused on learning at the project level. This section is divided into three subsections. The first subsection (Project Learning within a Team and Post Project Reviews) addresses articles that

primarily addressed learning within a project or post-project reviews. The second subsection (Project Learning among Projects) addresses knowledge transfer between projects or emerging project learning. The third subsection is a summary, analysis, and synthesis of the section.

Project Learning within a Team and Post-Project Reviews

Collier, DeMarco, and Fearey (1996) based on experience with 22 projects involving 1,300 project members developed guidelines to conduct project postmortems. The process consisted of five steps. First, a project survey was completed after the project to obtain objective information. The survey helped participants in postmortem meetings to focus on key issues. In addition, the survey helped measure improvement over time. Second, project metrics were captured. The teams used the metrics to compare performance across other teams and should help future project planning endeavors. Third, project team members should be debriefed. A meeting may include up to 20 to 30 people. It was important to have a chair person, coordinator, and a facilitator external to the team for the meeting. "These pseudo-ceremonial meetings can cleanse the air, empty old baggage, and give team members the hope and courage needed to attack the next project" (Collier, et al., 1996, p. 69). Fourth, selected team members with deep knowledge of the project should participate in a project history day. The project history day meeting lasted from four to six hours and was considered the most important step. The problem statement was formulated and root causes were analyzed. During project history day the team also developed solutions and prioritized them. Finally, the results of the meeting were published. The report included a project description, positive, and negative lessons learned. Results were then stored,

categorized, and assigned. Management was responsible to ensure that assignments were carried out.

Collier, et al. (1996) offered insights into the project postmortem process. The article did not discuss whether the learning process was cost effective or how the process affected future projects. However, it was likely that the organizations gained from carrying out action plans and the employees who participated brought the knowledge forward to their subsequent projects.

Kotnour (1999) studied the learning process in learning organizations by conducting a survey of 43 project managers who were members of a local Project Management Institute chapter. Members were asked open-ended questions to determine if they considered learning goals, practiced intra-project learning, practiced learning between projects, and how lessons learned integrated with project learning. The survey revealed that 31 respondents completed lessons learned and 12 did not. Managers placed emphasis on completing the project on time within budget in a manner that satisfied customers. Yet Kotnour found that project managers considered learning objectives as well. Managers focused their efforts on learning from project tasks that were problematic. Lessons were normally completed at the end of the project. Managers did not always complete lessons learned because they lacked time. In addition, project managers believed that the lessons learned may not be valuable in the future because a project was unique.

Kotnour (1999) developed implications and a framework based on the study. The framework was anchored to the quality framework known as Plan, Do, Study, Act (PDSA) cycle. This concept was also highlighted in Project Management Institute's

(PMI) project manager certification training (PMI, 2008). Kotnour theorized that lessons learned should be integrated into the project life-cycle and that learning should be continuous throughout the project. Anbari, et al. (2008) also developed a concept that integrated project learning into the project lifecycle using Total Quality Management which is the broad concept that included PDSA. Kotnour also suggested that intra-project learning should be undertaken at each of the milestones throughout the project. Finally, Kotnour called for further quantitative research that related the project learning to project management success.

Busby (1999a; 1999b) evaluated four post-project review meetings in three companies to understand how people learned and identified weaknesses in the reasoning that occurred. The value of the projects ranged from several hundred thousand dollars to a few million dollars. The companies were involved in capital equipment supply. Busby sought to answer two research questions. First, he wanted to know the degree of diagnostics developed in post-project reviews. Second, he sought to understand the appropriateness of the diagnostics process. Managers, engineers, customer service, and designers participated in the meetings. Meetings consisted of five to nine people at different levels. People learned in different ways. First, team members resorted to dialectic argument. One person stated a perspective, another person would present a different perspective, and still another person would combine perspectives. Second, team members replayed events that occurred during the project. Third, people simulated what may have happened had they done things differently.

Busby (1999a; 1999b) identified weaknesses in post-project review learning which were categorized into attribution problems, excessive concreteness, shallow

diagnosis, lack of data, and interpretation errors. One general limitation of learning related to a bias towards attributing problems to the environment and not focusing on what the team could have done to improve. Team members focused excessively on specific issues but did not look at the bigger issues that may have been involved. The diagnoses were shallow and did not probe the root causes. Busby theorized that participants did not want to ask participants direct questions in order not to damage relationships. Team members did not access data that in some cases was readily available including budget and schedule performance information. Team members tended to focus on technical matters instead of business outcomes. People also interpreted the outcomes incorrectly by dismissing issues because they were minor to the project team but could be important to future project teams.

Busby (1999b) theorized that the reviews focused on a single project and thus often the findings were not extended throughout the organization. Learning was incremental because meetings occurred at the working level by people who had little influence or incentive to develop enterprise lessons learned. The meetings provided people with an ability to explain what went wrong, to agree on remedies for the future, increased knowledge of the participants, provided a platform for experienced people to lead other members, and enabled people to vent concerns.

Busby (1999a) offered six recommendations to improve post-project review meetings. First, the team should use cause and effect diagram techniques to encourage team members to fully develop lessons learned. Second, refer to historical events beyond the team to understand if a problem was systemic. Third, look at the broader processes and systems to gain a broader perspective. Fourth, encourage team members

to think deeply and address root causes. Fifth, identify the side effects or risk of proposed solutions to the problems. Finally, allow outsiders to attend the meetings benefitting the team and outsiders with a deeper understanding of the issues and spread learning to other teams.

Busby (1999a; 1999b) developed insights that could improve project reviews. In order to put these ideas into practice an organization would need to have strong leadership, training program, and ongoing coaching. It appeared that the level of investment would only be warranted if the lessons were transferred and applied by other teams.

Birk, Dingsøyr, and Stålhane (2002) theorized that project postmortems were important for small, medium, and large projects. Project postmortems provided value to the individual team member and benefited future projects. Suggestions were provided to conduct a postmortem in small and medium sized projects. The project postmortem process consisted of three steps namely: preparation, data collection, and analysis. When a meeting was held a neutral person should facilitate the meeting. Lessons learned should include negative and positive issues. Based on experience with a satellite software company the authors confirmed that project postmortems were valuable in and of themselves to help employees to learn and carry forward knowledge to future projects. In the software company many projects were running over budget. Based on several project postmortems the company gained a better understanding of the causes and set up training forums to deliver projects within budget.

Schindler and Eppler (2003) provided an overview of proven experiences to capture project lessons learned after outlining the reasons that learning was not

accomplished. Lack of time, discipline, skills, and motivation were key reasons that project teams did not capture and transfer lessons learned. Even if the processes were followed they may not be followed faithfully. For example, lessons learned were not well documented, descriptions were too generic, archived in a way that made lessons difficult to retrieve, or people rejected lessons because they did not develop the lesson. Schindler and Eppler divided lesson learned techniques into two groups namely a process-based and a document-based approach. A process-based approach was focused on the procedures or steps undertaken to capture lessons learned. The document-based approach was focused on the means to represent and display the content of lessons learned.

Schindler and Eppler (2003) discussed four distinct process based methods. The project review or project audit was conducted either at the end of the project or at the end of project phases. An external moderator carried out the review working with the team members. The objective was to identify risks early and correct them. Post-project control was conducted at the end of the project by the project manager. The purpose of the post-project control process was to enable improvement of future projects. The outcome of the post-project control was a formal document that included recommendations for future teams. A post-project appraisal was conducted two years after the project ended by an external team. This could be a small team. The purpose of the post-project appraisal was to learn from mistakes and transfer knowledge to future project teams. This technique was generally used for large projects. After action reviews developed were conducted during a work process and may be facilitated by an

external party. An after action review enabled a team to learn from its mistakes and transfer knowledge within the team.

Schindler and Eppler (2003) also discussed three documentation methods namely: micro-articles, learning histories, and RECALL. Micro-articles were about a half page in length and included the topic, description, and keywords. Learning histories were written stories of what happened during the project. These histories ranged from 20 to 100 pages. RECALL was developed by the NASA. Team members were encouraged to enter lessons learned into a database. A check list was provided in order that team members may understand if the lesson was important. Schindler and Eppler encouraged teams to collect lessons learned continuously throughout the project, to use a facilitator to manage debriefings, to include lessons learned in the project lifecycle, and finally to set learning goals along with other project goals that are tracked.

Scarbrough, Bresnen, Edelman, and Laurent (2004) conducted an exploratory study on the tensions between two forms of learning namely "learning-by-absorption" (p. 492) and "learning-by-reflection" (p. 492). Learning-by-absorption was the capacity to recognize useful lessons learned, incorporating them into the organization, and applying them to achieve value. Learning-by-reflection was the process to make prior and implicit knowledge more explicit to the individual and the group. This could happen through reviews and diagnosis. Scarbrough, et al. selected a water company interviewing 14 employees. The case focused on a construction program consisting of three projects related to a new sewage plant. The £60 million program was considered a success largely because of program management changes made over the course of the program. During the first project learning was primarily technical. The core team

learned from prior efforts and absorbed those in its process. However, for the second and third projects the program manager instituted changes to the normal process. Functional managers in various corporate offices and project team members were located together at the site. In addition, contract personnel were located together. Contracts were developed with subcontractors based on shared-gain and shared-pain.

Scarbrough, et al. (2004) found that at the outset of the program learning-by-absorption dominated the learning process. As the first project moved along the project manager noticed that learning-by-absorption decreased in value because engineers constrained knowledge based on proven solutions that did not always meet the needs of the new project. The culture of the organization encouraged use of proven solutions. As the program proceeded to the second and third projects learning-by-absorption occurred primarily within the team that the project manager located away from the head office. In addition, learning-by-reflection became more important as 'walls' between functions eroded. Learning was enabled in the second and third projects because the same teams completed both projects. Trust had built up between team members. It was also observed that the more successful the team had become using its new approach to learning the more difficult it was to assimilate learning into the larger organization. The culture of the project team and the organization had diverged.

Scarbrough, et al. (2004) illustrated the importance of evaluating lessons learned and understanding their applicability to the team's specific mission. Learning-by-reflection was also important. It was also found that while 'walls' within the project were eroded that new 'walls' with the corporate office were unintentionally built. Thus, it was unclear if a new project could learn from the team that was studied in the case.

The organization would need to provide strong leadership to derive lessons from this team and assign members of this team to several other teams in the future to spread the unique process knowledge gained.

Sense (2007) theorized a model to evaluate learning in projects and used the model as basis to evaluate learning in a manufacturing plant. Sense developed his model within the framework of social constructivist theory which was focused on relationships, sense-making, informal interactions, collective actions, and conversation at work (Sense, 2007, p. 406). This theory helped to explain how project participants make sense of activities and learn. The model consisted of five elements. First, cognitive style referred to the way one normally learns. For example, one may learn by doing. Second, learning relationships referred to the interactions between team members and that affect on learning. Third, authority addressed how team members learn and depend on management for learning. Fourth, KM addressed the ways that the team managed its knowledge and shared knowledge with others. Fifth, situational context addressed the environment and its ability to enable learning. Within the cognitive style there could be adaptors and innovators. Adaptors focused on conducting work without straying far from the norm. Innovators think outside of the norm. Both learning styles may introduce tension but both were valuable to encourage learning. Learning could upset the delicate balance of relationships between people. Addressing these issues enabled a team to share knowledge.

The organization in the case had a culture that depended on senior managers for knowledge. One person noted that “dependency on the leader is built into our psychological contract” (Sense, 2007, p. 410). To reduce the negative impacts of

authority communal analysis and debate were promoted to mitigate the hierarchical dependency within the organization. This team after coaching focused on a personalization strategy to gain knowledge from each other and prior teams. This approach led to passionate exchanges but improved learning within the group. This model provided a method to learn lessons about learning itself and its effectiveness. In addition, an organizational team (Grillitsch, Müller-Stingl, & Neumann, 2007) could use Sense's (2007) model to review the learning assessments that came up from the project teams to make improvements.

Desouza, et al. (2005) compared two methods for conducting project postmortems namely reports and stories and provided insights on post-project reviews. The comparison was enabled by a number of case studies in different organizations of which two were described. The results of Desouza, et al. indicated that stories were more expensive but contained rich knowledge with context that readers readily recalled. Reports on the other hand cost less to prepare and were easy to comprehend but the information was not easily retained.

Desouza, et al. (2005) also identified issues with postmortems and potential solutions. In most case studies that software engineers did not have time to learn lessons before they were reassigned. Thus, it was recommended that a cost/benefit analysis be done to determine when it was cost effective to take the time to develop stories. Although post-project reviews were time consuming they proved effective when accomplished in one of the case studies reviewed. A key part of the benefits would come from down-stream use of the lessons learned. Moreover, it was important for individuals to reflect on what they had learned in addition to group and organizational

reflections. Desouza, et al. also recommended that organizations conduct reviews of all post-project reviews to identify macro-lessons.

Kotlarsky, van Fenema, and Willcocks (2008) evaluated coordination within two IT projects; one successful and one not successful through the prism of KM. The coordination mechanisms through which knowledge was exchanged depended on the formal organization infrastructure, the work process (including plans, requirements, and designs), technology enablers (such as the phone and video conference), and social or inter-personal relationships, and communication. From the two projects 19 people participated in semi-structured interviews enabling Kotlarsky, et al. to evaluate the positive and negative practices for each of the mechanisms.

Kotlarsky, et al. (2008) found that the organization infrastructure for the successful project was fairly stable throughout the project whereas the organization changed several times in the unsuccessful project. Moreover, management in the successful project developed a structure of contact people and fostered direct communication to enable coordination. The work process in the successful project included flexible project management and division of work to enable staff to work on functions from end-to-end minimizing the need for unnecessary knowledge exchange. Standardized specification formats enabled the successful team to effectively coordinate requirements. Both teams used standard software development tools and the internet to enable communication. In addition, the successful team used shared databases for project information. The successful project made an explicit effort to build the team and enable interactions among the team members. Actions included team building activities,

working together to reduce knowledge gaps, building relationships, and maintaining a team atmosphere. The unsuccessful team did not manage social coordination issues.

This model was interesting because to a large extent the project manager and the team could work together to manage several of the mechanisms. It would be much harder if the organization infrastructure impeded learning, but the project team or teams could use the model to understand what they could do to be successful.

Anbari, et al. (2008) conducted a conceptual study and offered a discussion to better understand the role of post-project reviews in projects and the contribution that these reviews make to PKM. The authors discussed different group perspectives on post-project reviews and the impact of organizational culture and structure on post-project reviews. The analysis was completed with a step by step process to conduct post-project reviews. Anbari, et al. theorized that there should be a balance between project sponsors, the customers, the project team, and the functional department from which the team may come. These four groups need to be aligned in order for post-project reviews to enable effective flow of information between the parties.

Anbari, et al. (2008) conceptualized a process that integrated lessons learned into the project lifecycle. The first step was to initiate the project by identifying how project success will be measured. The second step entailed the planning process which could be enabled with Total Quality Management (TQM) tools such as the House of Quality (HoQ). Product and service designers use the HoQ to prioritize customer requirements, integrate the customer's needs and technical solutions, and evaluate trade-offs between technical solutions (Blanchard, 1998). The HoQ itself was an integrated set of matrices combined to look like a house. The third step called for executing the project. Again

several TQM practices were suggested such as check sheets, run charts, and other mechanisms typically found in manufacturing but they could also be applied to IS projects. The fourth step entailed controlling the project using TQM tools such as Six Sigma techniques and cause and effect diagramming to enable knowledge sharing. Within the fifth step the post-project review process should be undertaken. Lessons learned should come from all of the prior steps. Anbari, et al. concluded that post-project reviews were strategically important for organizations. The information from post-project reviews could help improve staff selection, achieve better understanding of customer needs, and establish an environment for future project success.

Project Learning Among Projects

Ayas and Zeniuk (2001) used stories from a Ford Motor Company project and action research at Fokker Aircraft to identify the features of "project-based learning" (p. 64). The Ford case study was related by a former project manager within the organization. Ford partnered with MIT researchers to introduce an organizational learning model while a vehicle development project was underway. The project consisted of 1,000 team members across divisions. Within Fokker a project team was formed to develop a new airplane. The teams at Ford and Fokker were formed into project networks or teams within teams linked by members who were part of the main team and sub-teams. The two models enabled both Ford and Fokker to achieve significant improvements. At Ford the new vehicle model achieved record performance in on time delivery, cost, and quality. The project recovered from being four months late at the outset. The launch was the smoothest in Ford's history. At Fokker the team also achieved good performance delivering on time, within budget, and high quality.

The team also was rated highly in such factors as team building, leadership, and learning.

As a result of the two cases Ayas and Zeniuk (2001) outlined six elements of project-based learning. First, the entire project should have a common purpose consisting of short-term and long-term goals. It was the long term goals that enabled learning to spread to other projects. Second, leaders must act as role models. Third, team members should feel safe to openly discuss problems and issues truthfully. Fourth, employees should be encouraged to develop communities of practice to enable knowledge sharing. Fifth, the learning infrastructure was balanced between support for formal and informal practices. Sixth, there were systemic processes that enabled the team to reflect on problems during the project.

Ayas and Zeniuk (2001) built upon the project network structure discussed in Ayas (1996). The project network concept introduced in Ayas (1996) was a unique way for team members to share lessons between teams within a program. In Ayas and Zeniuk (2001) the network was expanded through communities of practice allowing team members to reach outside of their program to share tacit knowledge throughout the life of the project.

Disterer (2002) developed a conceptual study to address the problem that IT project teams did not share lessons between project teams. Disterer first reviewed the barriers to knowledge sharing between teams. Once projects were completed team members were quickly reassigned to many new projects around the organization and files may be stored but they were not accessible for later use. Time pressure increased because time-to-market had become more critical. In addition, team members did not

like to review lessons learned because they could be painful. Also, individual employees did not see the benefit to themselves in sharing information with future teams. Finally, processes and documentation that were effective in transferring knowledge between IT and users were not useful in knowledge sharing between IT project teams. As a result failure to transfer knowledge led to mistakes being repeated. Disterer sought to bring together project management and KM perspectives to better enable synergies between the two disciplines. Projects and project organizations required attention, but did not receive it. Organizations focused on innovation but did not invest in the effort to learn from the effort. Mostly individuals retained what they learn for future use. Thus, Disterer theorized that inserting KM techniques into projects could enable knowledge sharing between projects.

Disterer (2002) theorized that several steps would improve knowledge transfer between projects. First, KM activities should be included in the project budget and schedule. Second, someone should be assigned the role to manage the KM capture process in defining where new knowledge was expected, how the experience should be documented, and how the information should be preserved. Third, Disterer suggested a list of questions that should be covered when project teams review lessons learned. This further suggested that organizations should establish a template covering questions to ask and what to cover to capture lessons learned. Fourth, it was important to establish an environment in which it was safe for employees to discuss difficult lessons learned. Fifth, lessons learned should be documented in detail. Sixth, a database of project profiles that summarized the project would be helpful to future project team members. Finally, an expert locator system should be developed. Disterer in closing suggested

that project work was on the rise as corporations tackle new challenges and respond quickly to threats. Thus, Disterer theorized that it was important for project teams to incorporate KM into their work.

Garon (2006) conducted a conceptual study of project lessons learned in international space programs. Garon developed his theory from his experience, the literature, and discussions with partners in other space agencies. Garon theorized that while space agencies required project managers to document lessons learned the practice was ineffective and lessons were not utilized. It was particularly difficult to discuss budgets which were usually under stated at the outset of the project for fear of the repercussions. Garon based on his review of the literature found that organizations underestimated projects from 40% to 400%. Also, people feared that their careers may be limited if they reveal too much in lessons learned. In addition lessons learned systems were not easy to use. For long projects (five to ten years) it was difficult for team members to recall the lessons learned. Virtual teams did not take the time to learn each other cultures and to build the team. Finally, there was a culture in space agencies that knowledge came only with experience.

Garon (2006) offered seven suggestions aimed at improving management of lessons. First, lessons learned should be incorporated into risk management. Garon equated lessons learned with risk events which could be positive or negative. The Project Management Institute (2008) viewed risk events as either positive or negative as well. Second, train managers about lessons learned and create awareness through face-to-face meetings, presentations, and discussions. Make learning lessons a part of personnel development. Third, develop a lessons learned management model for the

organization. Garon offered one for space management. Fourth, identify the critical few lessons that can make a difference. Fifth, use professional cost estimators to develop budgets to improve the integrity of budgets. Sixth, reference the literature for lessons learned and before beginning projects. Seventh, foster collaboration in international meetings. Set up chat rooms and other vehicles to collaborate.

Petter, et al. (2007) theorized that sharing knowledge across projects was not easy and suggested a methodology that enabled project managers to obtain knowledge needed from prior projects. Ideas and tools for knowledge sharing were framed within the personalization or codification strategies. Petter, et al. theorized that project leaders need first to understand what they need the knowledge for. For example, a manager may ask what new knowledge was needed or could the manager reuse knowledge. Then managers needed to classify the knowledge. Should knowledge be to understand how to do something or understand the rationale for actions or processes? Next the manager should identify who will be involved in knowledge sharing and then how to share the knowledge. Finally managers need to understand whether the time focus is the past, present, or future. Knowledge that can be learned from the past may benefit from prior project lessons learned.

Petter, et al. (2007) outlined a number of tools and methods to enable knowledge sharing. Four suggestions could be considered organizational learning factors. Two OLFs support the codification strategy. It was recommended that organizations set up an information system to manage investments and portfolio performance related to budgets and project schedules. Also, future managers could use this system to look back and see how budgets and schedules were developed. It was

also suggested that a database be established to act as a repository for lessons learned. The other two OLFs involved a personalization strategy. It was recommended that knowledge maps be established in order that project team members could seek out experts. In addition collaboration systems would enable people to connect virtually around the globe. Six suggestions could be classified as PLPs. Four of the PLPs utilized a personalization strategy. These PLPs included networking, sharing stories, conducting postmortem analyses, and teams conducting SWOT analysis to determine strengths, weaknesses, opportunities, and threats of using prior project information. Two of the PLPs came from codification. Petter, et al. (2007) suggested that templates from prior projects could be used to enable future projects. Another suggestion was to develop risk assessments based on prior project documentation.

Grillitsch, et al. (2007) conducted a case study of a consulting firm to learn how newly implemented practices impacted project knowledge sharing. The organization evaluated in the case study introduced post-project review meetings. Meeting facilitators were trained to support the meetings. In addition, the case organization held strategic meetings to review the lessons learned from the various project review meetings. Two additional steps were included in the project development lifecycle. Early in the project a step was inserted to learn lessons from old projects. Late in the project a step was inserted to develop lessons from the project about to close. Finally, project teams utilized a system that covered consulting roles, change management, processes, and communications.

Grillitsch, et al. (2007) concluded that organizational attention and a structured approach to implementation of lessons learned practices offered a framework for

companies to invest in KM practices. Investment should be accomplished incrementally as results were proved according to the theory developed by Grillitsch, et al. during their case study.

Goffin, Koners, Baxter, and van der Hoven (2010) conducted five case studies for firms in Germany to understand how lessons learned and tacit knowledge were transferred between new product development teams. The firms were involved in several areas of manufacturing. Six experienced staff members in each firm were interviewed. In addition, the research team reviewed a number of documents including post-project review reports or meetings notes. The team found that in a typical meeting 56 lessons were discussed and only three were captured in a report (p. 46). While some of the 56 lessons may not have been important a number of lessons based on tacit knowledge were not captured. Organizations used a variety of means to pass the knowledge on to other teams. One method was to assign knowledge brokers who had specific responsibility to pass the knowledge on to others. Another method was to provide start-up teams with a presentation at their kickoff meeting. Goffin, et al. also found that one company strived to innovate new codification methods to articulate what had previously been tacit knowledge. Specifically, one firm could not understand why a certain plastic formulation after much work proved successful. The firm decided to develop further specifications based on the environment the plastic would be used in. Kickoff meetings were identified as a useful forum to review lessons learned by prior teams. An important method was to promote individual reflection on lessons learned through mentoring. Communities of practice were also found to help individual reflection. It was also suggested that employees maintain lessons learned logs.

Goffin, et al. (2010) offered a number of specific suggestions to transfer those lessons learned that deal with tacit knowledge. For example, it was important to hold post-project reviews shortly after the product was launched. The core team should all be present at the meeting. A professional facilitator should be used to guide the meeting. Similar to Desouza, et al. (2005) stories were encouraged. The article connected post-project reviews with down-stream knowledge sharing and re-use. Knowledge brokers, presentations at kickoff meetings, and codification were offered to enable tacit knowledge transfer between teams. Most of the solutions that the companies used could be implemented at the project level and were not expensive to execute.

Project Learning Summary

Learning from past projects begins with capturing lessons learned and storing them for future projects. Thus, many researchers addressed the importance of post project reviews. Busby (1999a & 1999b) described how teams learn and the different processes used to understand what the team had gone through. Collier, et al. (1996) described a rigorous process not only to learn lessons but to provide a means for project teams to bring closure and start fresh on their next assignment. Schindler and Eppler (2003) outlined documentation and process methods that could be used depending on an organization's needs. For example, an after-action review occurs in a tactical setting immediately following completion of a project milestone. Desouza, et al. (2005) also discussed using stories and reports to capture lessons learned. Stories were more expensive to capture and store but provided richer context to future project teams. Implementing effective practices to capture and store knowledge sets the stage for emerging projects to benefit from the knowledge.

Several researchers evaluated knowledge transfer between project teams. Ayas and Zeniuk (2001) focused on knowledge sharing between concurrent teams. Disterer (2002), Garon (2006), and Grillitsch, et al. (2007) in their conceptual studies included project learning in the initial steps of project initiation and planning. Anbari, et al. (2008) and Kotnour (1999) integrated total quality management and knowledge management into the work of project management. Goffin, et al. (2010) theorized means to transfer knowledge between projects using knowledge brokers, meetings, and relying on stories similar to Desouza, et al. (2005). Throughout the articles in this subsection on project learning it was either implied or explicitly stated that project success depends on project learning. Desouza, et al. (2005) indicated that poor project performance stemmed from a failure to exchange knowledge between projects. Disterer, Garon, Goffin, et al. and Grillitsch, et al. set the stage for further research on how emerging teams use and act upon lessons learned. More research focused on the emerging project team demands for knowledge is needed.

Project Success

Banker and Kemerer (1992) theorized that it was difficult for users and software developers to establish contracts because the performance metrics were unclear. Too much attention was paid to budget and schedule performance and insufficient attention to long term values such as maintainability and user satisfaction. The researchers developed a principal-agent model for the parties to use in developing software development contracts. The principal represent users and agent represents the software developers. The model was tested in two small case studies. The model was

mathematically structured to reward or compensate the agent for delivering value to the principal. The model consisted of four elements namely: "x_1 (initial development cost), x_2 (maintainability), x_3 (timeliness), and x_4 (effectiveness)" (Banker & Kemerer, 1992, p. 388). It was desirable to minimize x_1 and maximize x_2, x_3, and x_4. If a variable such as maintainability or effectiveness could not be observed then it was necessary to use a surrogate measure. Banker and Kemerer used system complexity metrics to serve as a surrogate for maintainability and user satisfaction at the end of the project to measure effectiveness. As one might expect the short term metrics related to budget and schedule were more precise than user satisfaction and maintenance complexity.

While doing the case studies Banker and Kemerer (1992) found that the organizations had metrics for budget and schedule. Yet the organizations did not have metrics for maintainability and user satisfaction. The authors noted with concern the emphasis on short term metrics. Banker and Kemerer theorized that if McCabe's cyclomatic complexity model could be shown to predict maintenance costs, and the agent could control code complexity then, perhaps, there may be a means to measure maintainability indirectly. Another factor to consider was the cost of developing and managing long term metrics. It would also appear that even if maintainability could not be measured that a good beginning would be to measure user satisfaction.

Purvis and McCray (1999) conceptualized a process to conduct project assessments when the project starts, while the project was underway, and when the project was closed. These assessments would cover the key lifecycle steps in the Project Management Body of Knowledge which continued to be the same in 2010 (PMI, 2008). These steps are "initiate project, plan project, execute project, control project, and close

project." The assessments would also cover supporting processes such as quality, communication planning, risk management, procurement, and staffing. The initial assessment sought to ensure the project was feasible. Progress assessments focused on comparing current status to the plan. Progress assessments were also used to ensure that lessons learned were being captured as the project proceeded instead of at the end. Purvis and McCray suggested that lessons learned be collected and organized as the project proceeded. Finally, at project close one should assess performance against four criteria including business value delivered, on time performance, delivery within budget performance, and quality performance.

Kutsch (2007) conducted a survey to learn what project managers believed were the criteria for project success and failure. The survey was conducted in the United Kingdom with 70 project managers in the computer services industry. Kutsch asked respondents on a scale of one to five to indicate the extent to which the project achieved the success criteria. Six project success variables were evaluated in the survey including efficiency (quality, cost, and time); obtaining pre-stated objectives (met specifications); team satisfaction; satisfaction of users, owners, and stakeholders; owner benefits; and achievement of purpose (Kutsch, 2007, p. 418).

Kutsch (2007) found that achievement of purpose ranked number one with a mean of 4.13 and benefit to owners ranked number two with a mean of 4.10. Further the study showed quality, cost, and time ranked number six with a mean 3.21. Thus, it appeared that many projects did not achieve quality, cost, and time objectives. However, managers, when asked, if the projects was a success or failure 72.5% indicated the project was a success. Quality, cost, and time objectives had a low

association with project success. Kutsch explained that project managers may have learned to fail (Lyytinen & Robey, 1999) or that cost, schedule, and quality have become secondarily important. Kutsch (2007) also indicated that the sample used in his study came from a narrow segment. Another issue may have been that some variables combined too many elements. For example, different stakeholders may have different expectations and perceptions of project success (Karlsen & Gottschalk, 2004). Kutsch provided empirical data that may be used to help define project success variables.

Zqikael, et al. (2008) conceived four project performance metrics. These metrics included cost overrun, schedule overrun, project performance, and customer satisfaction. Zqikael correlated 17 top management success factors to the four project success variables. The cost and schedule overrun variables were measured by percent variance from the plan and project performance and customer satisfaction on a scale from one to ten.

Anbari, et al. (2008) conceptually proposed measuring project performance based on two major metric groups. The first metric group came from the PMI's famous 'triple constraints' including scope, cost, and time as the primary metrics to measure project success (Anbari, et al.). The triple constraints called for a project team to deliver the project scope within budget and on time. The scope stipulated expected project accomplishments (Martin & Tate, 2001). Anbari, et al. established secondary triple constraints that included the ultimate project outcome from the customer perspective, quality, and mitigation of all risks which related to long term project success. These factors were not always established up front in a project as they were implicit.

However, the second set of triple constraints was most important in the customer's mind.

Anantatmula and Kanungo (2008) built on past research findings and conducted theoretical research. The authors theorized that project success factors can vary by stake holder. For example, a customer may determine success based on project functionality and the controller based on budget performance. In a similar vein to Anbari et al. (2006), Anantatmula and Kanungo defined project performance and project management performance. Project management performance related scope, cost, and time. Project performance related to the broader project objectives that originally drove the need for the project. A project team may consider the project a success based on project management performance while the customer might be dissatisfied based on their perception of project performance.

Anantatmula and Kanungo (2008) established three levels of measurement. First, scope, cost, and time were basic elements to measure project success. Second, project processes including planning, status updates, and decision-making should be measured. Finally, project success depended on harmony of the team. Thus, Anantatmula and Kanungo identified three metrics for projects. The three metrics included goal orientation, team and coordination, and measurement. Goal orientation involved the organization's culture to stay focused to achieve business targets. Team and coordination related to an organization's climate that encourages trust, harmony, and participation. Finally, measurement addressed an organization's ability to measure qualitative and quantitative success measures including business success and customer satisfaction.

Karlsen and Gottschalk (2004) conceptually developed five metrics specific to IT projects. The first one labeled project performance was similar to the PMI's triple constraints included time, cost, and quality. Quality meant that the technical requirements have to be met (Karlsen and Gottschalk, 2004). The second metric addressed maintainability, reliability, data integrity and system availability or the state of the system throughout its useful life. The third metric related to the success of initial system installation. Elements included the effectiveness of user training and the smoothness of the transition from the old information system to the new one. The fourth metric addressed benefits to the client organization including impact on profitability and the ability to attain strategic objectives. The final metric evaluated the system from an external perspective including social and environmental value.

Shenhar and Dvir (2007b) also developed their concept of project management metrics. The first metric addressed the need to deliver projects on time and within budget. The second metric related to customer satisfaction levels, achieved benefits, and retained loyalty. The third metric addressed employee satisfaction, and personal growth as well as retention in the organization. The fourth metric addressed financial returns, market position, and impact on growth. Finally, the fifth metric addressed how the project positions the company for the future.

Project Management Institute (2008) published the global standard for project management. This standard contained the body of knowledge that was the basis of the project management professional exam. PMI defined project success to include product quality, timeliness, budget compliance, and customer satisfaction.

Reich, Sauer, and Wee (2008) interviewed 57 successful IT project managers in the United Kingdom, United States, Canada, and New Zealand. The research looked at new techniques that project managers have applied to ensure success. The findings were divided into three categories including goal definition, project set-up, and project execution. With goal definition managers challenged their customers to ensure that the requirements would lead to business value. Project set-up included preparation for the unknown and specifically to "focus the team on business value" (p. 268). Among the ideas suggested in the interviews to improve project success the key idea was to focus on delivering business value even if the schedule needed to change. Thus, this article simply stressed one measure of project success that being IT projects should deliver business value.

Barclay and Osei-Bryson (2010) conceptualized an approach for developing IT project performance metrics. In addition they tested the process known as the project performance framework (PPDF) by conducting three case studies. This framework utilized two underlying methodologies. Value focused thinking (VFT) helped project managers to understand in-depth the strategic objectives of diverse stakeholders. VFT was accomplished by following a number of steps to identify all stakeholders, their values, and objectives. VFT was followed by the goal question metric (GQM). The GQM technique stressed that performance metrics were an outcome of goals. The Project Performance Framework combined the two methods with stakeholder identification and analysis, means to structure findings in VFT and GQM, and enabled teams to prioritize the goals. The PPDF also provided a means to develop a map or flow chart that related specific objectives in the context of the project to decision criteria and

to key stakeholders. In each of the three cases preliminary findings indicated that the projects were better off with the tool than without. The authors quoted managers who indicated that the framework helped them to think more clearly about the purpose of their project. In addition the framework helped managers develop goals related to the project outcomes of most interest to the stakeholders.

The maps indicated common outcomes such as maximize revenue, maximize customer experience, minimize operational costs, improve reputation, obtain buy-in to a new concept or maximize use of the application. These metrics did not consider project budget or schedule issues. Thus, Barclay and Osei-Bryson (2010) further enhanced the importance of project outcomes as opposed to project efficiency.

All perspectives have common threads. First, projects needed to be evaluated on more than just delivering on time, within budget, quality, and to specifications. Second, project success included delivering value to the organization and customer satisfaction. Reich, et al. (2008) stressed the importance of keeping the team focused on delivering business value even if the schedule had to change. Third, some articles assigned additional responsibilities to project teams. Karlsen and Gottschalk (2004) suggested a measure based on contributions to society, Shenhar and Dvir (2007b) introduced a notion for future preparation. Anbari, et al. (2008) included risk mitigation as a metric. Some researchers theorized that team satisfaction was also a measure of project success (Anantatmula & Kanungo, 2008; Kutsch, 2007; and Shenhar & Dvir 2007b). These higher standards for project management suggested that projects have a significant impact on organizations, their future, and their surrounding environment. However, it would be a mistake to suggest that the traditional measures are less important. For

example, few senior executives or boards of directors would tolerate budget overruns unless the change was justified and even then may take a dim view.

Summary

IT project teams are not learning from other project teams. PKM may offer a discipline that can improve the situation. Hanisch, et al, (2009) empirically found that leaders in German companies believed that PKM offered solutions in spite of the barriers. Failure to learn has led to specific project failures (GAO, 2002; Gauld, 2007). Cerpa and Verner (2009) empirically showed that the cause of IT project failures has remained essentially unchanged for three decades. There appears to be a positive relationship between organizational learning and organizational performance. Goh and Ryan (2008) concluded that an investor over a 20 year period would have done better than the S&P 500 by investing in learning organizations. Yet it has been difficult to quantitatively prove that project learning leads to project success. Yang (2010) and Henry, et al. (2007) did not find that learning from prior projects led to organizational or project success. In addition, Kasvi, et al. (2003) as well as Holsapple and Wu (2008) theorized that KM must be extremely well done in order to realize value. Thus, it may be a challenge to correlate organizational learning, project learning, and project success since many organizations may not have implemented learning practices (Desouza, et al, 2005; Hanisch, et al., 2009; von Zedtwitz, 2003) let alone have achieved a state of excellence.

On the other hand Landaeta (2008) empirically showed that teams that contained a higher body of knowledge from prior projects were more successful. Lierni and

Ribière (2008) found a relationship between learning and effective project management. Zqikael, et al (2008) empirically found that one of the most important actions senior management can take is to foster learning in an organization to promote project success. From case study research program management has proved an effective way to integrate knowledge across project teams working towards similar objectives (Ayas & Zeniuk, 2001; Desouza & Evaristo, 2006; Owen, et al., 2004). Caldas, et al. (2009) concluded from their empirical study in the construction industry that benefits from lessons learned programs were significant. Birk, et al. (2002) illustrated a specific case that illustrated the benefits of reviewing lessons learned from several teams. In general the literature supports the concept that knowledge sharing between teams can be beneficial if programs are well managed.

The literature review also helped establish and articulate the importance of leadership's role to enable effective organizational and project learning. If leaders do not see value in learning and do not believe project learning should be a priority then it is unlikely that an organization can address the other root causes. Ajmal and Koskinen (2008) theorized the importance of organizational culture as it relates to learning in project-based organizations. Holsapple and Wu (2008) also theorized that one must focus on addressing measurement in order to justify use of resources for PKM. Further research that relates learning to project success may enable leaders to review the situation in their organizations further.

Chapter 3

Methodology

Introduction

This research was focused on information technology projects. Through the eyes of IT managers who have led projects it was planned to determine if there was a relationship between organizational learning, project learning, and project success. Other researchers provided a foundation for this approach. Henry, et al. (2007) evaluated organizational knowledge on cost and schedule predictability by sampling individuals that had project management responsibilities in IT organizations. Laframboise, et al. (2007) measured IT department manager perceptions of knowledge management (KM) capabilities and knowledge transfer. IT managers who have led projects had a broad overview of their projects and thus enabled the goal of this study.

The goal of this research was to conduct a correlational study to determine the relationship among organizational learning factors (OLF), project learning practices (PLP), and project success variables (PSV) within information technology (IT) organizations. The goal and theoretical framework that outlined the relationship among OLFs, PLPs, and PSVs led to the research question (RQ). What relationships exist in IT organizations among the following?

a. OLFs and PLPs
b. OLFs and PSVs
c. PLPs and PSVs

In order to support the main research question four support questions (SQ) needed to be answered as follows:

SQ1: What elements define the following?

a. OLFs

b. PLPs

c. PSVs

SQ2: How effectively do IT organizations manage OLFs based on the elements that define OLFs (SQ1a)?

SQ3: How effectively do IT organizations manage PLPs based on the elements that define PLPs (SQ1b)?

SQ4: How well do projects perform based on the elements that define PSVs (SQ1c)?

The research foundation provided the basis for the support questions. SQ1 provided a foundation for SQ2, SQ3, and SQ4 which in turn supported the RQ answer. In order to answer SQ1 a content analysis of the literature reviewed in Chapter 2 was conducted. Answering SQ1 provided the basis to develop a survey that was sent to IT managers to answer SQ2, SQ3, and SQ4. Specifically, SQ1a supported SQ2, SQ1b supported SQ3, and SQ1c supported SQ4. Answering SQ2, SQ3, and SQ4 enabled by surveying a population of IT managers allowed assignment of quantitative values to the OLF, PLP, and PSV variables. A higher score for any given variable suggested that the variable was more influential. The values provided the basis for the statistical analysis which was then used to develop the answer to the RQ. Finally, the results were reported. The high-level approach is depicted in Figure 2:

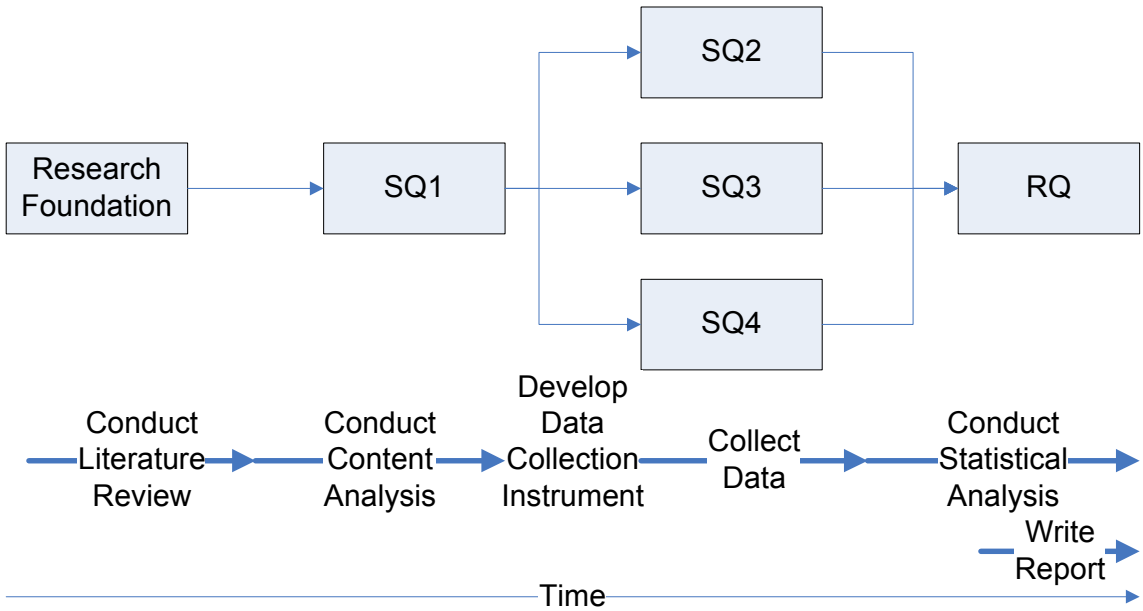


Figure 2. Research Flow to Answer Supporting Questions and Research Question

A correlational study was conducted to understand the relationship among variables (Creswell, 2005). Specifically, this research provides the basis to understand the relationship among OLFs, PLPs, and PSVs. The correlational study permits research with minimal impact in the work environment (Sekaran, 2003). This correlational study consisted of six critical milestones; completing the literature review, conducting a content analysis, developing a valid data collection instrument, collecting reliable data, completing a statistical analysis, and writing the report. The remaining sections address these milestones. Figure 3 outlines the main process and the key sub processes that were used in this research.

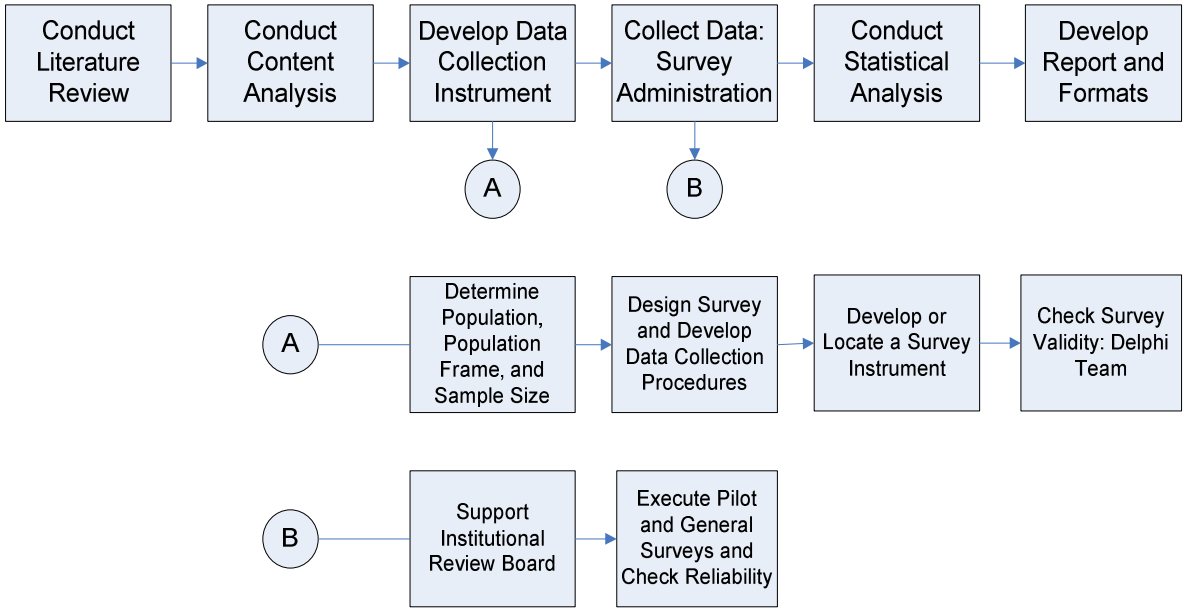


Figure 3. Research Process

Conduct Literature Review

Levy and Ellis (2006) noted that the foundation for all scholarly research was a literature review. In addition the literature review provided a foundation to answer SQ1. Lierni and Ribière (2008) indicated that the literature provided the foundation for their survey questions. The United States General Accounting Office (GAO) (2002) conducted a literature review to guide the development of appropriate questions in their study of project lessons learned in National Aeronautics and Space Administration (NASA). Han and Anantatmula (2007) stated that a literature review was the foundation for their correlational analysis between KM elements and employee willingness to share information within a single organization. Fowler (2009) suggested that a prior review of the literature was a foundation for survey research.

Levy and Ellis (2006) theorized that the literature search was an iterative process that continued throughout the research. Yet as a practical matter one must conclude the

literature review (Levy & Ellis, 2006). Webster and Watson (2002) suggested the end of the review was near when one does not uncover new concepts. Levy and Ellis noted that a signal that literature review was complete when no new citations were found. In this study the literature review was nearly done upon completion of the first draft of the survey.

Processing the literature was an iterative process consisting of six steps according to Levy and Ellis (2006). The first step was to know the literature. The second step involved comprehension of the literature. The third step called for the researcher to apply the literature. Levy and Ellis suggested that the concepts be organized in a matrix. Appendix A illustrates a matrix that was used in this research to organize articles by concept. The first column shows the article citations. The following columns indicate the concepts which included studies that establish the foundation for project knowledge management (PKM) in this research (Column: PKM); previous studies on project failures and their relationship to a failure to learn (Column: PF); articles that related knowledge to success (Column: K->S), and articles most relevant to OLFs, PLPs, and PSVs. During the fourth step articles were grouped into logical categories. This was simplified because Appendix A provided the author with a preliminary view of which articles belong to each concept. The literature review included a description of the article including the problem, method, and contribution in the concept section that related to the primary emphasis of the article (marked 'xx' in Appendix A). In addition, the analysis was conducted that revealed how to group and define specific PLP, OLF, and PSV variables that were measured from the perspective of project teams that demand knowledge. Grouping was a trial and error process in

which the objective was to find commonalities between concepts, suggestions, and ideas developed by researchers to improve organizational and project learning.

Upon completion of the analysis the individual literature reviews were synthesized in the fifth step and evaluated in the sixth step. The common message of the articles and key differences in the section were presented. An evaluation in the sixth step was conducted to assess the literature, derive conclusions, and indicate how the literature impacts this study. At the conclusion of each section in the literature review and within the summary for the literature review the material was summarized and evaluated.

Conduct Content Analysis

To determine the definition of OLFs, PLPs, PSVs and demographic variables (DEMs) a content analysis was conducted to objectively develop the elements of each variable (Coakes & Coakes, 2008). This approach was used to determine the major ideas through synonyms and an understanding of relationships with other terms (Coakes & Coakes, 2008). Content analysis enabled the researcher to put word groups into meaningful categories (Tesch, 1990). Coakes and Coakes also determined frequency of concepts by counting times mentioned in the literature. Heisig (2009) in a study of KM frameworks developed analysis categories and assigned content to demographic and research categories. Heisig also coded content to certain categories and counted times the concept was mentioned. Lakshman (2009) used content analysis to understand the relationship between CEO leadership in KM and organizational effectiveness. Lakshman developed structured questions for readers to use in evaluating CEO

interviews. The content analysis enabled development of OLFs, PLPs, PSVs and some DEMs.

In order to conduct content analysis the researcher developed a purposeful sample, described the data to be collected, designed recording protocols, evaluated the data, and validated the research (Creswell, 2003; Creswell, 2005). Creswell (2005) stipulated that a purposeful sample contained information that was pertinent to the research. Studies that related to project knowledge management, organizational learning within project-based organizations, and project learning offered useful material to define OLFs, PLPs, PSVs, and DEMs. The articles that were used for content analysis were reviewed during the literature review. Oh (2010) specified the sources used for his study using content analysis. Mitchell and Boyle (2010) also listed the four databases that they used for their content analysis regarding the study of knowledge creation measurement. In this research articles were found in the databases outlined in Table 2.

Table 2. Databases for Content Analysis

Database Name
ABI/Inform Complete-ProQuest
ACM Digital Library
IEEE Computer Society Digital Library
Computers and Applied Sciences Complete - EBSCO host
Academic OneFile - Gale Cengage Learning
Applied Science and Technology Full Text - Wilson Web
Emerald Management ejournals - Emerald Group
IBI Global Science Direct - Elsevier
Dissertations and Theses - ProQuest

The data included “sentences, paragraphs, or themes” (Tesch, 1990, p. 79) that researchers found were useful organizational learning and project learning approaches. In addition, data was extracted that helped define the variables that were used to measure

project performance. Finally, previous surveys used in KM provided a basis for defining demographic variables.

The protocol to capture the data involved taking short notes or quoting the sources using a table that captured the note or quote and a citation (Creswell, 2003). As data was captured it was necessary to first classify the data as an OLF, PLP, PSV, or DEM. References to the culture, processes, systems, tools, policies, and leadership that impacted organizational learning suggested an OLF. If a research article referred to processes and activities that emerging project teams conduct to access, evaluate, and decide which lessons to apply a PLP was suggested. In addition, if authors referred to methods and techniques to capture, store, and transfer lessons learned this also suggested a PLP. If an author theorized or had empirically concluded that project success should be measured based on certain dimensions or metrics a PSV was suggested. Finally, researchers that conducted surveys or correlational studies often stipulated the DEMs they used.

Each data element was given an identification code. For example, a data element that appears to be an OLF could initially be labeled OLF1. However, Tesch (1990) and Creswell (2005) noted that the process was iterative. Thus, a data element that was initially defined as an OLF may later have been reclassified as a PLP and the new id could be PLP227. The only purpose of the identification number in this research was to uniquely identify variables within a broad classification.

Creswell (2003) suggested six steps to evaluate the data. The steps and their application to this research follow. First, the data was organized and prepared. In this research the articles were organized in Appendix A. The recorded data was listed in

tables that stipulated the proposed OLFs, PLPs, PSVs, and DEMs. Appendix B is an example of a table for recording OLFs that ultimately were grouped together for a variable related to trust and support within the organizational environment. Second, one should read through the data multiple times. Third, the researcher needed to undertake analysis and coding to categorize the data. The analysis was undertaken by iteratively developing a theme and then grouping data elements within a theme. For example, several researchers suggested that there be an environment of trust within an organization to facilitate knowledge sharing. These elements were assigned to a single group. Fourth, the coding was used to generate a description of one's findings. For example, in this research the coding led to survey questions such as, "in my IT organization there is a trusting and supportive culture that enables knowledge sharing." Ajmal, et al. (2010) as part of preparing a survey listed KM enablers based on the literature and then classified the data within six factors that influence KM initiatives. Fifth, the methods to represent that data were indicated using tables. In this research the findings were represented in a subsection of the chapter on results using tables. Sixth, the data was interpreted. The interpretation included the number of times the research supported a research question (Coakes and Coakes, 2008). In a sense an inventory of the research was provided (Tesch, 1990). Finally, the interpretation led to a group of best learning practices that were translated into survey questions.

Creswell (2003) suggested a number of strategies to validate qualitative research. This research used three methods predominantly namely triangulation, member checking, and descriptions of opposing or negative views. Aman (2008) used triangulation from interviews, observations, and documentation in a study on the impact

of KMS towards enabling greater returns for an IT division. In this research triangulation was achieved by reviewing a wide variety of studies to corroborate that a grouping was appropriate. For example, correlational studies, case studies, and grounded theory research all supported an idea that senior management support for knowledge sharing was important. Moreover, an expert panel consisting of a group of ten people reviewed the final OLF, PLP, PSV, and DEM variables as expressed in the survey questions. Thus, a form of "member checking" (Creswell, 2003, p. 196) was used to validate the research. Negative or opposing views in the themes that emerged from the content analysis were described.

Develop Data Collection Instrument

PKM correlational studies often used surveys to collect data (Jugdev, 2007; Karlsen & Gottschalk, 2004; Laframboise, et al., 2007; Lierni & Ribièri, 2008). Thus, it was envisioned that a survey was needed to answer support questions 2, 3, and 4. Creswell (2005) suggested an eight stage process to conduct survey research. The first stage helped determine if a survey was the correct process to use. The second stage was to develop the research questions. The third stage related to identifying the population and sample. The fourth stage related to designing the survey and data collection procedures. The fifth stage addressed the need to develop or locate an instrument. The sixth stage regarded administration of the survey. The seventh stage called for analysis of the data addressing the research questions. The eighth stage involved writing the report. The first two stages were completed and documented in Chapter 1. The third, fourth, and fifth stages are discussed in this section "Develop Data Collection

Instrument." In the following sections the sixth (Collect Data: Survey Administration), seventh (Conduct Statistical Analysis), and eighth (Develop Report and Formats for Presenting Results) stages are addressed.

Determine Population, Population Frame, and Sample

The IT project was the logical unit of analysis because project teams capture lessons learned. Also, emerging project teams used lessons learned to provide value (Desouza, et al. 2005). By focusing on the project the research avoided a focus on evaluating centralized learning which Keegan and Turner (2001) found to be an impediment to project learning. Instead the focus was at the working level. In similar studies prior researchers have established the project as their unit of analysis. Henry, et al. (2007) asked participants to think about their most recent project in their study that looked at how project estimating techniques and knowledge supported practices related to predictability of cost and duration and in turn project success. Cerpa and Verner (2009) asked participants to think of two completed projects: One that failed and one that succeeded. Landaeta (2008) used the completed project that transferred knowledge as the unit of analysis in his study of the effort involved in transferring knowledge across projects. Thus, the project was determined to be the unit of analysis and participants were asked to consider a recently completed project. Furthermore, in this research the emphasis complemented Landaeta. Landaeta focused on the maturing team's efforts to capture project lessons learned and transfer them to other project teams. This research focused on emerging IT project teams seeking to access lessons learned from prior projects and utilizing those lessons to potentially improve project success.

The population ideally covered all IT projects in the United States. Rea and Parker (2005) suggested that a researcher identify a working population which is a clear sub-set of the population. In this research the sample was drawn from ZoomInfo (2010). ZoomInfo's database contained approximately 5,000 names of managers in IT organizations with 1,000 or more employees in the United States, and employee information that had been updated within the last 18 months. Researchers have used a variety of sources to draw a sample for their studies related to PKM. Cerpa and Verner (2009) sent their survey to IT practitioners in the north east of the United States and obtained over 300 responses. Tanriverdi (2005) used a mailing order firm to send surveys to 356 firms and achieved 40% response rate. Harlow (2008) selected 1,128 names from a list of over 68,000 managers with a 10% response rate. Various means have been used successfully by researchers to relate KM practices to outcomes. Ettlie, Perotti, Joseph, and Cotteleer (2005) conducted a study of strategic enterprise system deployment using a competitor to ZoomInfo to confirm their base-line sample of the Fortune 1000. Kathuria, Maheshkumar, and Dellande (2008) also used a competitor to ZoomInfo to sort out problems with name changes in their database of Fortune 500 companies. Thus, ZoomInfo was selected as the database from which to extract the population frame.

The initial goal was to attain a sample of 300 projects from 300 respondents, based on an assumed 30 variables. The final goal of 320 respondents was derived using Sekaran's rule of thumb of 10 respondents per question (Sekaran, 2003) and was considered conservative. Ultimately, there were 32 questions in the survey plus six demographic questions. The demographic results were not included in estimating sample

size. The following formula was used to derive minimum acceptable sample size (Rea and Parker, 2005):

$$n = \square_{a}^{2} s^2 / ME_{i}^{2} + (\square_{a}^{2} s^2 / \square\text{-}1) \quad (1)$$

where n = sample size

$\square_{a}^{2}$ = desired confidence interval squared

s^2 = sample standard deviation squared

ME_{i}^{2} = Margin of error squared (confidence interval in terms of scale)

$\square$-1 = Working population less 1

Based upon initial assumptions equation 1 was used to derive a sample size of 233 as shown below in Table 1.

Table 3: Sample Size Calculation for an Interval Scale

Variables	Amount	Units	Scale	% of Scale
Given:				
Confidence Interval (95%)	1.96			
Assumed Sample Standard Deviation	2			
Margin of Error	0.25		5	0.05
Assumed Working Population	4,400	projects		
Result:				
Sample size	233	projects		

The original goal was to obtain a sample size of 320 respondents or a minimum 233 respondents using Rea and Parker (2005). Based on the actual sample size of 97 respondents, the desired sample size was recalculated (Rea & Parker, 2005) in Table 4 using equation 1.

Table 4: Sample Size Recalculated

Variables	Amount	Units	Scale	% of Scale
Given:				
Confidence Interval (95%)	1.96			
Sample Standard Deviation	1.199			
Margin of Error	0.25		5	0.05
Working Population	5,000	projects		
Result:				
Sample size	87	projects		

The highest standard deviation for any question related to project success, organizational learning, or project learning was 1.199 (Senior Management support). This change from the assumed standard deviation of 2 reduced the required sample size even though the working population was increased from the assumed 4,400 to an actual 5,000. Thus, a sample of 87 respondents for 87 projects was deemed to be adequate for this research. In the actual survey that closed on 29 February 2012, 101 IT managers responded producing 97 completed surveys. Even though the working population was increased from 4,400 in the proposal to 5,000 here fewer respondents were required because the highest standard deviation (SD) of 1.199 was lower than the assumed SD estimate of 2 used in developing the methodology.

Researchers have used similar sample sizes in research related to PKM. Karlsen and Gottschalk (2004) in their research on factors affecting knowledge transfer in IT projects used a sample of 68 respondents for a survey instrument that included 51 questions and used a similar scale to this research (1 to 5). Lierni and Ribière (2008) studied the relationship between improving project management and use of KM. The survey instrument contained 43 questions and the sample size was 99 respondents (Lierni and Ribière, 2008). Landaeta (2008) evaluated knowledge transfer across

projects using a sample of 46 respondents (one per project) to answer 48 questions. Thus, it was decided that 97 respondents were adequate to complete this study.

Design Survey and Data Collection Procedures

A cross-sectional self administered survey was used to evaluate OLF, PLPs, and PSVs (Creswell, 2005). Bourque and Fielder (2003) suggested a check list be used to define the criteria respondents of an email/mail questionnaire:

1. Respondents had to be motivated to participate.
2. Respondents must be literate.
3. Respondents should be asked about a current event.
4. The questions needed to be written so that all participants could respond. The survey should be written to avoid skips and branches.
5. Borque and Fielder noted the research should not be exploratory.

Thus, the survey was designed to meet the criteria for a self-administered survey.

The requirements defined by Borque and Fielder (2003) were met. On no. 1, about a dozen respondents sent emails expressing satisfaction with the process. It was expected that participants would like to see project performance improve and therefore would have an interest in the results. On no. 2, one could not be an IT manager and be illiterate. On no. 3, Henry, et al. (2007) asked participants to consider a recently completed project. This research focused on a recently completed project. Borque and Fielder pointed to small exceptions to their list and noted that surveys could still be successful. Thus, a recently completed project appeared acceptable. On no. 4, all of the respondents in this research were able to respond as they were IT managers who recently participated in at least one completed project. In this research skips and

branches were not used. On no. 5, the survey was not exploratory. Thus, all of the criteria that Borque and Fielder (2003) established were met.

In this research the survey was divided into four sections; project success, organizational learning, project learning, and demographics. Creswell (2005) suggested that a group of questions can be used to obtain information about actual behavior. This survey instrument contained questions related to project success, organizational learning, and project learning. Borque and Fielder (2003) suggested that the demographics section should go at the end of the survey to improve the response rate and number of completed surveys. Three reasons were offered. First, placing demographics first can negate to some extent the positive effect of the cover letter. Second, many respondents may think that demographic questions are boring. Third, respondents may consider some the demographics questions too personal. Demographics were included at the end of the survey after validating the approach with the expert panel.

Some researchers described the survey processes or data capture process that they used (Jugdev, 2007; Lierni and Ribière, 2008; Tanriverdi, 2005). Tanriverdi used a mailing firm to personalize cover letters and customize surveys. Letters were sent out and three follow-ups were sent out four weeks apart. Participants were given the option to mail a survey response or do the survey on-line. Jugdev sent a cover letter, consent form, and self addressed envelope to 2,000 project managers. Project managers were invited to consent to do the survey. Upon receipt of the consent forms that contained the respondent's email address Jugdev sent each respondent a link to the survey. Jugdev sent out three reminders a week apart. Lierni and Ribière (2008) sent a post card to

1,000 project managers asking them to participate online. A reminder was sent out after 30 days.

Develop or Locate a Survey Instrument

Landaeta (2008) described a four step process to develop the survey. The first step involved research to find questions that were used in prior research that could be applied to this study. The second step entailed development of the questions and scales that could not be located in the literature based on guidelines from Fink (2009). The third step involved consultation with experts to review the survey. Fourth, the survey should be continually refined. In this research the third and fourth steps were integrated and discussed in the next subsection (Check Survey Validity: Delphi Team). Landaeta's process was used in this research to develop a survey instrument.

The first step entailed a search for survey questions in the literature. During the literature review and the content analysis potential survey questions were identified. Haas (2006) extracted questions from several sources for his survey. Henry, et al. (2007) posed two questions to their participants that could be used directly in this study related to schedule and cost performance. For example, participants were asked to rate their level of agreement with the statement "the project with which I was most recently involved was completed within budget" (Henry, et al., 2007, p. 609). Demographic questions may come from prior surveys (Lierni & Ribièri, 2008; Lindbergh, 2009). After evaluating available questions it was decided that the survey would be more coherent if the author developed all of the questions using a common structure.

The second step entailed creating the survey questions and scale. Bourque and Fielder (2003), Creswell (2005), and Fink (2009) offered guidelines to develop the questionnaire. Borque and Fielder and Creswell emphasized that open ended questions

should be avoided and that was done in this research. Borque and Fielder, Creswell, and Fink stressed that questions should be succinct. Writing succinct questions was emphasized and tested with the Delphi group.

Table 5 shows that most researchers exclusively used a five point interval scale for questions relating to agreement. Landaeta (2008) used a common five point Likert scale to enable participants to answer questions quickly. Hong, et al. (2008) also used a single five point Likert scale. Henry, et al. (2007) used a scale from one to five where:

1 – strongly disagree

2 – disagree

3 – somewhat agree

4 – agree

5 – strongly agree

The scale used for this research was similar to Henry, et al. (2007). However, based on comments from the Delphi team the middle point was adjusted to read 3 – Neither agree nor disagree which was consistent with a five point scale used by Rea and Parker (2005).

Table 5: Scales used in Knowledge Management Research

	Number of Points on the Scale				
Researchers	**4**	**5**	**6**	**7**	**Mixed**
Anantatmula & Thomas (2010)		x			
Haas (2006)		x			
Han & Anantatmula (2007)		x			
Harlow (2008)		x			
Hartman & Ashrafi (2002)		x			
Henry, McCray, Purvis, & Roberts (2007)		x			
Hong, Kim, Kim, & Leem (2008)		x			
Jugdev (2007)				x	
Karlsen & Gottschalk (2004)		x			
Laframboise, Croteau, Beaudry, Manovas (2007)				x	
Landaeta (2008)		x			
Lierni & Ribiere (2008)		x			
Lindbergh (2009)					x
Rose, Kumar, & Pak (2009)				x	
Tanriverdi (2005)		x			
Count	0	11	0	3	1

Lierni and Ribière, (2008) added a sixth scale item identified as “I do not know” associated with a value of six (p. 138). Kasvi, et al. (2003) included 0 and 9 on either end of their 4 point scale for not needed and not knowing. Creswell (2005) illustrated a survey with “don’t know” as one of the possible answers. In this research, “I do not know” was used associated with a value of zero.

Check Survey Validity: Delphi Team

Landaeta’s (2008) third step called for the consultation of process experts before finalizing the survey. Sekaran (2003) noted that the validity of the survey instrument was important. A valid instrument measures what it was intended to measure (Sekaran, 2003). Carmines and Seller (1979) also theorized that validity relates to the intent of the design. If an instrument measures something other than what it was designed for then the instrument would not be valid. Sekaran identified three validity groups including content validity, criterion-related validity, and construct validity. Carmines and Zeller

(1979) theorized that it was difficult to measure content validity and criterion-related validity due to the ambiguous nature of the concepts. Researchers used an expert panel to determine validity of their surveys. Landaeta (2008) used an expert panel to ensure that the scale and questions measured what they were purported to measure and to determine if the questions could cause a threat to data collection and analysis. Henry, et al. (2007) also used a team of five project managers to ensure clarity of the questions and to validate the variables. Lierni and Ribièri (2008) and Tanriverdi (2005) also checked for content and face validity using an expert panel. Harlow (2008) used two Delphi teams to validate that his survey would generate consistent answers across geographic regions. Thus, it was important to engage experts to validate the survey instrument.

This third step included five sub steps. First, it was necessary to determine the method that would be used to engage the experts. Second, the criteria for measuring success should be defined. Third, team membership criteria needed to be established. Also during this sub step the appropriate size for the team of experts was determined. Fourth, the team needed to be organized. Fifth, the process was implemented.

Researchers have used several methods to pretest surveys (Sub step 1). Harlow (2008) utilized the Delphi technique to pretest his survey while doing KM research. Erffmeyer and Lane (1984), based on an experiment of 288 university students, found that the Delphi technique produced higher quality decisions than the nominal group technique, interacting teams, and consensus groups. Tanriverdi (2005) interviewed 10 academic experts and 25 corporate managers. Other researchers used different techniques to pre-test surveys working with a panel of experts, but it was not clear if

they used a formal nominal group technique or another approach (Henry, et al., 2007; LaFramboise, et al., 2007; Lierni & Ribière, 2008).

The Delphi technique was used in this study because of its effectiveness and efficiency as the team members did not need to come together. Yousuf (2007) theorized that the Delphi method was an effective method to use when time and distance separate the team members. Another benefit was that the Project Management Institute (PMI) contained several references to the Delphi technique in its training materials (PMI, 2008). Many of those surveyed could have been members of PMI. Thus, some potential candidates for the Delphi group might have been familiar with the Delphi technique. The down-side of the Delphi technique was that participants needed to stay with the process through all of the rounds which fortunately did not prove to be an issue. On the whole though the Delphi technique was an accepted methodology and fit well with this research.

The Delphi group completed its work when the team reached consensus that the survey would be an effective tool to answer the support questions and the research question (Sub step 2). Yousuf (2007) indicated that a characteristic of the Delphi process was that a consensus was reflected in the statistical average including each team member's response. Consensus that the survey was ready to distribute to the people in the research sample would be achieved if the average (mean) for each question equals four or better and there was no individual score for a question equal to two or less. If the average (mean) for any single question was less than four or a participant score for a question was two or less then the survey was not ready to release and another round was be conducted. Skulmoski, Hartman, and Kahn (2007) suggested that often three rounds

were sufficient to reach consensus. Erffmeyer, Erffmeyer, and Lane (1986) conducted an experiment to determine if six rounds yielded a better result than four rounds. It was determined that the consensus resulting from additional rounds in excess of four did not materially improve a Delphi team's results. Thus, it was estimated that it would not take more than five rounds to complete the process. To mitigate the need for too many rounds the following sub steps actions were taken to minimize risk of failure particularly in sub step 5. The next step was to define Delphi team qualifications and team size.

Before the Delphi team could begin its work, the qualifications for team membership were established as well as the size of the team (Sub step 3). Skulmoski, et al. (2007) citing (Adler & Ziglio, 1996) suggested that Delphi team members should meet four requirements to be considered expert. First, the team members needed to have knowledge and experience related to the issue being researched. Second, the team members had to be willing and capable of participating. Third, the team members needed to have enough time to participate. Fourth, the team members needed to be effective communicators. Yousuf (2007) indicated that Delphi team members had to be well informed but he noted that a high level of expertise was not essential. Rea and Parker (2005) indicated that participants were selected at the researcher's convenience; however, the selected individuals should have the desired characteristics. On the other hand, Hsu and Sanford (2007) opined that Delphi team members should be quite experienced and highly trained. Landaeta (2008) included people with experience in KM, project management, and survey development on his team. Lierni and Ribière (2008) included academics and practitioners with experience in survey design, KM, and project management. In order to obtain a Project Management Professional (PMP)

certification the candidate must document that they have participated in projects for three years (PMI, 2008). One may use PMI's criteria to establish a level of expertise.

Researchers suggested that Delphi teams could include from six to 15 members. Skulmoski, et al. (2007) and Hsu and Sanford (2007) noted that a homogeneous Delphi team can consist of from 10 to 15 members. Skulmoski, et al. illustrated research with fewer team members that were successful. Hsu and Sanford theorized that the researcher needed to strike the right balance between a Delphi team that is too small or too large. Fowler (2009) suggested that a focus group should come from the study population and consist of six to eight people. Yousuf theorized that the number of Delphi team participants was related to the design of the research. Laframboise, et al. (2007) pre-tested their survey with four IT practitioners. Harlow (2008) formed two Delphi teams of six people each. One team consisted of U.S. citizens and the other team consisted of citizens from various European countries. In this research ten people who had experience in organizational learning or KM and others who worked on IT projects as a project manager for three or more years were selected (Fowler, 2009; Harlow, 2008; Hsu & Sanford, 2007; PMI, 2008). The Delphi team was organized after sub step 3.

With the start of sub step 4 the Delphi team transitioned from planning to execution. In this research prospective Delphi team members were called and then sent a follow-up email (Appendix C) and an informed consent form (Appendix D). Each participant was also assigned a maritime call sign based on the International Maritime Organization's standards. Maritime call signs included Alpha, Bravo, Charlie, Golf, Hotel, Juliet, November, Oscar, Romeo, and Sierra. Given that some people were expected to drop out of the Delphi team 11 people were invited to be on the team. Of the

11 who were invited 10 people ultimately accepted. All 10 Delphi team members remained with the project until consensus was reached. Upon acceptance and execution of IRB forms the Delphi team began its work.

Skulmoski, et al. (2007) outlined a Delphi process that graduate IT researchers used (Sub step 5). Once the team was formed and in place the Delphi process was divided into rounds. The team never came together nor did they know who else was on the team (Erffmeyer, et al., 1986). In preparation for the first round participants were provided with a description of the research (Appendix E), a short description of the Delphi team process (Appendix F), a draft survey and instructions (Appendix G), and finally a questionnaire about the survey for the first round (Appendix H). In round one the participants were not asked to quantitatively rate the survey. Hsu and Sanford (2007) suggested that the initial questionnaire be open-ended. Similar to Landaeta (2008) the Delphi team participants were asked if the survey instrument would appropriately measure OLFs, PLPs, and PSVs. The Delphi team members were asked to identify and comment on how deficient questions may be improved. The Delphi team members returned the questionnaire about the survey to the researcher completing the first round.

Preparation for round 2 began after the questionnaire about the survey was returned. The researcher prepared return comment matrix (Appendix I), a revised survey, and starting with round 2 the questionnaire about the survey included quantitative ratings for each question in the survey (Appendix J). Appendix I includes each team member's comment and the author's reply. It was important that the participants could validate that their opinions were included in the results (Skulmoski, et

al. 2007). Thus, individual participants could view Appendix I to see that their comments were noted and what action was taken. The researcher then sent the return comments, a revised survey, and the new questionnaire about the survey back to the Delphi team to commence round 2. Once again the Delphi team members provided feedback to the researcher.

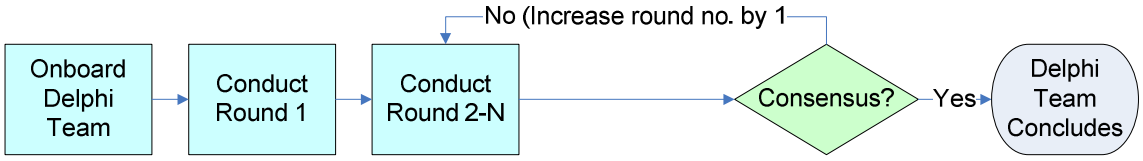
It was anticipated that the responses could be incomplete or team members may disagree. If a response was incomplete then the researcher followed-up with the participant to obtain clarification regarding their response. If two or more respondents disagreed about what should be done with a question and the researcher understood the comments then the researcher would address the issue. It was possible that the researcher might need to remove a question or add one or more questions to address concerns. During the subsequent round the team members were advised of the different view-points and the reasoning for the change this researcher made to the survey. Each comment was associated with the member's maritime call sign enabling each team member to confirm that their comments had been considered or not (Skulmoski, et al., 2007). The survey instrument was revised based on all comments or a reason was provided for not acting on a comment.

As an example, the team members disagreed regarding the best approach to measure two project success criteria, namely schedule and cost. Some team members preferred quantitative answers such as on budget (plus or minus a percent) to define each of the intervals on the scale or an absolute under or over budget. Other team members believed that some judgment should be used to qualify the criteria. The resulting three

point scale for two questions on budget and schedule was a compromise that led to a consensus in round 4.

The process for the third round and subsequent rounds was similar to the second round. Yousuf (2007) noted that Delphi team members might change their answers to questions during each round and this did happen. In preparation for the third round the Delphi team respondents were provided the survey results and again all of the comments and actions taken. Once again each respondent was able to confirm that their scoring and comments were included in the results as tables were organized by each maritime call sign (Skulmoski, et al., 2007). Statistics were also used to help determine consensus (Hsu & Sanford, 2007; Skulmoski, et al., 2007; Yousuf, 2007). Team members had the option to change their answers on all constructs during subsequent rounds. Hsu and Sanford noted that the degree of consensus was determined by the researcher by varying the number of rounds. Once consensus had been reached the Delphi team was concluded. Figure 4 illustrates the Delphi team process that was used in this research.

Figure 4. Delphi Technique Process



Collect Data: Survey Administration

Support Institutional Review Board

This stage involved several factors including the need to gain necessary approvals to conduct the research and using procedures noted above to conduct the survey (Creswell, 2005). As Appendix K indicates approval from the NSU IRB was received on 5 July 2011. Wang (n.d.) outlined the process and key considerations one should follow to protect participants' privacy and rights. Four steps were undertaken in this research to ensure that this research was conducted in an ethical manner and in compliance with university policy. The NSU IRB Submission Form and Informed Consent Forms were submitted for review and approved by the university. The key issue in this research was to respect the confidentiality of all participants. In this research the pilot and general surveys were anonymous. In addition, an informed consent form from each Delphi team member was obtained. Finally, the NSU IRB policy was executed faithfully.

Within this research the main ethical issue related to confidentiality. Confidentiality was preserved at all times. During the Delphi process each participant was assigned a nondescript identification. The Delphi participants did not know who the other Delphi team members were. They only knew each other by their identification in this case a maritime call sign such as Alpha, Bravo, or Charlie. The pilot and general surveys were conducted exclusively on-line and participant responses were anonymous. Finally, all survey data was reported at an aggregate level.

The Informed Consent Form was distributed to prospective Delphi team participants as part of organizing the team. The Informed Consent Form was included

on the welcome screen for the survey. Nova Southeastern University (2010) developed a check list to develop the Informed Consent Form which enabled the development of a consent forms for this research. Lindbergh (2009) described ethical issues. The first screen of her survey was used to obtain informed consent. Users read the statements and then could check "yes" or "no." If users checked "yes" they could take the online survey.

Execute Pilot and General Surveys and Check Reliability

Creswell (2005) suggested that survey administration involved steps to check for response bias. Sekaran (2003) defined reliability as a measure that is un-biased and consistent over time as well as across the items in the instrument. Various tests have been used to ascertain reliability. Lindbergh (2009) conducted a test-retest by asking a pilot group to do the survey twice two weeks apart. Lindbergh calculated correlation coefficients to compare the two sets of responses. Lindbergh reported that the test-retest was moderate to highly positive when the correlation $r > .70$, $\rho < 0.5$ and two-tailed. Her results indicated that all tests were significant at 0.01 and were not less than .708. Most scores were above 0.8. In addition, Leech, Barrett, and Morgan (2011) suggested that Pearson's r be used to conduct a test-retest correlation. Leech, et al. suggested that the correlation needs to be highly significant. Sekaran (2003) also suggested that the higher the correlation the better. For this research a test-retest through a pilot survey was conducted after the Delphi group reached consensus. The test-retest in this study was two-tailed striving for significance at $\rho < 0.5$. The means and standard deviation for both surveys were calculated and correlated using a two-tailed Pearson's Product Moment.

Cronbach's alpha was used test for the internal consistency of the results in the pilot and general surveys (Creswell, 2005). Rose, et al. (2009) citing Nunnally (1978) and Han and Anantatmula citing Nunnally and Bernstein (1994) indicated that the minimum alpha should be 0.7. Leech, et al. (2011) theorized that the ideal range was between 0.7 and 0.9. A Cronbach's alpha above .9 suggests that redundant questions may be in the survey (Leech, et al., 2011).

Conduct Statistical Analysis

Statistical methods were an essential component of correlational studies (Creswell, 2005). The statistical analysis would prove successful if the results enabled an answer to the research question in a manner that could withstand peer review. Data analysis involved two tasks to answer the research question. The first task was to describe the data to gain a broad understanding of the information. The second task was to answer the research question by correlating the variables.

The first task was to quantitatively describe the data. Han and Anantatmula (2007) used pie charts and bar graphs to illustrate demographic data. Tanriverdi (2005) illustrated the mean and standard deviation for each of the 16 variables measured. Haas and Hansen (2005) provided the mean, standard deviation, minimum, and maximum results using multiple scales. Ajmal, et al. (2010) graphically displayed the results of the factors that impede KM. Anantatmula and Thomas (2010) rank ordered 12 critical success factors measured on a five point Likert scale that enabled global projects to succeed and determined that communication was most important. Cerpa and Verner (2009) also rank ordered project failures that occurred most often in projects. Harlow (2008) provided means and standard deviations for his Delphi teams. Within this step

the project data was evaluated noting the frequency distribution, central tendency, variability, and ranking (Creswell, 2005; Rea and Parker, 2005). Histograms were developed in order to visualize the potential skew of the data. The descriptive data was used to identify any unusual issues and provide a sense of lessons that could be learned from the survey (Rea & Parker, 2005). The PLPs and OLFs were also ranked to gain an initial understanding of relative importance. At the completion of the descriptive analysis SQ2, SQ3, and SQ4 could be answered.

The second task addressed the research question directly. Jugdev (2007) used Pearson's Product Moment Correlation (two-tailed) to correlate the variables in his study. Experts differ on the interpretation of the strength of the correlation amongst the variables. A relationship that is from 0.3 to 0.4999 is considered "MEDIUM" and a relationship greater than 0.5 is "LARGE" (Gray & Kinnear, 2012). Leech, et al. (2011) used four levels to interpret the magnitude of the correlation. From 0.3 to 0.499 the association was considered medium, from 0.5 to 0.699 was large, and over 0.7 very large. Jugdev citing Rowntree (2004) stipulated that a negligible to weak correlation exists between 0 and 0.20, a weak to low correlation exists between 0.20 and 0.40, a low to moderate relationship exists between 0.40 and 0.70, and a strong correlation exists between 0.70 and 0.90 and a very strong relationship exists when the correlation exceeds 0.90. Creswell (2005) theorized that the results between 0.35 and 0.65 have limited predictive capabilities though many correlations fall within this band. A correlation between .66 and 0.85 enables good prediction among variables.

Researchers who used the Likert scale conducted a Product Moment Correlation with two-tailed significance. Harlow (2008) used the Pearson Moment Correlation

(two-tailed) to correlate 12 variables in his research on tacit knowledge and firm performance. Rose, et al. (2009) used descriptive statistics and Pearson's Product Moment (two-tailed) to understand the relationship between organizational learning, organizational commitment, job satisfaction and work performance. Haas and Hansen (2005) correlated 19 variables including demographic variables. In this research the variables were correlated using Pearson's Product Moment Correlation ($\rho < .05$, two-tailed). This test demonstrated the correlation between any variable and the other variables in the study. Thus, it was possible to learn how well the OLFs, PLPs and PSVs correlated with each other.

Develop Report and Formats for Presenting Results

The final step of the research was to evaluate, synthesize, and summarize the findings. Writing the report took several iterations and was concluded after a thorough proof-reading indicated that the document appeared error free and subsequently approved by the committee. The lessons gleaned from the literature review to answer SQ1 and the survey to answer SQ2, SQ3, and SQ4 should be combined to answer the research question. The report consisted of the written word supported by tables, charts, graphs, and flow charts as needed. Creswell (2005) suggested that comments pertaining to the generalizability of the findings to the population need be included and this has been done. In addition, it was only appropriate to identify lessons learned during this research. The limitations of the study and suggestions for future research were outlined.

It was also appropriate to outline how the findings may be applied in practice. Henry, et al. (2007) included a conclusion section dedicated to managers. Henry, et al.

covered the key points that managers should take away from the research. Hartman and Ashrafi (2002) made specific recommendations in their research on project management in IT organizations. Tanriverdi (2005) outlined how his research contributed to IT KM and project management practices.

The report consisted of the text supported by tables, charts, graphs, and flow charts as needed. Charts and graphs were used to support written arguments. Finally, the report was presented and formatted in a manner consistent with the Publication Manual of the American Psychological Association Sixth Edition.

Resource Requirements

This project required the aid of the advisor and the committee. Use of the NSU library was vital. In addition the project required working with a Delphi group of six to ten people (Fowler, 2009). The project also required the aid of 15 pilot respondents and 97 general survey respondents. A Sony VAIO laptop computer with a memory of 4.0 GB and a 500 GB hard drive with the capability of accessing the internet was used. Finally, resources included a survey tool, a statistical analysis tool, a list of people to sample (ZoomInfo), and the means to facilitate the survey invitations (stamps and stationary).

Summary

This research built upon several methods to determine if a correlation existed among OLFs, PLPs, and PSVs. A literature review included the use of content analysis was used to derive the variables for this research answering SQ1. A Delphi team

evaluated the survey and helped to clarify and define the research variables confirming the answer to SQ1. A survey provided the basis to answer SQ2, SQ3, and SQ4 and the data to answer the research question.

This chapter provided a description of how the literature review was conducted. Moreover, the literature review section was used to describe how the variables would be extracted from the literature. The survey process was also described. Use of ZoomInfo was justified. The sample size and population frame were derived. The survey design and development process was outlined. The Delphi team process was described. Survey administration was reviewed to indicate how the survey's reliability and validity were determined. Finally, the analysis to develop the answer to the research question was provided. The chapter concluded by outlining the report and format as well as resources required to complete the research.

Chapter 4

Results

Introduction

Chapter 4 is primarily organized by support question. The first section offers the results the content analysis and work by the Delphi team to determine the definitions of the variables within the OLFs, PLPs, and PSVs to answer SQ1. The second section (*Survey Validity, Administration, and Reliability*) addresses results of the tests for survey validity, actual sample size, reliability, and demographics. The third, fourth and fifth sections address support questions 2, 3, and 4 on the effective use of OLFs and PLPs and success attained for the PSVs. The sixth section offers the results for the research question. Finally, a summary is presented.

The sections in Chapter 4 also relate to Chapter 3 (*Methodology*). Support Question 1 was supported by the methodology chapter outlined in the section *Conduct Content Analysis and section Develop Data Instrument Collection - subsection Check Survey Validity: Delphi Team*. The section in this chapter *Survey Validity, Administration, and Reliability* was supported by two sections in Chapter 3 namely *Develop Data Instrument Collection* and *Collect Data: Survey Administration*. The results for Support Questions 2, 3, and 4 and the research question relate to the section *Conduct Statistical Analysis* in the prior chapter.

Support Question 1: Elements that Defined OLFs, PLPs, and PSVs

Support Question (SQ1) 1 asked what elements define OLFs, PLPs, and PSVs. In addition answering SQ1 enabled the development of the survey instrument. Thus, the answers to SQ1 are stated in question form. SQ1 was answered by conducting a content analysis followed by work with a Delphi team that validated the survey and contributed to the definition of the OLFs, PLPs, and PSVs. In this section there are three subsections. The three subsections present the results of the content analysis and Delphi team contributions for PSVs, OLFs, and PLPs.

Organizational Learning Factors

The content analysis, based on a total 220 citations from 58 articles, produced a set of OLFs. Table 6 describes the OLFs, derived through the content analysis and validated by the Delphi team. Appendix L outlines OLF definitions, number of citations for each OLF variable and number of articles that made relevant citations regarding an OLF.

Table 6: Organizational Learning Factors

OLF Id	OLF Variables
OA	In my IT organization there is a trusting and supportive culture that enables knowledge sharing.
OB	In my IT organization senior management actively encourages knowledge sharing (e.g. knowledge sharing champion, off site meetings, training seminars, special budgets, etc.).
OC	In my IT organization there are sufficient resources to support knowledge sharing between project teams (e.g. financial, personnel, technology, and training) to support knowledge sharing between teams.
OD	In my IT organization the staff receives comprehensive training in knowledge sharing practices (e.g. culture of knowledge sharing, venues available, writing effective content, organizing content for ease of retrieval, etc.)
OE	In my IT organization project teams have access to information systems that facilitate knowledge sharing (e.g. a database or repository that contains helpful lessons learned by other project teams, content management, work-flow, and/or decision support systems).
OF	In my IT organization one can easily locate an expert without knowing the person's name or location using a directory or information system (sometimes called an expert locator or yellow pages).
OG	In my IT organization the customer and/or management allows time in the project schedule for knowledge sharing.
OH	In my IT organization project teams are expected to conduct and document post project reviews.
OI	In my IT organization a process is used to facilitate learning between IT project teams.
OJ	In my IT organization employees are encouraged to share knowledge with effective incentives (e.g. bonuses, promotions, more opportunities, and/or peer recognition).
OK	In my IT organization there is an organizational structure (e.g. project management office, program management, knowledge managers/analysts, project networks) that effectively facilitates knowledge sharing between teams.
OL	In my IT organization people actively share knowledge through personal communication (communities of practice where people with common interests informally share knowledge, get-togethers, other informal settings, and/or social media).

Trusting and Supportive Culture (OA): Culture referred to the personality of an organization (Ajmal & Koskinen, 2008). A trusting and supportive culture was an environment in which people could openly and freely discuss issues (Desouza, et al.,

2005). Such a culture was achieved when knowledge was not centralized for a few but widely shared throughout the organization (Keegan & Turner, 2001).

To the extent that a trusting culture was established the organization could improve sharing of tacit knowledge (Koskinen, et al., 2003). Tacit knowledge, being personal, related to intuition, deeply embedded, physical, and difficult to communicate was more readily shared in a trusting environment (Koskinen, et al., 2003; Nonaka, et al., 2006). A trusting and supportive culture improved cross-functional communication, enabled people to focus on the issues, and increased knowledge sharing. Trust also improved the efficiency of knowledge transfer (Leseure & Brookes (2004).

Senior Management Leadership (OB): Senior management leadership established the framework for organizational learning (Ayas & Zeniuk, 2001), promoted the right culture for knowledge sharing (Anantatmula & Kanungo, 2008), and could allocate funds to support a knowledge management system (Pretorius & Steyn, 2005). Indeed senior management leadership was more important than incentives or bonuses to achieve a learning environment (Alavi, et al., 2006). Project knowledge management (PKM) success was dependent on senior management (Hanisch, et al, 2009).

Goffin, et al. (2010) observed in a new product development division of an appliance firm that senior management attended post project reviews and encouraged personal reflection. As a result attendees were motivated to develop meaningful conclusions that would be presented to management at the close of the meeting.

Resources (OC): Resources included investments in people and technology. Newell and Edelman (2008) theorized that it was time consuming to learn, document, and make available to others lessons learned. The United States General Accounting

Office (GAO) (2002) recommended that National Aeronautics and Space Administration (NASA) invest more in information technology to support knowledge sharing. Schindler and Eppler (2003) offered that external moderators could help when teams meet to review lessons learned. Yang (2010) theorized that substantial financial investments may be necessary to facilitate knowledge management (KM).

Desouza, et al. (2005) theorized that post-project reviews were expensive. The reviews required investment of people, time, and money. It was recognized that it may be inappropriate to hold post-project reviews after every project. Thus, Desouza, et al. recommended that companies do a cost/benefit analysis. In addition, projects should be categorized and post-project reviews grouped based on the novelty of the issues faced and the characteristics of the projects. In this way fewer post project reviews would be leveraged to deliver greater benefits.

Training (OD): Leseure and Brooks (2004) theorized that project team members should be trained to discuss difficult issues. Grillitsch, et al. (2007) specifically theorized that it was important to train internal post-project review facilitators. Petter and Randolph (2009) theorized that mentorship was a means to model behaviors and create KM expectations. GAO (2002) also recommended mentoring.

Owen (2006) reported that within an engineering firm mentoring between the program director and project managers played a key role in effective knowledge transfer throughout the projects. In the same firm senior project managers that were near retirement mentored junior project managers. Mentoring was used as a means to develop junior project managers.

Information Systems (OE): Disterer (2002) and Anbari, et al. (2008) theorized that lessons should be routinely gathered and stored in a historical database that was easy for future teams to access. The database could include surveys, meeting minutes, objective project data, and so on (Collier, et al., 1996) as well as lessons learned, financial performance, and process information (Owen, 2006). The system should include performance metrics that identify symptoms and soft data to understand the underlying context (Lyttinen & Robey, 1999).

Hirai, et al., (2007) built an information system to store and reuse knowledge supporting R and D laboratories in an organization. The system was developed based on the work breakdown structure consisting of all the tasks within the project. This approach enabled the system to notify project team members of up-coming tasks and provide necessary knowledge for the task. Project team members came together at intervals to screen lessons learned and determined which ones should be included in the system. The system, in operation for six years, improved document sharing, led to continuous improvement in the project lifecycle processes, and enabled knowledge sharing across the organization. The screening meetings enabled teams to share tacit knowledge as well as decide what lessons should be stored in the system.

Expert Locator (OF): An expert locator or yellow pages provided a real-time method to identify people with needed expertise (Leseure & Brookes, 2004). Disterer (2002) theorized that an expert locator or yellow pages enabled a personalization knowledge sharing strategy. People could contact one another to review strategic and tactical problems (Ebert & De Man, 2008).

Van Donk and Riezebos (2005) developed a knowledge inventory management system that identified and measured three aspects of knowledge in project-based organization labeled entrepreneurial, technical, and project management. Entrepreneurial related to knowledge regarding business acquisition, technical to specific technical expertise, and project management to related skills and experience. Skills were measured for each market served. For example, this firm served Dairy, Food processing, Chemical and other customer groups.

Time in the Project Schedule (OG): Lack of time was often given as a primary cause for lack of knowledge sharing in organizations. Keegan and Turner (2001) said knowledge sharing was impossible in environments where people were quickly transferred among projects. Haas (2006) evaluated knowledge gathering in challenging work environments. A project team with sufficient time improved the quality of their project by gathering knowledge. However, if teams had insufficient time then attempting to gather knowledge hurt project quality.

One approach may be to specifically include within the project schedule steps for learning (Grillitsch, et al., 2007). Offering simple guidelines to teams about time available may improve knowledge integration (Okhuysen & Eisenhardt, 2002),

Conduct and Document Post Project Reviews (OH): Delphi team member Charlie suggested that one should add a question that asked if teams were required to conduct and document post project reviews. Charlie believed that answers to this question would help ascertain the reliability of answers to other questions on organizational learning for emerging project teams.

Process (OI): Knowledge management (KM) process entailed the organization of people, systems, and procedures into work flows (Pall, 1987). Garon (2006) theorized that a model or process should be used to enable management of lessons learned.

Knowledge could be applied when it is received just before one is to begin a task (Ebert & De Man, 2008). Templates and project methodologies could drive consistent reporting of lessons learned (Owen, 2006). Laframboise, et al. (2007) through a survey of IT managers in Canadian organizations empirically found that knowledge process capabilities improved efficiency but did not enable effectiveness.

Incentives (OJ): Incentives could be financial or otherwise to motivate people to adopt a particular action or behavior (Ajmal, et al., 2010). Ajmal, et al. also theorized that incentives could include moral, coercive, or remuneration. Goffin, et al. (2010) theorized that incentives were essential to establish a learning culture.

Terrell (2000) indicated that personnel were verbally recognized for their participation in learning. Keegan and Turner (2001) reported that some companies evaluated managers on their efforts to promote and obtain lessons learned. GAO (2002) encouraged NASA to use financial incentives, awards, and personnel evaluations to encourage knowledge sharing.

Organizational Structure(OK): Organization structure could take several forms. The Project Management Office (PMO) was one structure to centralize knowledge and share it among project teams (Desouza & Evaristo, 2006). A PMO enabled teams to coordinate lessons learned and promote reuse across project teams (Henry, et al., 2007). Program managers who oversaw several projects acted as a means for knowledge

sharing between teams (Newell, et al., 2006; Owen, 2006). GAO (2002) theorized that a KM steward should be appointed to facilitate knowledge sharing across NASA.

Falbo, et al., (2004) reported on a software development organization (CMM level 3) that formed a software engineering process group (SEPG). The SEPG was charged to make available data on the processes, maintain a process library, seek continuous process improvement, and enable improved planning and estimating. This was accomplished by developing a KM process and system to improve organizational memory. Project managers were required to review lessons learned and suggestions given by the system. The manager could reject a standard procedure but had to document the reason as a lesson learned. The authors indicated that the process had potential to make it easier to plan and estimate project schedules.

Personal Communication (OL): Personal communication was an informal way to learn, encouraged and enabled by the organization. Alavi, et al. (2006) theorized that a tea room be set up where people may come together. Garon (2006) opined that using chat rooms and other high technology solutions helped people to come together virtually. Liebowitz and Megbolugbe (2003) theorized a number of solutions to bring people together face-to-face such as brown bag lunches, knowledge fairs, inter-departmental seminars, and bird of a feather tables.

Kampf and Longo (2009) theorized that women entrepreneurs and their business student advisors could work together through communities of practice to develop business plans, prepare micro-loan submissions, and other issues that the entrepreneurs faced. The communities of practice could foster diverse opinions, create an atmosphere of mutual respect, and engender two-way communication.

Project Learning Practices

Based on the content analysis including 83 citations from 35 articles and the Delphi team's work 11 variables were identified. Table 7 describes each variable derived through the content analysis and validated by the Delphi team. Appendix M also provides number of citations and articles for each PLP.

Table 7: Project Learning Practices

PLP Id	PLP Variable
PA	On my last completed IT project our team benefitted from post-project reviews completed within the same IT organization by other IT project teams.
PB	On my last IT project I used lessons brought from earlier projects within the same IT organization to help my performance.
PC	On my last IT project the project team members brought the right skills and experience gained from previous projects and applied them to my project (e.g. technical, business, interpersonal, communication, tolerance of ambiguity, and/or project management).
PD	On my last completed IT project our team networked with others inside and outside of the organization to gain knowledge applicable to the project.
PE	On my last completed IT project lessons learned by other project teams were disseminated during the kickoff meeting or other meetings early in the project lifecycle.
PF	On my last completed IT project resources from outside our team (partners, subject matter experts, knowledge brokers, etc.) enabled our team to benefit from lessons learned by other projects.
PG	On my last completed IT project we used information systems to facilitate knowledge sharing (e.g. a database or repository that contains helpful lessons learned by other project teams, content management, work-flow, and/or decision support systems)
PH	On my last completed IT project our team located a subject matter expert(s) within the organization without knowing the name or location of the person by using a directory or IT system (sometimes called an expert locator or yellow pages).
PI	On my last completed IT project our team evaluated lessons learned by other IT project teams to determine if they were appropriate to apply to my project.
PJ	On my last completed IT project our team applied lessons learned by other project teams.
PK	On my last completed IT project we captured lessons learned from the team's experience.

Benefits from Earlier Post-Project Reviews (PPR) (PA): Petter, et al. (2007) theorized that a project team could benefit by pro-actively learning from the lessons learned developed by prior project teams. Teams would avoid repeating mistakes and continuously improve project management processes and performance. Teams benefitted from the successes and failures that past teams experienced (Collier, et al., 1996).

Goffin, et al. (2010), based on their interviews with new product development project teams suggested that lessons learned could be disseminated through presentations to other project teams. Team members also consciously briefed their new teams on lessons learned. Collier, et al. (1996), based on their experience, suggested that lessons learned from post-project reviews should be specifically assigned to someone for implementation and follow through.

Personal Reflection and Use (PB): Goffin, et al. (2010) theorized that organizations should encourage learning through personal reflection. Desouza, et al. (2005) theorized that individuals should reflect on the difficulties and barriers faced on a project and techniques that helped them overcome the barriers.

Barker and Neailey (1999) reported that a company developing a new automobile model encouraged team members to maintain personal logs of what they learned. The logs were a structure that enabled learning and provided the foundation of the organization's model for team learning. Barker and Neailey reported that the model led to success which was measured by the number of innovations.

Right Skills and Experience (PC): Reich (2007) theorized that at the start of a project the project manager needed to staff the team with the right skills and experience.

Haas (2006), in a case study, found that organizational learning positively moderated the relationship between knowledge gathering and product quality. Fong (2003) also found that project team diversity contributed to greater access to lessons learned and richer discussion.

Swan, et al. (2010), based on six case studies, reported that organizations relied heavily on people to bring their skills with them to new projects. Indeed, informal knowledge sharing methods appeared to be more effective than use of formal knowledge sharing methods including post-project reviews.

Networking (PD): Through networking, team members develop social relationships that facilitate learning and knowledge sharing (Petter, et al., 2007). Social relationships were strengthened when people shared their experiences in the form of storytelling (Goffin, et al. 2010). For many, networking was also a fast way to share knowledge (Owen, 2006).

Desouza, et al. (2005) related a case study in which an Information Systems consulting firm documented lessons learned in the form of a story. The story related misunderstandings in requirements, communications, and scheduling. The story specifically addressed the causes of the misunderstandings. A professional writer wrote the story after interviewing participants and rechecking facts as necessary. This story was used throughout the organization to help people understand key issues that this medium sized consulting firm had in managing a global operation.

Kickoff Meetings (PE): Kickoff meetings were a means to disseminate lessons learned from other project teams. Goffin, et al. (2010) theorized that new product development teams would benefit from knowledge shared at the project kickoff meeting.

Not only would lessons learned be reviewed but the discussion may lead to new ideas. Reich (2007) also theorized that project teams should come together at the start of a project to discuss lessons that the team members gained from similar projects.

Kickoff meetings were not often mentioned in the literature. Yang (2010), in a correlational study of Chinese high technology firms, did not find a significant statistical relationship between KM strategy and lessons integration from past projects. Integration from prior projects was tested in part by asking firms if they had post launch meetings to review lessons from prior projects and if there were active discussions during the project about lessons learned. Thus, more work is needed to validate whether or not kickoff meetings is a cost effective PLP.

External Resources (PF): Busby (1999a) observed in a case study that it was beneficial to invite outsiders to post-project reviews to support learning. Owen (2006) theorized that quality assurance managers could play a key role helping teams to develop lessons learned.

Senior project managers offered support to teams by presenting their lessons learned to other project teams (Garon, 2006, Goffin, et al., 2010). One interviewee in a new product development team reported favoring distributing lessons learned by making presentations to other teams. The interaction in the meeting made the learning more effective (Goffin, et al., 2010).

Used Information Systems (IS) (PG): Documenting and storing knowledge was referenced often. Desouza, et al. (2005) theorized that knowledge can be documented in report or story form. Schindler and Eppler (2006) also emphasized writing history in story form. Owen (2006) theorized that knowledge could be stored by project number

and made available on a network. Terrell (2000) reported on capturing lessons in a database for distribution to the organization upon project completion.

Desouza and Evaristo (2006) used the personalization and codification strategies developed by Hansen, et al. (1999) to describe PKM information systems architectures. A centralized architecture that may be found on mainframe computer or client server supports the codification strategy. A decentralized architecture such as peer to peer (P2P) enabled a personalization strategy. Desouza and Evaristo concluded that a hybrid strategy based on centralized and P2P approaches enabled other teams to learn about prior projects and extract lessons. However, as the project developed its own knowledge this would be managed within the P2P environment in which the team would have the freedom to use its own protocols. Motorola used the hybrid model (Desouza & Evaristo, 2006). Using central systems documents and reports could be utilized by other project teams.

Used Expert Locator (PH): The research did not provide examples in which IT project team members used an expert locator. However, since this was an OLF it was important to ask if project team members used the tool. The Delphi team accepted this question.

Evaluated Lessons Learned (LL) (PI): Scarbrough, et al. (2004) theorized that project teams needed to recognize and assimilate lessons learned in order to apply them. Garon (2006) recommends that space agencies evaluate lessons learned that were in the public domain. Petter, et al. (2007) theorized that risk assessment begins with evaluating lessons from past projects.

Caldas, et al. (2009), using a survey and case study research found that member firms in the Construction Industry Institute used different methods to analyze lessons learned. Most firms evaluated lessons learned in meetings. Firms also relied on subject matter experts to analyze lessons learned. Many companies also applied informal methods to evaluate lessons learned. Caldas, et al. concluded that analysis provided data consistency and helped companies to prioritize lessons and that lessons learned programs had numerous benefits.

Applied Lessons Learned (LL) (PJ): Desouza, et al. (2005) theorized that project post-reviews were only valuable if the lessons were applied to future projects. Goffin, et al. (2010) theorized that emerging project teams needed processes to evaluate and apply lessons learned complementing the post-project reviews. Laframboise, et al., (2007) stressed that it was not enough to transfer knowledge it must be effectively used and managed. Petter, et al. (2007) theorized that templates are an effective way to transfer and utilize knowledge between projects.

Terrell (2000) reported that Duke Power replaced 12 steam generators at two nuclear power stations. The team consisted of 520 people along with a number of sub contractors. The team captured over 1,100 lessons learned from the first three replacements which were included in subsequent projects. The results were significant resulting in reducing the critical path from 109 to 74 days while doing 27% more work.

Captured Lessons Learned (LL) (PK): Charlie, a member of the Delphi team, proposed adding a question about the project team's practice experience in capturing its own lessons learned. Charlie's suggestion was confirmed by the remainder of the team.

Project Success Variables

The content analysis based on 58 citations from 12 articles initially revealed five PSVs including budget, schedule, quality, organizational benefits, and customer satisfaction. The Delphi team reached consensus on nine PSVs with the Delphi team adding three variables and dividing one variable into two variables. Table 8 illustrates the nine variables that were used in the survey. Following the table the variables are defined. Appendix N also illustrates number of citations and articles.

Table 8: Project Success Variables

PSV ID	PSV Variables
PSA	My last completed IT project relative to the final approved budget was within a tolerable budget variance.
PSB	My last completed IT project was within a tolerable schedule variance.
PSC	My last completed IT project was delivered within specifications based on the customer's final approved project scope.
PSD	My last completed IT project was delivered with high quality (e.g. few bugs, good human computer interface, maintainability, reliable data, and/or smooth implementation) based on the customer's final approved project scope.
PSE	My last completed IT project delivered measureable organizational benefits (e.g. strategic value, financial returns, market share, stronger brand, and/or future capabilities).
PSF	My last completed IT project achieved customer (user) satisfaction based on objective feedback (e.g. customer satisfaction survey, user focus group, or project lessons review conducted with users).
PSG	My last completed IT project reflected strong communication between customers and the project team. Examples: (1) The customers' goals and performance criteria were clear to the project team. (2) The project team provided timely and clear status updates to customers.
PSH	My last completed IT project included a change control process to manage changes to the scope, budget, schedule, technical solution, and so on.
PSI	My last completed IT project mitigated all risks that were identified to have direct impact on implementation or go-live.

Budget (PSA) and Schedule(PSB): Cost and time considerations for project success were most often considered together. Shenhar and Dvir (2007b) theorized that budget and schedule measured project efficiency. Anbari, et al. (2008) opined that budget and schedule were the most common metrics for project success.

Reich, et al. (2008) theorized that traditionally IT projects deliver value at the end of the project. However, setting up project schedules so that projects can deliver early offers several benefits. Foremost, the organization gains value from the effort. It also gives the project team confidence in the endeavor's purpose and helps gain client support for the project.

Specifications (PSC) and Quality (PSD): Delphi team member Juliet initially proposed the idea of separating user specifications from Quality. A closer review of the literature validated the Delphi team member's suggestion. Anantatmula and Kanungo (2008) referenced delivery to scope as a project success variable. Anbari, et al. (2008) theorized that delivering to the legal specifications was a measure of project success. Kutsch (2007) stated in a similar manner that achieving the initial purpose of the project was a measure of success.

Karlsen and Gottshalk (2004) included maintainability, reliability, validity, and quality of information use within Quality. Project Management Institute (PMI) (2008) divided quality into project and product quality. Product quality referenced the outcome of the project and project quality referenced the conduct of the project. Purvis and McCray (1999) theorized that project success entailed in part delivery to specified quality standards.

Business Value (PSE): Shenhar and Dvir (2007b) theorized that return on investment, market share, and growth were aspects of project success. Purvis and McCray (1999) evaluated project success in part on whether the envisioned benefits for the project were realized. Kutch (2007) theorized that the owners or the financiers of the project should realize value from the project to be considered successful.

Barclay and Osei-Bryson (2009) conceptualized a project performance development framework (PPDF). The PPDF enabled the team to focus on identifying, prioritizing, and measuring success based on value delivered to the stakeholders.

Customer Satisfaction (PSF): Customer satisfaction related to the customer's perception of the project (Kutsch, 2007). Customer satisfaction PMI (2008) indicated that the degree of customer satisfaction was an outcome of projects. Barclay and Osei-Bryson (2010) theorized the importance of enhancing the customer's experience. Kutsch (2007) opined that stakeholders, owners, and users need to be satisfied with the project outcome.

Banker and Kemerer (1992) theorized that user satisfaction was often a commonly used technique to measure project effectiveness. It was often difficult to measure business value. In the author's experience customer satisfaction provided a means to standardize measurement of effectiveness where as schedule and budget were used to measure project efficiency (Shenhar & Dvir, 2007b).

Communication (PSG), Change Control (PSH), and Risk Mitigation (PSI): Delphi team members suggested that project success should be gauged while the project was under way. Team member November stated that a project should be measured

based on communications, issues and risks. Team member Charlie added that there were more variables to project success than the five proposed.

Delphi team member Oscar suggested that effective communications were an element of success, especially how effectively the project goals were disseminated. Reich, et al. (2008) theorized that creating a project vision enabled project team members to understand the end goals. Members can see how the project deliverables were linked to the customer's business needs.

Survey Validity, Administration, and Reliability

Validity: Delphi Team

The validity of the survey was confirmed after the content analysis by the Delphi team (Also see Chapter 3: Develop Data Collection Instrument: Check Survey Validity: Delphi Team). The team's qualifications are noted in Appendix O. The Delphi team members were invited towards the end of the content analysis and their work took place between the conclusion of the content analysis and the start of the pilot survey.

Appendix P shows the final survey that the Delphi team reached consensus on. This survey was used in the research. In Appendix P after question 3 the scale was removed. The scale was the same from question 3 through question 32. Later the introduction was shortened but otherwise the ultimate survey reflected the team's consensus. Appendix Q shows the quantitative scores achieved in the final round. Consensus was reached after four rounds.

Administration: Pilot and General Surveys

The sample for the pilot test came from a convenience sample of 15 IT managers with experience in large corporations. Specifically, the sample came from members of

this author's Linked-in contact list of which there were 425 members. The pilot group was asked to take the survey twice with an interval of two weeks between the surveys (Lindbergh, 2009). However, there were three people in Pilot 2 who took the survey three to four weeks after the initial pilot. The pilot group was asked not to review answers from the previous time that they took the survey.

In this research, the general survey introduction was sent to 4,986 people on 9 January 2012 of which 288 email addresses were invalid. On 31 January 2012 a letter was sent to 3,340 potential respondents of which 334 letters were returned. Addresses were not available for all people in the initial working population and the initial population included job titles that were inappropriate for this research. On 8 February 2012 The International Project Management Association (Association of American Project Managers – ASAPM) in their news letter posted the survey to their members in the United States. The association was supportive even noting that in their experience that the survey took less time to complete than the author told the members (ASAPM, 2012). ASAPM is a part of the International Project Management Association which has many members primarily in Europe and Australia. Following up on the letter campaign, the first reminder was sent on 14 February 2012 by email. About 300 people replied that they were out of the office. The second reminder was sent on 23 February 2012. About 185 people replied that they were out of the office. From these efforts 101 people responded of which four surveys were discarded. For two surveys there were no responses, one survey only answered two questions, and in another survey the respondent did not answer six questions. This left 97 usable responses.

To-date seven people have asked to see the results. In addition, some people wrote supportive emails indicating that the survey was “excellent”. People have also asked for copies of the survey. Finally, respondents thanked the author for conducting the survey.

The survey was completed by 97 respondents. All respondents were IT managers or directors working in companies with 1,000 or more employees that were based in the United States. Appendix R outlines the demographic frequencies for the respondents. Most of the respondents (65.6%) worked on projects in which the organization had a core competence or had experience doing a similar project previously. Another 28.1% worked on projects that were new to the company. On the other hand, 64.9% worked on projects with a large scope that spanned the organization or multiple organizations. Most of the IT project managers (69.8%) led teams that were fewer than 20 people, leading projects that 88.5% of the time were completed within two years. The IT project leaders who responded had significant experience as 77.3% had 5 or more years experience in IT project management. In addition, 59.6% of the respondents worked in IT organizations with fewer than 300 people and 19.6% worked in IT organizations with more than 1,000 employees and contractors.

Reliability: Pilot and General Surveys

The results of the pilot survey test-retests are shown in Tables 9 to 11. Pearson's Product Moment was used to derive the correlation between Pilot 1 and Pilot 2. Cronbach's alpha for the pilot surveys was also developed as shown in Table 12.

Table 9: Correlation for Organizational Learning between Pilot 1 and Pilot 2

Correlations

		OLF 2	OLF 1
OLF 2	Pearson Correlation	1	.727**
	Sig. (2-tailed)		.002
	N	15	15
OLF 1	Pearson Correlation	.727**	1
	Sig. (2-tailed)	.002	
	N	15	15

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

Table 10: Correlation for Project Learning between Pilot 1 and Pilot 2

Correlations

		PLP 1	PLP 2
PLP 1	Pearson Correlation	1	.570*
	Sig. (2-tailed)		.027
	N	15	15
PLP 2	Pearson Correlation	.570*	1
	Sig. (2-tailed)	.027	
	N	15	15

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

Table 11: Correlation for Project Success between Pilot 1 and Pilot 2

Correlations

		Project Success 1	Project Success 2
Project Success 1	Pearson Correlation	1	.919**
	Sig. (2-tailed)		.000
	N	15	15
Project Success 2	Pearson Correlation	.919**	1
	Sig. (2-tailed)	.000	
	N	15	15

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

For the three test-retests there was a positive correlation between the test results in pilot 1 and pilot 2 significant at the 0.05 level or better. Between the pilots the PSVs had a correlation of 0.919 significant at the 0.01 level, OLFs had a correlation of 0.727 significant at the 0.01 level, and PLPs had a correlation of 0.570 significant at the .05 level.

In addition to conducting the test-retest, Cronbach's Alpha was calculated from the pilot data for the PSVs, OLFs, and PLPs. N is double the number of questions because both Pilot 1 and Pilot 2 were included in the results as shown in Table 12.

Table 12: Cronbach's Alpha Results for Pilot 1 and Pilot 2 Combined

Variable	Cronbach's Alpha	N
Project Success Variables (PSVs)	.860	18
Organizational Learning Factors (OLFs)	.894	24
Project Learning Practices (PLPs)	.889	22

All of the studies related to Cronbach's Alpha exceeded 0.8. Leech, et al. (2011) theorized that Cronbach's alpha should be between 0.7 and 0.9. If it was lower than 0.7 then the items may not be very similar. If the score exceeds 0.9 then some questions may be repetitious. On the whole the results were positive and the decision was made to move forward with the general survey.

Upon completion of the pilot test the general survey reliability was again determined. Here under Cronbach's Alpha was repeated for the general survey and the results are shown in Table 13.

Table 13: Cronbach's Alpha Results for General Survey

Variable	Cronbach's Alpha	N
Project Success Variables (PSVs)	.802	9
Organizational Learning Factors (OLFs)	.887	12
Project Learning Practices (PLPs)	.862	11

As the table shows Cronbach's alpha exceeded 0.8 for all variables as it did with the pilot study. Once again the reliability results of the survey came within the ideal range of 0.7 through 0.9 (Leech, et al., 2011).

Support Question 2: Effective Use of Organizational Learning

Frequencies and descriptive statistics were used to respond to SQ2. Appendix S provides descriptive statistics for each survey question including OLFs. Appendix T provides frequencies for each OLF variable. The histogram in Figure 5 appears to indicate that OLF construct has a normal distribution.

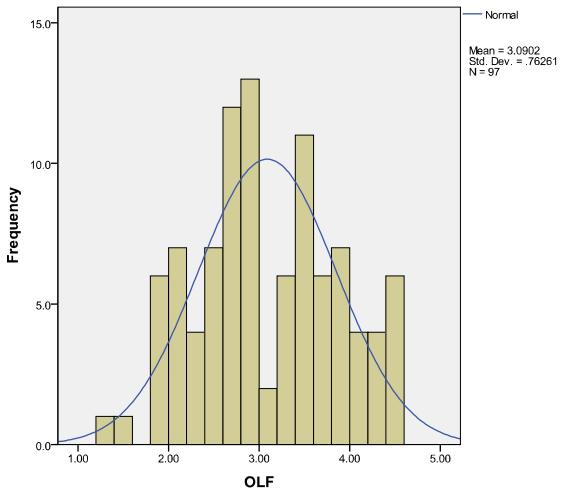


Figure 5: OLF Histogram

SQ2 asked how effectively do IT organizations manage OLFs based on the elements that define OLFs. Effective use was made of OLFs if respondents indicated a score of four or five. Table 14 illustrates the percent of respondents who reported effective use of OLFs and descriptive statistics.

Table 14: Summary of OLF Frequency of Effective Use and Descriptive Statistics

Organizational Learning Factor	**Frequency of Effective Use**	**Valid Percent**	**Mean**	**Standard Deviation**	N
Trust	68	70.1%	3.75	1.061	97
Senior Management	54	55.7%	3.44	1.199	97
Resources	40	41.2%	2.99	1.150	97
Training	30	31.3%	2.75	1.178	97
Information Systems	54	55.7%	3.27	1.177	97
Expert Locator	31	32.3%	2.53	1.178	96
Time	30	31.3%	2.82	1.124	96
Required to Conduct Post Project Reviews	58	60.4%	3.50	1.170	96
Process	35	36.1%	3.04	1.045	96
Incentives	21	21.7%	2.46	1.128	97
Organization Structure	37	39.8%	2.96	1.132	96
Personal Communication	64	66.0%	3.57	1.089	97

Within organizational learning IT project leaders were positive about trust (3.75), personal communication (3.57), conduct of post project reviews (3.5), and senior management leadership (3.44). Information systems (IS) had a mean of 3.27 with 56% of respondents indicated that IS supported organizational learning. Training (2.75), expert locator (2.53), and incentives (2.46) appeared to have weighed down the

effectiveness of organizational learning factors. Figure 6 provides a Pareto chart of the mean scores for OLFs.

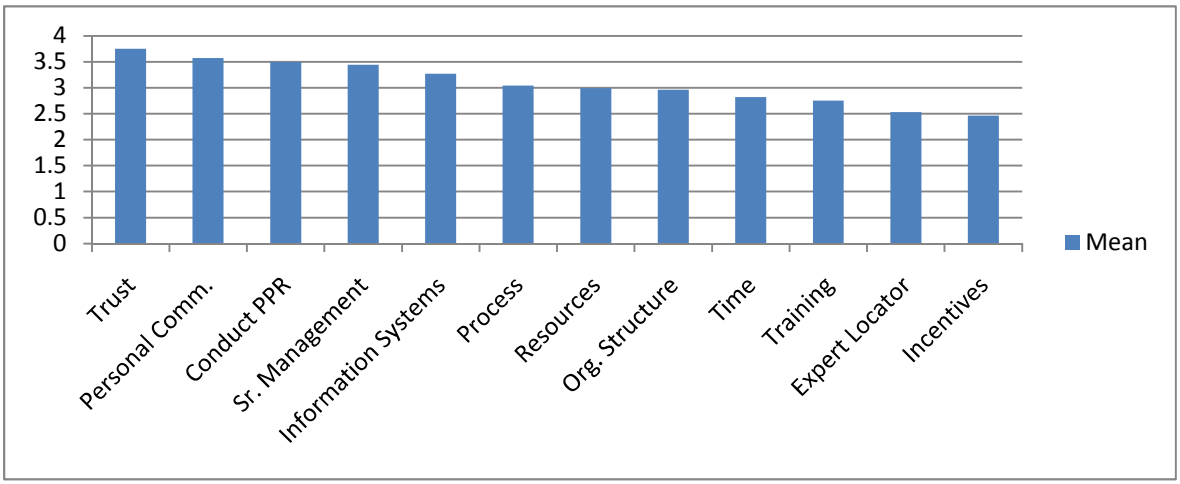


Figure 6: Pareto Chart for OLFs

Support Question 3: Effective Use of Project Learning

Appendix U provides frequencies for each PLP variable. Appendix S provides descriptive statistics for each survey question including PLPs. Figure 7 appears to show that the PLP construct has a normal distribution.

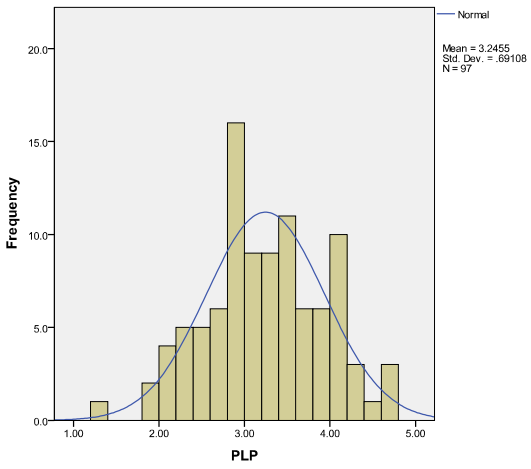


Figure 7: PLP Histogram

SQ 3 asks how effectively do IT organizations manage PLPs based on the elements that define PLPs. Effective use was made of PLPs if respondents indicated a score of four or five. Table 15 illustrates the percent of respondents who reported effective use of OLFs and descriptive statistics.

Table 15: Summary of PLP Frequency of Effective Use and Descriptive Statistics

Project Learning Practice	**Frequency of Effective Use Scores**	**Valid Percent**	**Mean**	**Standard Deviation**	N
Benefits from Earlier PPRs	37	39.8%	3.03	1.088	93
Personal Reflection and Use of LL	74	76.3%	3.85	.972	97
Right Skills	77	79.3%	3.94	.814	97
Networking	72	75.0%	3.94	.792	96
Kickoff Meetings	34	35.0%	2.92	1.155	95
External Resources	45	46.9%	3.17	1.149	96
Used IS	45	47.4%	3.06	1.174	95
Used Expert Locator	22	23.2%	2.37	1.185	95
Evaluated LL	29	29.9%	2.74	1.151	93
Applied LL	40	42.1%	3.11	1.115	95
Captured LL	61	62.9%	3.55	1.113	96

IT project leaders indicated that teams are staffed with people who have the right skills (3.94), networking was effective (3.94), and individuals used lessons they learned

from prior projects (3.85). Evaluated lessons learned by the team scored low (2.74). Haas (2006), in his survey of consultants that it is important for project teams to evaluate knowledge they apply or it could have adverse consequences. Kickoff meetings (2.92) to disseminate lessons learned which also was mentioned infrequently in the literature appeared not to be effectively used. Finally, an expert locator (2.37) was not used most likely because the tool does not exist given the low mean score within the OLFs. Figure 8 provided a Pareto analysis of the mean scores for PLPs.

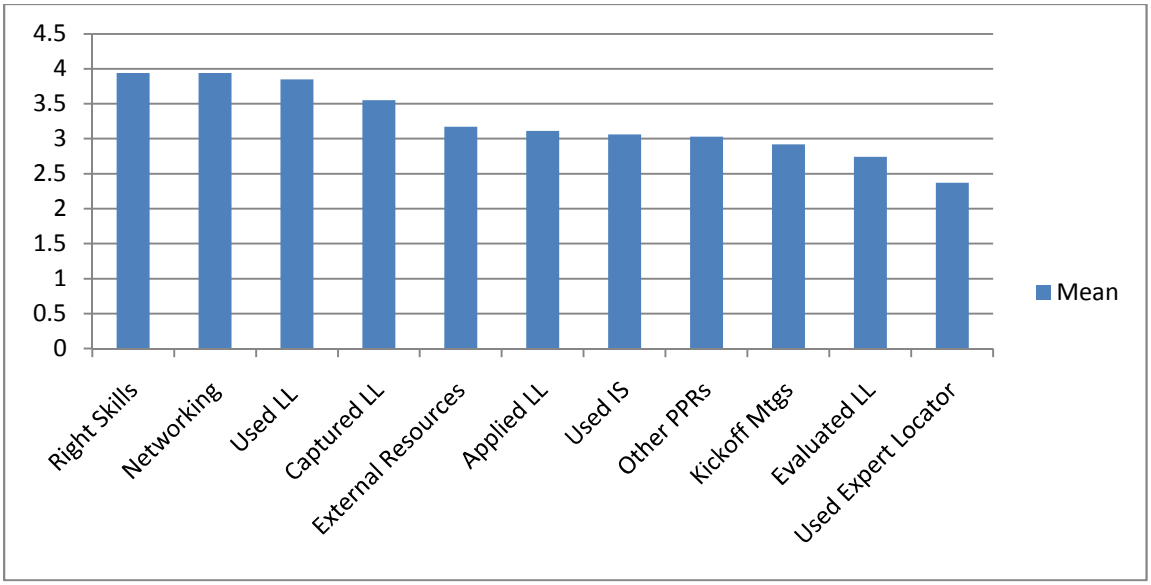


Figure 8: Pareto Chart for PLPs

Support Question 4: Project Success Levels

Frequencies and descriptive statistics were used to respond to SQ4. Appendix V provides frequencies for each PSV variable. Appendix S provides descriptive statistics for each survey question including those related to PSVs. Figure 9 appears to show that the PSV construct has a normal distribution.

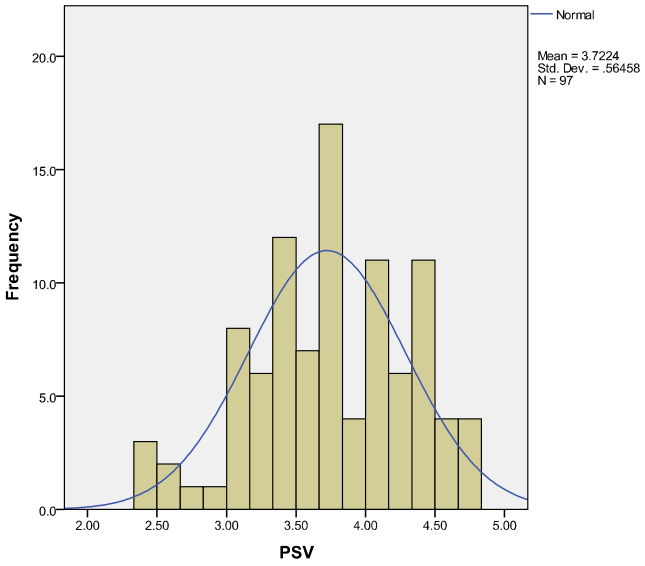


Figure 9: PSV Histogram

SQ4 asked how well do projects perform based on the elements that defined the PSVs. A good score for budget or schedule was three or four that success was achieved. For the other PSVs a score of four or five would indicate success. Table 16 illustrates the percent of respondents who reported achieving successful scores and associated descriptive statistics.

Table 16: Summary of PSV Frequency of Success and Descriptive Statistics

Project Success Variable	Frequency of Success Scores	Valid Percent	Mean	Standard Deviation	N
Budget	86	88.6%	3.10	.568	97
Schedule	77	79.4%	2.98	.629	97
Specifications	81	83.5%	4.11	.967	97
Quality	77	79.4%	3.97	.895	97
Business Value	76	80.9%	4.14	.946	94
Customer Satisfaction	73	76.9%	3.93	.890	95
Communication	70	72.9%	4.04	.928	96
Change Control	68	70.1%	3.74	1.083	97
Risk	54	56.2%	3.53	1.12	96

The highest mean related to delivering business value (4.14) to the organization followed by conformance to specifications (4.11). Risk mitigation scored the lowest (3.53) with 56% of respondents indicating that the project mitigated risks. Otherwise, 70% to 89% of respondents reported scores of 4 or 5 for each question.

Another view of the data indicated that 29 of 97 respondents reported a high score for all categories. A high score was 3 or 4 for budget and schedule performance and 4 or 5 for the other PSVs. The remaining 68 respondents had at least one low score out of the nine variables.

Research Question: Relationship Among OLFs, PLPs, and PSVs

The combined statistics for the major constructs are captured in Table 17. The mean score for PSVs were 3.7 with the narrowest standard deviation of .56. OLFs have a mean score of 3.1 with a standard deviation of .76. Finally, the PLPs have a mean score of 3.2 with a standard deviation of .69.

Table 17: Descriptive Statistics for OLFs, PLPs, and PSVs

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
PSV	97	2.44	4.78	3.7224	.56458
OLF	97	1.33	4.50	3.0902	.76261
PLP	97	1.30	4.73	3.2455	.69108
Valid N (listwise)	97				

The research question asked what relationship existed in IT organizations among OLFs, PLPs, and PSVs. Table 18 was developed to answer the research question. The correlation was derived using Pearson's Correlation. The table indicated a positive correlation amongst the three constructs significant at the 0.01 level.

Table 18: Pearson's Correlation for OLFs, PLPs, and PSVs

Correlations

		PSV	OLF	PLP
PSV	Pearson Correlation	1	.537**	.474**
	Sig. (2-tailed)		.000	.000
	N	97	97	97
OLF	Pearson Correlation	.537**	1	.705**
	Sig. (2-tailed)	.000		.000
	N	97	97	97
PLP	Pearson Correlation	.474**	.705**	1
	Sig. (2-tailed)	.000	.000	
	N	97	97	97

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

Jugdev (2007) as noted in Chapter 3 indicated that a correlation between 0.4 and 0.7 was a low to moderate correlation and a correlation higher than .7 was strong. Creswell (2005) theorized that the correlation had limited predictive capability between 0.35 and 0.66 and good predictive capability from 0.66 to 0.85. Using Creswell and Jugdev the interpretation suggests the results between PSV and OLF and between PSV and PLP would have moderate predictive capability and the result between OLF and PLP would have a strong predictive capability. However, Gray and Kinnear, (2012) theorized that a relationship from 0.3 to 0.4999 was considered "MEDIUM and if the relationship was greater than 0.5 was "LARGE." Leech, et al. (2011) used four levels to interpret the magnitude of the correlation. The top three levels included a level from 0.3 to 0.499 in which the association was considered medium, from 0.5 to 0.699 was large, and over 0.7 very large. Using the latter two measuring methods the relationship between OLFs and PSVs and between OLFs and PLPs were large and between PLPs and PSVs the relationship was medium. Finally, the results in this research were significant where $\rho = .01$ (two-tailed).

The experts used somewhat different characterizations and ranges to interpret correlation results. The exact ranges and wording were associated with a scale from very low to very high in Table 19. Table 19 may help to determine a reasonably common interpretation which was attempted in Table 20.

Table 19: Correlation Ranges for Researchers Using a Common Interpretation

	Very Low	**Low**	**Medium**	**High**	**Vey High**
Creswell, 2005, pp. 33-334	0 to 0.20	0.20 to 0.35 "Slight relationship"	0.35 to 0.65 ("Limited prediction")	0.66 to 0.85 ("Good prediction")	0.86 to 1.0 (May measure the same thing)
Jugdev, 2007, p. 433	0 to 0.20 ("Weak or negligible")	0.20 to 0.40 ("Weak to low ")	0.40 to 0.70 ("Moderate")	0.70 to 0.90 ("Strong and high")	0.90 to 1.0 ("Very strong and very high")
Gray & Kinnear, 2012, p. 407	0 to 0.1	0.1 to 0.30 ("Small")	0.30 to 0.5 ("Medium")	0.5 to 1.0 ("High")	
Leech, et al., 2011, p. 92	0 to 0.1	0.1 to 0.30 ("Small or smaller than typical")	0.30 to 0.50 ("Medium or typical")	0.50 to 0.70 ("Large or larger than typical")	0.70 to 1.0 ("Much larger than typical")

Using the common interpretation across the top of Table 19 one may interpret the results of each expert using Table 20. This permits a judgment to be made about the strength of the relationship in qualitative terms which most experts might accept.

Table 20: Interpretation of Correlations Among OLFs, PLPs, and PSVs

Researchers	**OLFs ---PSVs** **0.537**	**PLPs --- PSVs** **0.474**	**OLFs ---PLPs** **0.705**
Jugdev (2007)	Medium	Medium	High
Creswell (2005)	Medium	Medium	High
Leech, et al. (2011)	High	Medium	High
Gray & Kinnear (2012)	High	Medium	Very High
Finding	Medium / High	Medium	High

Using Table 20 there was a medium to high correlation between the OLFs and PSVs. Between the PLPs and PSVs there was a medium correlation. Finally, between OLFs and PLPs there was a high relationship. Leech, et al. (2011) theorized that when one was not testing for reliability it was rare that a correlation exceeded 0.70.

Summary

The content analysis followed by work with a Delphi Team consisting of 10 members identified 12 questions for organizational learning, and 11 questions for project learning, and 9 questions for project success. The questions defined organizational learning, project learning, and project success answering support question 1.

The pilot and general surveys indicated that the survey was reliable. The test-retest for the pilot surveys indicated positive correlations significant at the 0.05 level or better. In addition, Cronbach's alpha was 0.8 or better and fell within the ideal range between 0.7 and 0.9.

Descriptive statistics and frequencies were developed to answer support questions 2, 3, and 4. The overall mean score for organizational learning was 3.1, for project learning 3.2, and for project success 3.7. The data was characterized by a normal distribution. The top four OLFs included trust, personal communication, requirement to conduct post-project reviews, and senior management support. The top four PLPs included right skills on the team, networking, personal reflection and use of lessons learned, and capturing lessons learned.

A positive relationship was found among OLFs, PLPs, and PSVs significant at the level where $\rho = .01$. An analysis of interpretations by different experts enabled characterization of the results. The relationship between OLFs and PLPs was high, between OLFs and PSVs medium/high, and between PLPs and PSVs medium.

Chapter 5

Conclusions, Implications, Recommendations, and Summary

Introduction

Shenhar and Dvir (2007b) theorized that project leaders were responsible for all metrics of project success, establishing a high bar for managers who do not fully control their environment. Thus, tools that could enable IT project managers to achieve success would be important. One such tool may be project knowledge management (PKM). The primary purpose of this research was to understand the relationship among organizational learning factors (OLFs), project learning practices (PLPs), and project success variables (PSVs) as a better way to understand PKM. Thus, a content analysis of research literature was conducted to define a set of variables which were validated by an expert panel. Then through a general survey the level of project success that IT managers were achieving and their effective use of OLFs and PLPs was clarified. Finally, using statistical analysis the relationship among the OLFs, PLPs, and PSVs was determined.

In this chapter the conclusions, implications, and recommendations are presented. The conclusions address the support questions and the research question. Limitations and the ability to generalize this research are also addressed in the conclusions. The implications are then presented, focusing on the relevance of this research to the PKM body of knowledge and potential value for IT organizations. The section on recommendations outlines possible next steps for organizations and offers

suggestions for future research. Finally, a summary of the chapter and this research is presented.

Conclusions

This research asked four support questions in support of a single research question. This section relates answers derived for the support questions and the research question. This section also describes the limitations of this research and the extent to which the results maybe generalized.

Support Question 1: Elements that Defined OLFs, PLPs, and PSVs

The original support question asked - what elements define the following?

a. OLFs

b. PLPs

c. PSVs

The content analysis supplemented by the Delphi team concluded that there were 12 OLFs, 11 PLPs, and 9 PSVs. OLFs included those activities at the organizational or corporate level that enabled project team members to learn from other projects. PLPs included processes and activities that mature project teams conducted to capture, store, and transfer lessons learned; and emerging project teams conduct to access, evaluate, and decide which lessons to apply. PSVs addressed delivering a good result within constraints that created value and provided a good experience for all stakeholders while mitigating risk. Table 21 provides a summary of the major variables and the underlying elements.

Table 21: Summary of OLFs, PLPs, and PSVs

OLFs	PLPs	PSVs
Trust & Supporting Culture	Team Benefitted from Earlier Post-project Reviews	Budget
Sr. Management Leadership	Personal Reflection and Use	Schedule
Resources	Right Skills and Experience	User Specifications
Training	Networking	Quality
Information Systems	Kickoff Meetings	Business Value
Expert Locator	External Resources	Customer Satisfaction
Time in Project Schedule	Information Systems	Communication
Conduct PPRs	Expert Locator	Change Control
Process	Evaluate Lessons Learned	Risk Mitigation
Incentives	Applied Lessons Learned	
Organizational Structure	Captured Lessons Learned	
Personal Communication		

The emphasis in the literature was on the organizational level to enable learning within project-based organizations. Leadership, a culture of trust, incentives, process, and resources were essential to develop and maintain a successful learning environment. This finding was consistent with Hanisch, et al. (2009) who theorized that PKM was primarily impacted at the organizational level. Lindner and Wald (2011), in their empirical research concluded that culture and leadership were important enablers of

PKM as well as the firm's organizational structure, processes, and technology. All were necessary for a complete and successful PKM initiative. The United States General Accounting Office (GAO) (2002) in its audit report emphasized the organizational role to establish a business plan that included knowledge management (KM), for senior managers to set the example, and for the organization to invest in the lessons learned system.

Support Question 2: Organizational Learning

The original support question asked - how effectively do IT organizations manage OLFs based on the elements that defined OLFs. The descriptive data and ranking provides insight into the effective use of OLFs in IT organizations. IT organizations were effectively implementing some OLFs but there was room for improvement with an overall mean score of 3.1 with effective use (a score = 4 or 5) frequency for each variable ranging from 22% to 70%.

More than 55% of the IT leaders reported that trust and supportive culture, senior management leadership, requirement to conduct of post project reviews, personal communication, and information systems were effective. These same attributes were often cited in the content analysis as well. Thus, a degree of alignment between research and use in IT organizations appears to exist. The emphasis of four of the five variables indicated that it was important to bring people together to share knowledge. Ajmal and Koskinen (2008) theorized that project-based organizations needed to create a culture that promotes knowledge sharing. Thus, it was a good sign that these four factors (trust, conduct of post-project reviews, personal communication, and senior management support) were used often and had relatively higher mean scores. In addition, many

respondents reported that information systems were an effective knowledge sharing enabler. On the other hand resource intensive variables were used less frequently. The following variables scored well less than 45% of the time including adequate resources, training, expert locator, sufficient time, process, organization structure, and incentives.

For all OLFs though the mean scores suggest room for improvement exists. Some IT organizations may be effective while others were not. This conclusion was consistent with the literature. Cerpa and Verner (2009) reported that IT projects have been failing for the same reasons for over 30 years. GAO (2002) reported that NASA had not used a number of best practices in organizational learning that led to repeated space exploration mishaps.

Support Question 3: Project Learning

The original support question asked - how effectively do IT organizations manage PLPs based on the elements that defined PLPs? The answer to this question is similar to the answer for OLFs. IT organizations were effectively implementing some PLPs but there was room for improvement with an overall mean score of 3.2 with effective use (a score = 4 or 5) frequency for each variable ranging from 23% to 79%. Effective use frequency distributions, however, were more polarized for PLPs than OLFs.

Effective use of the top four variables including personal reflection and use of lessons learned, right skills, networking with others, and team capturing lessons learned exceeded 60%. Here there was somewhat less alignment with what researchers mentioned most often except that both IT leaders and researchers appear to have emphasized the importance of project teams having the right skill sets. However, once

again it was positive that the top three PLPs related to the organizational fabric or culture of the organization. Team members brought the right skills, teams networked outside of the team, and individuals used lessons they learned from prior projects. The latter suggested that individuals were reflecting on prior projects and bringing new knowledge with them. It was also note worthy that teams were capturing lessons learned from their experiences. Goffin, et al. (2010) theorized that companies that were seeking to improve knowledge management (KM) should strive to make post-project reviews meaningful and to encourage personal reflection.

The frequency of effective use for several variables was lower than 40% including use of post-project reviews from other teams, use kickoff meetings to disseminate knowledge, use of an expert locator, and evaluation of lessons learned. Application of lessons learned from prior projects was effective for 42% of the projects reported on. These variables would require more effort to manage as well as scarce resources which was an issue at the organizational level too.

Overall, the conclusion that IT organizations can more effectively utilize PLPs was supported by the literature. Gauld (2007) outlined a serious IT project failure at a major hospital in New Zealand in which the board did not learn lessons from another hospital nor its own experiences. Keegan and Turner (2001) evaluated 19 project-based firms and concluded that while managers could describe ideal learning processes that they were often not followed. Garon (2006) reported that while lessons learned were available they were rarely used in space agencies.

Support Question 4: Project Success

The original support question related to the PSVs asked - how well do projects perform based on the elements that define PSVs? In this study, IT managers reported that their projects were successful with a combined mean score of 3.7 and frequency of success scores for each PSV ranging from 56% to 89%. Yet 70% of the respondents that led IT projects reported one or more success criteria that were not a strong indicator of success. Of special concern was that 44% of the IT managers reported low scores for risk mitigation. Nonetheless this research appeared to show a more optimistic view of project success than some prior research.

The Standish Newsroom (2009) reported that over two-thirds of IT projects failed or were challenged. Wu, Ong, and Hsu (2008) cited companies that spent millions of dollars on failed ERP implementations. Gauld (2007) citing Dalcher and Genus, (2003) noted that both public and private organizations in the United States and Europe wasted around US$290 billion per year on IS failures.

Research Question: Relationship Among OLFs, PLPs, and PSVs

The original research question posed – what relationships exist in IT organizations among the following?

a. OLFs and PLPs
b. OLFs and PSVs
c. PLPs and PSVs

This research demonstrated a positive and significant correlation among organizational learning, project learning, and project success in IT organizations. Figure 10 repeats the

diagram shown in Chapter 1 indicating the correlation among the variables which were all significant at the .01 level.

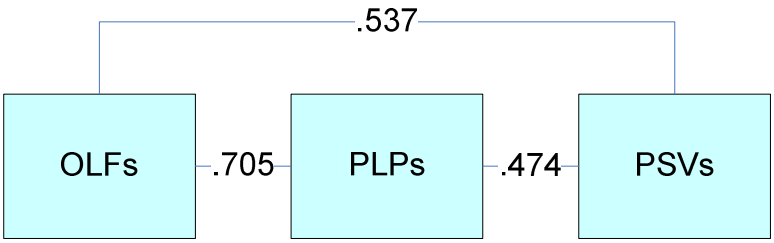


Figure 10: Relationship Among OLFs, PLPs, and PSVs ($\rho < .01$)

Overall, the finding of a positive relationship amongst OLFs, PLPs, and PSVs appeared to be consistent with the literature. Lee, Shin, and Lee (2011) found a relationship between knowledge transfer amongst project teams, their consultants, and users which in turn correlated with user perceptions of system quality ($r = .45$) and user benefits ($r = .53$). The participants of the study of Lee, at al. included an IT project team member and a user for each project. Tanriverdi (2005) empirically found that KM capability was related to market-based and financial performance. Hong, et al. (2008) found a causal relationship between systems integration project success and team member knowledge. Lierni and Ribièri (2008) found a relationship between KM practices and project management. Henry, et al. (2007) found that the combination of traditional project management practices and KM enabled schedule and budget predictability. Rose, et al. (2009) found a positive relationship between organizational learning and work performance. In addition, employee commitment increased with improvements to organizational learning. Lindner and Wald (2011) concluded that culture and leadership, organization and processes, and information systems correlated with PKM effectiveness. Goh and Ryan (2008) found that learning companies in 159 of 264 months out performed the S&P 500 index. Karlsen and Gottschalk (2004)

concluded in their correlational study that project success related to an effective KM culture. Researchers found positive relationships between KM and project management or organizational success which helps to validate the results of this research.

Specific cases also illustrated a relationship between project success and learning. Terrell (2000) in a specific case study on Duke Engineering and Services reported that applying lessons learned for major projects in which generators were replaced at power stations. Using lessons learned the company was able to reduce the critical path of the emerging project by 33% while accomplishing 27% more work. In another specific endeavor Hirai, et al. (2007) developed an IT system and a process to enable research and development projects. The system had been in place for six years when the article was written. The knowledge management system enabled a group to shorten lead times to improve processes. Ebert and De Man (2008) also developed a knowledge management system at Alcatel-Lucent and reported that 89% of the sales and marketing forces considered the tool an important for their jobs. The company also uncovered 40% of all defects sooner in the process enabling a cost savings of 30%.

OLFs and PLPs evolved from the literature and related to the concept of organizational and project layers thus providing an improved understanding of learning variables within organizations (Ajmal & Koskinen, 2008; Crossnan, Lane, and White, 1999; Nonaka, et al., 2006). It was also concluded that OLFs and PLPs have a correlation with each other and each correlated positively with IT project success. Within limits IT leaders may have, in PKM, a strong tool to enable improved project success.

Limitations and Ability to Generalize Conclusions

Originally, a goal of this research was to achieve 320 respondents or 10% of the working population. Using a sample sizing formula it was initially determined that 233 respondents may be adequate using a conservative standard deviation of two (Rea & Parker, 2005). This goal was not achieved. However, the largest actual standard deviation achieved turned out to be 1.199 for all of the questions. Using Rea and Parker's (2005) sample sizing formula again the acceptable sample was revised to 87 respondents. In this study 101 IT managers responded, producing 97 valid responses.

The findings related to IT project success appeared to be more optimistic than reported in the literature. Cerpa and Verner (2009) theorized that managers were reluctant to report project failures even when none of the benefits were met. Rose, et al. (2009) theorized that perceptual measures may not reflect the subject being studied. This research may have similar limitations.

Acknowledging the limitations, it appears that the results can be generalized for IT organizations in the United States where the firms have more than 1,000 employees. Researchers have used similar size samples and reported useful findings (Karlsen & Gottschalk, 2004, Landaeta, 2008; Lierni & Ribièri, 2008). Hartman and Ashrafi (2002) used a small sample in their research but stipulated that since there was a correlation between their findings and observations in the literature that the findings could be broadly applied. In this research the validity of the conclusions appeared to be consistent with KM and specifically PKM research in the literature.

This research found that 70% of respondents reported that at least one area of project success could be improved. Moreover, 44% of the respondents reported a

relatively low score for risk mitigation. Cerpa and Verner (2009) were also able to ultimately to uncover unsuccessful projects. Rose, et al. (2009) were able to draw conclusions on the relationship between learning, work performance, organizational commitment, and job satisfaction. This research also may have had similar limitations yet exposed useful findings.

Implications

This section covers the implications of the conclusions discussed above in three sections. The first subsection relates the implications of the constructs and their foundation in the literature. The second subsection discusses the impact of the answer to the research question for IT organizations. The third subsection addresses the implications of this study towards measuring PKM effectiveness.

Extending PKM Foundation

This study extended prior research by delineating the variables at the organizational and project layers within project-based organizations based on the foundations of KM. Nonaka, et al. (2006) theorized that knowledge assets could be used at the organizational and project layers. Crossnan, et al. (1999) established that organization learning was multi-level at the organizational, group, and individual levels. Ajmal and Koskinen (2008) applied the multi-level model to project-based organizations. Keegan and Turner (2001) theorized that project team learning was an important element of organizational learning in project-based organizations. Thus, the concept of OLFs and PLPs rested on a theoretical foundation within the literature.

Heisig (2009) developed KM frameworks using the literature. One of Heisig's lists included "human oriented factors: culture – people – leadership, organization processes and structure, technology infrastructure and applications, and management process: strategy, goals, and measurement" (Table VIII, p. 11). Linder and Wald (2011), based on interviews and review of the literature, concluded that important PKM factors included "culture and leadership, organization and processes, and ICT-systems" (Figure 2, p. 882). Jabar, Yeong, and Sidi (2012) listed individual and organizational factors that contributed to knowledge sharing during requirements gathering. The list of factors included "trust, communication, information systems, reward, organizational, and cultural" (Jabar, et al., 2012, Table 1, p. 34). These frameworks correlated well with OLFs.

Goffin, et al. (2010) identified eight areas of learning that research and development staff perceived to be important. The list included "budget and costs, schedule, and product specifications" (Goffin, et al., 2010, Table 3, p. 45) which were similar to attributes listed in the PSVs. In addition, "resources" was listed which was also an OLF. "Problem solving" was also mentioned which is similar to evaluate lessons learned, a PLP.

This research reached similar conclusions regarding OLFs, PLPs, and PSVs as other researchers. In addition, this research specified variables at the organizational and group levels within project-based organizations (Ajmal & Koskinen, 2008; Crossnan, et al., 1999). Thus, this research brought together a common set of specific organizational and project learning variables that can be related to project success.

IT Organizations

Hesseldahl (2011) reported that the Gartner Group forecast IT spending would be $3.6 trillion in 2011 of which $419 billion would be spent on computer hardware, $268 billion on enterprise software, $846 billion on IT services, and $2.1 trillion on telecommunications. Gartner Group (n.d.) had previously forecast $3.3 trillion would be spent in 2010. Senior executives sought to use IT to improve business processes, reduce enterprise costs, improve productivity, and improve customer experience (Gartner Group, n.d). In this research 65% of the projects appear to have been large in scope serving customers throughout an organization or multiple organizations. While the magnitude of IT projects expenditures and their impact on individual organizations and society is large, it rests with individual senior IT leaders and project leads to prioritize learning for each IT organization. The results of this study presented a justification for IT leaders to further explore the potential of PKM in their IT organization.

Consistent with the literature, it was determined that more needs to be done to effectively implement PKM. Hanisch, et al. (2009), based on their exploratory study, found that PKM was insufficiently used. Von Zedtwitz (2003) in his survey found that 80% of the projects were not reviewed after completion and the other 20% ineffectively. Desouza and Evaristo (2005) theorized that project failures were the result of poor KM practices. Disterer (2002) theorized that after projects were completed team members were released throughout the organization and information was stored in folders that were not accessible to future teams. This research confirmed that more effective use can be made of OLFs and PLPs.

Fong (2003) theorized that some repetition of processes improved learning prospects among projects. Fully 66% of the respondents worked on projects in which the organization had prior experience. Another 28% worked on projects new to the company suggesting that an emphasis on external networking and benchmarking may be helpful to improve project success though in some cases competitive forces may prevent knowledge sharing among organizations. In other cases alliances among companies may facilitate knowledge sharing. Thus, it appears that 94% of projects evaluated here are good candidates to benefit from knowledge learned in prior projects within and external to an IT organization.

The setting established above and the strength of the correlation among OLFs, PLPs, and PSVs suggests that IT organizations have an opportunity to improve project success through PKM. PKM is an emerging field of study (Hanisch, et al., 2009) that warrants continued research and development within individual organizations.

Measuring PKM Effectiveness

Holsapple and Wu (2008) theorized that there was a missing link between excellent KM and profitability. The missing link was the means to measure the financial impact of KM. Choy, et al. (2006), upon completion of two case studies recommended that performance outcomes should be correlated with KM. This research has taken one step towards understanding the missing link and correlating PKM with project success in IT organizations.

Bose (2004) theorized that organizations should integrate KM measurement into the firm's overall performance systems. Organizations may use this survey to measure progress towards improving PKM and understanding the relationship among OLFs,

PLPs, and PSVs in an IT organization. One respondent requested a copy of the survey to measure PKM effectiveness in his IT organization. The respondent believed that the most value would come from using the survey over time. Employees within organizations could use the survey instrument to determine how effective OLFs and PLPs are being and used their relationship with the PSVs. Survey results could be the foundation that enables IT leaders, using data, to continuously improve PKM and ensure it enables project success.

Over time the survey may be supplemented by specific PKM measurements that measure costs and time invested in PKM as well as improvements in results in customer satisfaction, on-time delivery, and performance within budget. For example, as noted above Duke Energy was able to document specific results that could be attributed to its PKM initiative (Terrell, 2000).

Recommendations

This section covers next steps that organizations may take and future research. Organizational next steps discuss planning for PKM and evaluating its success. This section also poses areas for future research.

IT Organizations: Next Steps

IT organizations should consider implementing or strengthening their PKM initiatives. The research developed a set of organizational learning factors and project learning practices some or all of which may enable managers to define a program that meets the needs of the organization. Both survey respondents and the literature emphasized factors such as trust, senior management, and personal communication

suggesting that organizational emphasis on these OLFs may be a good way to initially implement PKM in organizations. This could begin to bring about the cultural shift necessary to become a learning organization (Garon, 2006). Both the Delphi team and the survey respondents emphasized conducting post-project reviews. Collier, et al. (1996) outlined a rigorous process to conduct post-project reviews that helped ensure action is taken on the lessons learned.

Organizations may also consider methods to evaluate the effectiveness of their PKM program. Desouza, et al. (2005) theorized that organizations should conduct cost/benefit studies and focus resources on a few projects with different characteristics to gain more leverage from lessons learned on future projects. In this way it would not be necessary to utilize significant resources to evaluate every closed project but only those which may produce the most value from the effort.

Future Research

This research suggests future research may be possible in five areas. First, more research can be done to understand the relationship between organizational learning, project learning, and project success in other project-based domains such as construction, consulting, research and development, and so on. Anantatmula and Thomas (2010) theorized that one way to reduce study limitations was to validate a model across organizations and industries.

Second, researchers may seek to determine the extent to which learning is the cause of IT project success. Such a study could involve other critical success factors for project success. Zqikael, et al. (2008) empirically identified 17 processes that senior management could take to enable project success including KM.

Third, this research provides an initial basis for action-based research. Implementation of the OLFs and PLPs could be implemented within organizations. Hirai, et al. (2007) implemented a knowledge management system that was utilized for six years, providing a strong foundation for how a PKM process may work in an organization. Likewise, Falbo, et al. (2004) introduced a process and system to manage the flow of knowledge in an IT organization. This research provides a foundation for action-based research to execute OLFs and PLPs.

Fourth, there is an opportunity to use PKM to reduce project risks. This research found that 44% of the project managers reported a weak mean score for risk mitigation. Indeed the mean score was relatively low at 3.53 with the highest standard deviation of the PSVs. Lierni and Ribièri (2008) theorized in their conclusion that use of KM in project-based organizations could reduce project management risks. Reich (2007) theorized that there were 10 knowledge-based risks in IT projects including: lessons not learned from prior projects, flawed team selection, volatility with sponsors, misunderstanding roles, inadequate knowledge integration, team member turnover, lack of knowledge transfer, absence of a knowledge map, knowledge loss between project phases, and failure to learn. Garon (2006) and GAO (2002) emphasized learning to help reduce the possibility of mission failures. Garon recommended that KM should be an integral part of risk management and administered by risk management staff. Cerpa and Verner (2009) in their research found that risks were not managed in 76% of the projects they studied and in 70% of the projects risks were not incorporated into the project plan. In this research it appeared that risk mitigation needs to be improved. Thus, researchers may explore integration of PKM with risk management in IT projects.

Fifth, researchers may continue to explore the value of PKM for organizations. This research may include models that IT leaders could use to develop cost/benefit studies (Desouza, et al., 2005). Research may include direct costs and time consumed to execute PKM strategies and processes. Models may also enable non-financial metrics such as impact on product quality, service reliability, productivity, and so on.

Summary

Knowledge gained from completed projects was not effectively shared with emerging project teams (Ajmal & Koskinen, 2008; Newell, et al., 2006; Owen, et al., 2004; Petter & Randolph, 2009; von Zedtwitz, 2003). It was recognized as the research progressed that IT managers and other project-based managers did not believe that knowledge sharing should be a high priority within project-based organizations. Choy, et al. (2006) in one of their case studies reported that a significant challenge for a KM leader was an inability to measure the impact of KM on organizational success. This interim finding led to the goal of this research to conduct a correlational study to determine the relationship among organizational learning factors (OLFs), project learning practices (PLPs), and project success variables (PSVs) within IT organizations. If a positive correlation existed among OLFs, PLPs, and PSVs then this might spur IT managers and researchers to evaluate and use knowledge management techniques.

The research question then asked - what relationship existed in IT organizations among OLFs, PLPs, and PSVs? In order to answer the research question four support questions were posed. First, what elements defined OLFs, PLPs, and PSVs? Second, how effective were OLFs employed? Third, how effective were PLPs used? Finally, what level of project success were IT organizations achieving? In order to answer the

first support question a content analysis was developed followed by validation with a Delphi team consisting of 10 experts in KM and IT project management. As a result of the content analysis and the Delphi team's work a survey was finalized.

The content analysis along with the Delphi team's validation permitted the identification of 12 OLFs, 11 PLPs, and 9 PSVs. Specifically, OLFs included trust and a supportive culture, senior management leadership, sufficient resources to enable learning, training, information systems, an expert locator, time in project schedules for learning, a requirement to conduct post-project reviews, processes to facilitate learning, incentives, an organization structure, and personal communication. The PLPs included a team benefiting from earlier post-project reviews, personal reflection and use, right skills and experience on the team, networking, kickoff meetings, external resources, evaluation of lessons learned to apply, application of lessons learned, and actually capturing a team's own lessons learned. Finally, PSVs included budget, schedule, user specifications, quality, business value, customer satisfaction, communication, change control, and risk mitigation. Organizational learning was an important foundation for project learning (Ajmal & Koskinen, 2008; Disterer, 2002; Keegan & Turner 2001).

Upon validating the survey a pilot survey was conducted. The 15 participants took the same survey two weeks apart. A test-retest correlation was performed that indicated that there was a positive correlation between the two surveys for the OLFs, PLPs, and PSVs. In addition, the pilot survey Cronbach's alpha was used to test the internal consistency of the variables. Internal consistency for each construct was between 0.8 and 0.9 which fell within the ideal range for Cronbach's alpha (Leech, et al., 2011). Thus, the decision was made to proceed with the general survey.

There were 97 valid responses to the survey. This was less than the original goal. However, a recalculation of the desired sample size indicated that 87 responses were adequate (Rea and Parker, 2005). The actual standard deviation of the highest variable was less than the assumed standard deviation used when the original goal was established. Thus, it was decided that the survey had a sufficient base to conduct the statistical analysis to answer the support questions and the research question.

The study found that OLFs and PLPs could be used more effectively within IT organizations. However, it appeared that IT leaders had a foundation for organizational learning including trust and supportive culture, senior management leadership, personal communication, and a requirement to conduct post-project reviews (Ajmal & Koskinen, 2008). In addition, IT leaders at the project level appeared to be reflecting and using lessons individuals learned, had right skills and experience, were networking, and capturing lessons learned from their projects. Overall, though, effective use of OLFs and PLPs could be improved.

IT leaders reported project success that appeared to be reasonably good overall and in general the findings were more optimistic than others have reported (The Standish Newsroom, 2009). However, 70% of the respondents reported that at least one of the PSVs had a low score. In addition, 44% of the respondents indicated that not all risks were addressed. Thus, there is room to improve project success in IT organizations.

This study found that there was a positive and significant relationship between organizational learning, project learning, and project success. The relationship between organizational learning and project learning was high ($r = .705$), between organizational

learning medium/high (r = .537), and between project learning and project success medium (r = .474) all significant at the .01 level. Moreover, given the enormity of IT spending and the scope of IT projects within IT organizations suggests that knowledge management could have a positive impact on project success which may be significant. IT organizations were expected to spend $3.6 trillion in 2011 (Hesseldahl, 2011). In this research 65% of IT projects were conducted for the benefit of an entire enterprise or multiple enterprises. In addition, this research found that 66% of the projects reported in this study were ones in which the company had prior experience. Another 28% of projects were new only to a company. Thus 94% of the projects may have benefitted from prior external or internal knowledge. Thus, it was recommended that IT leaders consider developing an IT strategy to utilize the power of knowledge management. It was also recommended that IT leaders develop the means to measure the impact of knowledge management.

Future research opportunities were presented. One research suggestion was to conduct similar research in other project-based domains. Another future research suggestion suggested that research be done to determine the causal effect that learning may have on project success. It was also recommended that action-based research that involved actual implementation of the OLFs and PLPs be conducted. Another recommendation proposed IT leaders study the relationship between knowledge management and risk mitigation. Not only do IT leaders have insufficient time to learn it is likely they often have insufficient time to conduct the project itself. Insufficient time may lead to short cuts that could in turn lead to higher ongoing costs and potential product problems after the project is closed. Finally, it was recommended that research

be under taken to measure the effectiveness of project-based knowledge management in financial and non-financial terms.

Knowledge management may offer opportunities to improve IT project success. It may help IT leaders to reduce project risk, enable continuous improvement, enhance innovation, and bring down total cost of ownership. Thus, it is recommended that research and development of KM in IT organizations continue.

Appendix A

Literature Review Matrix

Researchers	PKM	PF	K-> S	OLF	PLP	PSV
Abdel-Hamid & Madnick (1990)				xx		
Ajmal & Koskinen (2008)				xx		
Ajmal, Helo, P., & Kekale (2010)				xx		
Alavi & Leidner (2001)	xx					
Anantatmula & Kanungo (2008)						xx
Anbari, Carayannis, Voetsch (2008)					xx	x
Ayas & Zeniuk (2001)					xx	
Ayas (1996)				xx		
Banker & Kemmerer (1992)						xx
Barclay & Osei (2010)						xx
Birk, Dingsøyr, and Stålhane (2002)					xx	
Bresnen, Edelman, Newell, Scarbrough, & Swan (2003)				xx		
Busby (1999a)					xx	
Busby (1999b)					xx	
Caldas, Gibson, Weerasooriya, & Yohe (2009)				xx		
Cerpa & Verner (2009)		xx				
Christensen & Bukh (2009)				xx		
Collier, DeMarco, and Fearey (1996)					xx	
Desouza, Dingsoyr, Awazu (2005)					xx	
Desouza & Evaristo (2004)				xx		
Desouza & Evaristo (2006)				xx		
Dingsøyr & Conradi (2002)			xx			
Disterer (2002)					xx	
Ebert & De Man (2008)				xx		
Falbo, Borges, & Valente, (2004)				xx		
Fong (2003)				xx		
Garon, S (2006)					xx	
Gauld (2007)		xx				
Goffin, Koners, Baxter, van der Hoven (2010)					xx	
Goh & Ryan (2008)			xx			
Grillitsch, Mueller-Stingl, Neumann (2007)					xx	
Haas (2006)				xx		
Haas & Hansen (2005)			xx			
Hanisch, et al. (2009)	xx					
Hansen, Nohria, & Tierney (1999)	xx					
Henry, et al. (2007)			xx			
Hirai, Uchida, Fujinami (2007)				xx		
Holsapple & Wu (2008)	xx					
Hong, Kim, Kim, & Leem (2008)			xx			
Jugdev (2007)			xx			
Kampf & Longo (2009)				xx		
Karlsen & Gottschalk (2004)						xx
Kasvi, Vartiainen, Hailikari (2003)	xx					
Keegan & Turner (2001)	xx					
Koskinen (2004)				xx		
Kotlarsky, van Fenema, Willcocks (2008)					xx	
Kotnour (1999)					xx	
Kutsch (2007)						xx

Appendix A (Continued)

Literature Review Matrix

Researchers	PKM	PF	K->S	OLF	PLP	PSV
Laframboise, Croteau, Beaudry, Manovas (2007)				xx		
Landaeta (2008)			xx			
Leseure & Brookes (2004)				xx		
Liebowitz & Megbolugbe (2003)				xx		
Lierni & Ribiere (2008)			xx			
Lyytinen & Robey (1999)		xx				
Newell & Edelman (2008)			xx			
Newell, Bresnen, Edelman, Scarbrough, Swan (2006)				xx		
Nonaka, von Krogh, and Voelpel (2006)	xx					
Owen, 2006				xx		
Owen, Burstein, Mitchell (2004)	xx					
Petter, Mathiassen, & Vaishnavi (2007)					xx	
Petter and Randolph (2009)				xx		
Project Management Institute (2008)						xx
Pretorius & Steyn (2005)				xx		
Purvis & McCray (1999)						xx
Reich (2007)				xx		
Reich, Sauer, Yong (2008)						xx
Ribeiro & Ferreira (2010)				xx		
Robertson & Williams (2006)		xx				
Rose, Kumar, & Pak (2009)			xx			
Scarbrough, Bresnen, Edelman, Laurent (2004)					xx	
Schindler and Eppler (2003)					xx	
Sense (2007)					xx	
Shenhar & Dvir (2007a)	xx					
Shenhar & Dvir (2007b)						xx
Swan, Scarbrough, & Newell (2010)				xx		
Tanriverdi (2005)			xx			
US Government Accounting Office (2002)		xx				
van Donk & Riezebos (2005)				xx		
von Zedtwitz (2003)				xx		
Weiser & Morrsion (1998)				xx		
Yang (2010)			xx			
Zqikael, Levin, & Rad (2008)				xx		x
Legend:						
Project Failures and Failure to Learn	PF					
Project Knowledge Management Foundation	PKM					
Knowledge impact on Success Studies	K-> S					
Organizational Learning Factors	OLF					
Project Learning Practices	PLP					
Project Success Variables	PSV					
Primary focus	xx					
Secondary focus	x					

Appendix B
Content Analysis Example: Trust and Supporting Culture

OLF Id	OLF Description	Reference	Study Type	Group ID
OLF602	"It is necessary for project-based organizations to develop an organizational culture that coordinates and facilitates knowledge transfer" (p. 10).	Ajmal & Koskinen (2008)	Grounded Theory	OA
OLF2	"A key element of success in any KM initiative is encouraging people to communicate and share their knowledge with others" (p. 162).	Ajmal, Helo, & Kekäle (2010)	Correlational	OA
OLF6	"Culture is a key factor in determining the effectiveness of knowledge sharing" (p. 163).	Ajmal, Helo, & Kekäle (2010)	Correlational	OA
OLF17	Promote a culture of trust. "Trust end dependence: an organization's ability to promote a culture of mutual trust and dependence as a result of open and better communications" (p. 360).	Anantatmula & Kanungo (2008)	Grounded Theory	OA
OLF18	"An organization's ability to expand knowledge base and collaborative network among employees to promote knowledge transfer and improve employee skills" (p. 360).	Anantatmula & Kanungo (2008)	Grounded Theory	OA
OLF20	"Dissemination of lessons learned and generation of knowledge gained from post-project reviews are influenced by: (1) the overall culture of the organization, i.e. how the organization normally gets work done, (2) the extent to which the organization's strategy requires a structure over the other, and (3) the extent to which the organization has implemented an enterprise project management (EPM) approach to achieve its goals" (p. 637).	Anbari, Carayannis, & Voetsch (2008)	Grounded Theory	OA
OLF609	"There exists a learning infrastructure and there is a balance between emerging and formal structures" (p. 64).	Ayas & Zeniuk (2001)	Case Study (Two organizations)	OA
OLF805	"The project environment offers psychological safety and there is a commitment to telling the truth" (p.64).	Ayas & Zeniuk (2001) p. 64	Case Study (Two organizations)	OA
OLF49	Establish a culture condusive to lessons learned practices. "...culture should be addressed in development and maintenance of a LLP to ensure consistent use" (p. 538). "The organization must develop a 'learning and teaching' culture to embrace and effectively use a LLP" (p. 536).	Caldas, Gibson, Weerasooniya, Yohe (2009)	Survey	OA
OLF52	Create a political climate that allows post morten reviews. "We believe that political climate is one reason for a lack of post mortem reviews" (p. 121).	Cerpa & Verner (2009)	Survey	OA
OLF615	"The success of the postmortem--or of any learning process--demands a context that makes organization learning possible" (p. 71).	Collier, DeMarco, & Fearey (1996)	Action research	OA
OLF168	"Create an arena where people can reflect openly on both problems and successes" (p. 212)	Desouza, Dingsøyr, & Awazu (2005)	Case Studies (2 organizations)	OA
OLF106	Establish a "precondition for an open and constructive atmosphere of generosity, freedom and safety between project team members" (p. 518).	Disterer (2002)	Grounded Theory	OA
OLF680	"A corporate culture that encourages knowledge sharing is a key element for success" (p. 39). "Develop ways to broaden and implement mentoring and 'storytelling' as additional mechanisms for lessons learning" (p. 44).	GAO (2008)	Case Study (1 organization)	OA
OLF625	"The most important consideration is of course the motivation of writers and users , which is most influenced by visible support from senior management (executives) and a corporate culture that encourages release of information" (p. 111).	Garon (2006)	Action research	OA
OLF632	"Constitution of of knowledge-oriented organisational culture (trust,cooperation, reflection, learning" (p.21).	Grillitsch, Müller-Stingl, & Neumann (2007)	Grounded Theory	OA
OLF683	"A trustful cooperation needs to be built and obtained" (p. 156).	Hanisch, Lindner, Mueller, & Wald (2009)	Grounded Theory	OA
OLF144	Promote an environment of two-way communication. "The women entrepreneurs receiving micro-loans who have knowledge about their everyday lives and the impact of business practices on them. They also need to coomunicate this situational knowledge to the FSI employees in order to enable FSI employees to support them"	Kampf & Longo (2009)	Case Study - one organization	OA
OLF157	Involve all employees in learning: Avoid centralization of knowledge. "By promoting centralization these organizations signal that learning is not the responsibility of everyone but the sole province of a few 'enlightened' people in the organization" (p. 93).	Keegan and Turner (2001)	Interviews with 44 people in 19 firms Grounded Theory	OA
OLF646	"The greater the level of trust, the greater the level of accessibility and the better the opportunities for tacit knowledge to be transferred" (p. 288).	Koskinen, Pihlanto, Vanharanta (2003)	Grounded Theory	OA
OLF648	"Knowledge infrastructure capabilities are related to the knowledge transfer success and more specifically to its effectiveness..." (p. 47). Knowledge infrastructure includes "technological scanning. Facilitation mechanism, culture of sharing, establishment of standards, culture of learning, collaboration technology, system of rewards" (p. 59-Table 9).	Laframboise, Croteau, Beaudry, & Manovas, (2007)	Survey - 127 responses	OA
OLF202	"The companies that benefitted from post-project reviews indicated that the major benefits are not archived reports: instead it is the culture of information sharing that is being built, the training in discussing controversial issues, in reaching consensus, and the knowledge of each team member opinions, which generate true value" (p. 112).	Leseure & Brookes (2004)	Grounded Theory	OA
OLF197	trust is needed for efficient knowledge transfer	Leseure & Brookes (2004)	Grounded Theory	OA
OLF656	Need "a culture that encourages learning" (p. 43)	Owen (2006)	Case Study (1 organization)	OA
OLF59	"Trust is needed for efficient knowledge transfer among people" (p. 43)	Pretorius & Steyn (2005)	Grounded Theory	OA
OLF662	"This would include recognizing project managers as knowledge workers and creating an environment in which project managers could share their knowledge and experience, contribute to organisational learning and develop personally" (p. 47)	Pretorius & Steyn (2005)	Grounded Theory	OA
OLF139	"The goal is to create a project climate of learning together one that cuts across the individual norms and practices that accompany project members from different organizations and disciplines" (p. 13).	Reich (2007)	Grounded Theory	OA
OLF665	"actively encourage a view of the project as a vehicle for learning" (p. 341)	Swan, Scrarbrough, & Newell (2010)	Case Study	OA
OLF182	"There is a good deal of organizational conversation that keeps alive lessons learned from history" (p. 222)	Yang (2010)	Causal-Comparative	OA

Appendix C

Initial E-mail to Delphi Team Participants

Dear _____,

Further to our phone call today here is a written invitation to participate on an expert panel known as a Delphi team. As part of my doctoral dissertation at Nova Southeastern University I am forming this team to gain expert counsel prior to launching a survey to 3,000 IT project managers and team members. The goal of this research is to determine the relationship between the practices project teams use to learn from other teams and project performance within IT organizations. This research also seeks to understand how team learning may be enabled positively or negatively by organizational learning factors.

If you agree it is likely that the effort will consume about one and a half hours for the first week and thereafter one hour per week for about four to five weeks. By 6 September 2011 it is planned to start the Delphi team. All of the work can be done from your home or office. It will not be necessary to come to a meeting. In addition, Delphi team members do not know who else is on the team.

Prior to week one you will be provided:

- A one page description of the research
- A description of the Delphi team process
- A copy of the instructions and survey draft that would be sent out to 3,000 IT project managers and team members
- A short questionnaire about the survey

If you agree to participate could you please sign the Informed Consent Form attached and return to me. For your information this research has been approved by the Institutional Review Board (IRB) at Nova Southeastern University. The IRB has responsibility to ensure that all academic research conducted at Nova Southeastern University is conducted in an ethical manner respecting the rights of all participants.

Thank you for your time.

Sincerely,

Donald McKay

Appendix D

Delphi Informed Consent Form

NOVA SOUTHEASTERN UNIVERSITY
Graduate School of Computer and Information Sciences

Consent Form for Participation in the Research Study Entitled
The Interactions Among Information Technology Organizational Learning, Project Learning, and Project Success

Funding Source: None.

IRB protocol #

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For questions/concerns about your research rights, contact:
Human Research Oversight Board (Institutional Review Board or IRB)
Nova Southeastern University
(954) 262-5369/Toll Free: 866-499-0790
IRB@nsu.nova.edu

Site Information
Nova Southeastern University
Graduate School of Computer and Information Sciences
3301 College Avenue
Fort Lauderdale, FL 33314

What is the study about?
You are invited to participate in a research study. The goal of this study is to understand the relationship between organizational learning, project learning, and project success in information technology organizations.

Why are you asking me?
We are inviting you to participate because you are an experienced information technology leader who has managed IT projects or information technology professional who has participated in IT projects.

What will I be doing if I agree to be in the study?
You will evaluate a draft 35 question survey as part of a Delphi team. The Delphi team consists of six to twelve members who never come together in a meeting. Each member's participation is kept anonymous from other team members. Thus, each member will be given a code name. Each member evaluates the study at their home or office and returns the evaluation to the principal investigator (PI). Upon receiving comments from the team members the PI seeks to improve the survey and then sends back the revised survey along with each team member's comments. From the second round onward the participant quantitatively rates the quality of each question. This process is repeated until the team reaches consensus that the survey is ready to be distributed or five rounds have been completed. Consensus will be achieved when the average score for each question has an average score of four or higher and all individual scores for each question are greater than two. It is expected that each round will take one week. For the first week the review may take one and a half hours and thereafter not more than one hour per round.

Is there any audio or video recording?
There will not be any audio or video recordings required for this study.

What are the dangers to me?
The risks to you are minimal. It is possible that someone other than the PI could see your name and answers compromising your confidentiality. In order to prevent this the PI will keep the list of Delphi team member names strictly confidential in a safe place. Only the PI will handle correspondence with each Delphi team member.

If you have questions about the research, your research rights, or if you experience an injury because of the research please contact Mr. Donald McKay at (925) 625-2349. You may also contact the IRB at the numbers indicated above with questions about your research rights.

Are there any benefits to me for taking part in this research study?
There are no benefits to you for participating in the research.

Will I get paid for being in the study? Will it cost me anything?
There are no costs to you or payments made for participating in this study. Self stamped envelopes will be included with any correspondence by mail.

How will you keep my information private?
The questionnaire will not ask you for any information that could be linked to you. The materials will be kept in a safe place and participant names will be separated from the study documentation. The records containing your names will be destroyed 36 months after the study ends. It is required to maintain study records for three years after the study ends. All information obtained in this study is strictly confidential unless disclosure is required by law. Dr. Ellis, the IRB or regulatory agencies may also review research records.

What if I do not want to participate or I want to leave the study?
You have the right to leave this study at any time or refuse to participate. If you do decide to leave or you decide not to participate, you will not experience any penalty. If you choose to withdraw, any information collected from you **before** the date you leave the study will be kept in the research records for 36 months from the conclusion of the study and may be used as a part of the research.

Other Considerations
If the researchers learn anything which might change your mind about being involved, you will be told of this information.

Voluntary Consent by Participant
By signing below you indicate that:

- this study has been explained to you
- you have read this document or it has been read to you
- your questions about this research study have been answered
- you have been told that you may ask the researchers any study related questions in the future or contact them in the event of research-related injury
- you have been told that you may ask the Institutional Review Board (IRB) personnel questions about your study rights
- you are entitled to a copy of this form after you have read and signed it you voluntarily agree to participate in the study entitled The Interactions Among Information Technology Organizational Learning, Project Learning, and Project Success

Participant's Signature **Date**

_____ _____

Name Printed

_____

Principal Investigator's Signature **Date**

_____ _____

Name Printed

_____

Appendix E

Research Description for Delphi Team Participants

Problem

IT project teams are not learning lessons from other project teams. This leads to rework, a tendency to "reinvent the wheel," and lost employee skills which all in turn may lead to reduced project success.

Premise

Organizational learning may impact the way in which project teams learn and may also impact project success. In addition how well project teams learn influences project success as illustrated in Figure 1. In this research we plan to study the relationship between organizational learning factors (OLFs), project learning practices (PLPs), and project success variables (PSVs).

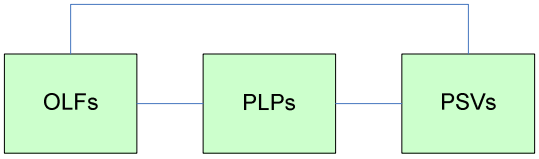

Figure 1
Model for Learning in a Project-Based Organization

OLFs may include senior management leadership, the degree of trust and support in the environment for learning, effective staff training, sufficient resources to enable learning, communities of practice, knowledge sharing incentives, a facilitating process, and sufficient time to share knowledge. PLPs may include project activities that the team under takes to learn lessons from prior projects such as researching lessons learned, holding initial meetings to review lessons learned by other teams, analyzing the lessons, deciding which lessons to implement, and execution. PSVs involve traditional variables including on time delivery and performance within budget, and delivering a quality product. In addition, PSVs relate to achievement of business objectives and customer satisfaction.

Goal of this Research

The goal is to understand the interaction between OLFs, PLPs, and PSVs.

Method

It is planned to send a survey to 3,000 IT project manager and team members. The answers to the survey questions will permit the author to conduct statistical procedures to relate OLFs, PLPs, and PSVs. Your help is elicited to ensure that a reliable and valid survey is sent to the survey participants. To be reliable respondents should generally answer the same questions in the same way over time and questions within the document should be consistent. To be valid the survey must measure what the researcher intends and not inadvertently something else.

Appendix F

Delphi Team Process

Overview

Your help is elicited to ensure that a reliable and valid survey is sent to 3,000 IT managers and IT project team members. In order to ensure the survey is reliable respondents should generally answer the same questions in the same way over time and questions within the document should be consistent. In order to ensure the survey is valid the survey must measure what the researcher intends and not something else.

The Delphi process is divided into rounds. Prior to each round you will receive certain information. After you have evaluated the survey you return a completed survey and the questionnaire about the survey to the researcher. The goal is to achieve consensus that the survey is ready to be distributed to the participants. Consensus is achieved when the average rating from all Delphi team members for each question is 4 or better on a 1 to 5 scale and no single score is less than 2. Once consensus is achieved the process is completed.

Round One

Prior to Round one each Delphi team participant will receive as follows:

- Brief description of the research
- Delphi team process
- Draft Survey
- Questionnaire about the survey
- A call sign from the International Maritime Organization which will be your identifier. For example, one member may be identified as Alpha and another as Bravo.

Each Delphi team member fills out the survey and responds to the questionnaire about the survey and returns it to the researcher within one week.

The researcher reviews all of the comments and prepares a matrix that includes all of the comments by question. In addition, the researcher acts on the comments and revises the survey.

Round 2

Prior to Round 2 each participant receives:

- Matrix that shows by call sign all of the comments each participant made. The purpose of this matrix is to show each participant that their comments were noted and action taken.
- Draft survey
- Questionnaire about the survey. This time the survey will include questions that ask the team to rate the survey.

Once again the participants take the survey and evaluate the survey. The participants can change anything in the survey including what they said in the previous round. All comments and ideas are welcome. Within one week the Delphi team participant returns the survey and the questionnaire,

Once again the researcher reviews all comments and completes a new comment matrix and revises the survey.

Round 3 to 5

Round 3 proceeds in the same way that Round 2 did. The team takes the survey and answers the questionnaire. Assume the team reaches consensus in that each section is rated a score of 4 or 5 by each team member. If a consensus is achieved before round 5 the process will end. In any event the process will end after five rounds in order to respect everyone's time.

At this point the process is completed.

Appendix G

First Draft of the Survey

Welcome and thank you for your participation in this survey. The purpose of this study is to improve our understanding about the interaction between organizational learning, project learning, and project success in information technology organizations. Please review the instructions below and then proceed to the survey. As you take the survey please reflect on your last IT project and the IT division within which the project was undertaken.

There are 35 questions in this survey. For the first 31 questions you are invited to indicate your level of agreement with the statement. You may strongly agree, agree, somewhat agree, disagree, or strongly disagree. Also you may not know or the question is not applicable.

Please click on the answer that best represents your choice. For example, if you "agree" with the statement "My last project was completed within budget" then click on the radio button next to the number 4 to the left of "agree."
For the last four questions we ask some questions about your IT division, your last project, and your experience. Please click the radio button next to the answer that best represents your choice.

Questions that start with "my last project" or "on my last IT project" ask about the last IT project that you were either a manager or team member on. Questions that start with "in my IT organization" ask you to reflect on practices in the information technology (IT) division or the company if you are in the information technology business. "Our team" is used in many questions and refers to you, any member of the team including the project leader, or all of the team members.

This survey should take from 15 to 30 minutes to complete. All responses will be strictly confidential. Thank you very much for taking time to answer this survey. If you have any questions or comments about this survey please contact me at donald_mckay@att.net.

1. My last IT project was completed within budget.

   Strongly agree…….5
   Agree…….4
   Somewhat agree……...…….…….3
   Disagree……...……2
   Strongly disagree…….1
   I do not know……...……0

2. My last IT project was completed on-time.

3. My last IT project was delivered with high quality (e.g. to specifications, few bugs, good human computer interface, maintainability, reliable data, smooth implementation).

4. My last IT project targeted and enabled realization of organizational benefits (e.g. strategic value, financial returns, market share, stronger brand, or future capabilities).

5. My last IT project achieved customer (user) satisfaction (e.g. ease of use, smooth implementation, and helped user do their job better).

6. In my IT organization there is a trusting and supportive culture that enables knowledge sharing.

7. In my IT organization senior management actively encourages knowledge sharing.

8. In my IT organization there is sufficient time to engage in learning

9. In my IT organization an effective process is used to facilitate learning between IT project teams.

10. In my IT organization employees are given effective incentives or encouraged to share knowledge.

11. In my IT organization there is a structure (e.g. a project management office, program management organization, knowledge managers/analysts, or project network structure) that effectively facilitates knowledge sharing between teams.

12. In my IT organization people effectively share knowledge through personal communication (communities of practice, get-togethers, and other social settings).

13. In my IT organization there are sufficient resources to support knowledge sharing between project teams.

14. In my IT organization the staff is effectively trained in knowledge sharing practices.

15. In my IT organization project teams have access to a database or repository that contains helpful lessons learned developed by other project teams.

16. In my IT organization one can easily locate an expert without knowing the person's name or location using a directory or IT system (sometimes called an expert locator or yellow pages).

17. In my IT organization there are technologies that enable effective analysis of lessons learned by other project teams (decision support systems, expert systems, document management, work-flow, data warehouse, etc.).

18. On my last IT project our team benefitted from post-project reviews conducted by previous IT project teams.

19. On my last IT project I reflected on lessons learned from earlier projects which helped my performance.

20. On my last IT project the project manager and team members brought the right skills and experience gained from previous projects.

21. On my last project our team included learning goals in the project charter or scope statement.

22. On my last IT project our team held an effective meeting(s) to review lessons learned by other project teams.

23. On my last IT project our team learned lessons throughout the project from other IT staff or project teams.

24. On my last IT project our team effectively learned by networking, discussion, and sharing stories with others in and out of the organization.

25. On my last IT project resources from outside our team (partners, experts, knowledge brokers, etc.) enabled our team to benefit from lessons learned by other projects.

26. On my last IT project our team accessed lessons learned from a database or repository that provided useful information.

27. On my last project our team was able to readily locate an expert(s) without knowing the name or location of the person using a directory or IT system (sometimes called an expert locator or yellow pages).

28. In my last IT project our team effectively used an information system that enabled effective analysis of lessons learned (e.g. decision support systems, expert systems, document management, work flow, data warehouse, and so on.)

29. On my last IT project our team effectively evaluated lessons learned from other IT project teams.

30. On my last IT project our team decided which lessons learned by other project teams would be applied to our project.

31. On my last IT project our team applied lessons learned by other project teams.

32. How many people were on your last IT project team?

    Less than 10……1

    From 11 to 20…….2

    From 21 to 30…….3

    From 31 to 50…….4

    More than 51……..5

33. How long did the IT project last?

Less than 6 months……1

From 7 months to 12 months……2

From 13 months to 24 months……..3

From 25 months to 36 months……..4

Over 37 months…….5

34. How many years of experience do you have working on IT projects?

Less than 12 months…….. 1

From 13 months to 36 months…….. 2

From 37 months to 120 months…… 3

From 121 months to 240 months…….. 4

Over 241 months…….5

35. How many employees are in your IT organization?

Less than 100…….…….1

From 101 to 300…...……..2

From 301 to 500…...……..3

From 501 to 1,000.…..……4

Over 1,001..……5

Appendix H

Delphi Team Round One Questionnaire

This is an actual example of the questionnaire for round 1 and responses from one Delphi Team participant. Each team member filled out the same form.

Identification:	
Survey Instructions	The instructions are clear, simple, and understandable. If this is not the case please comment. Specific suggestions to improve would be welcome.
Your comments >>>	
Project Success	This section addressed questions 1 through 5. Each question should be understandable and a good measure of project success. If this is not the case please provide comments for the specific survey question(s). Also, please feel free to add a general comment for this section. Specific suggestions to improve would be welcome.
	Your Comments
Question	
1. My last IT project was completed within budget.	*This is a very subjective question. Budgets and schedules often get renegotiated thoughout a complex project. Does it matter if you are measuring the initial agreements? Should you have followup questions? Eg. If no, what percent over? Was budget re-negotiated? Was scope renegotiated? Could / did "lessons learned" from other projects helped keep project on budget?*
2. My last IT project was completed on-time.	*Same comment as above relative to scheduling?*
3. My last IT project was delivered with high quality (e.g. to specifications, few bugs, good human computer interface, maintainability, reliable data, and smooth implementation).	*Were deliverables met as initially outlined in project charter or renegotiated?*
4. My last IT project enabled realization of organizational benefits (e.g. strategic value, financial returns, market share, stronger brand, and future	*Was this measured? Was there time for post implementation review?*
5. My last IT project achieved customer (user) satisfaction.	*Was this measured?*
General Comment	*I think this section needs more"meat" since this is the basis of your study. There are so many more variables to the success of the project -- is that important? How do you co-relate lessons learned to success?*
Organizational Learning Factors	This section addresses questions 6 through 17. Each question should be understandable and a good measure of what an organization may do to encourage IT project teams to learn from another project team. If this is not the case please provide comments for the specific survey question(s). Also, please feel free to add a general comment for this section. Specific suggestions to improve would be welcome.
	Your Comments
Question	
6. In my IT organization there is a trusting and supportive culture that enables knowledge sharing.	
7. In my IT organization senior management encourages knowledge sharing.	*Did the customer/ business management allow time in the schedule for knowledge sharing?*
8. In my IT organization there is sufficient time to review lessons learned developed by other teams.	
9. In my IT organization an effective process is used to facilitate learning between IT project teams.	
10. In my IT organization employees are effectively incentivized to share knowledge.	*Effectively incentivized???*
11. In my IT organization there is a structure (e.g. a project management office, program management organization, knowledge managers/analysts, or project network structure) that effectively facilitates knowledge sharing between teams.	
12. In my organization people effectively share knowledge through personal communication (communities of practice, get-togethers, and other social settings).	in my *IT* Organization
13. In my IT organization there are sufficient resources to support knowledge sharing between project teams.	
14. In my IT organization the staff is effectively trained in knowledge sharing practices.	
15. In my IT organization project teams have access to a database or repository that contains helpful lessons learned developed by other project teams.	
16. In my IT organization one can	

Appendix I

Return Comment Matrix to Team: Actual from Round 1

Identification:	
Survey Purpose	**The purpose of this study is to improve our understanding about the interaction between organizational learning, project learning, and project success in information technology organizations. This understanding may help practitioners decide if it is worthwhile to consider further investment in resources that support knowledge sharing between IT project teams.**
Survey Instructions	**The instructions are clear, simple, and understandable. If this is not the case please comment. Specific suggestions to improve would be welcome. The purpose of this study is to improve our understanding about the interaction between organizational learning, project learning, and project success in information technology organizations.**
Alpha	Questions 1 through 5 have the implicit assumption that the last project worked upon was actually completed and delivered. In fact of course, many projects are never completed. So I wonder whether the instructions need to specify that the respondents are replying to questions concerning their last successful project, if not, then the questions have to be redesigned to accommodate just the last project. Actually from my perspective finding out why projects failed is more instructive!
To Alpha	I asked respondents to answer for their last completed project. I changed the instructions and the questions to include the word "completed." This may include some projects that were not successful based on some of the criteria.
Bravo	Instructions are generally fine - suggest rewording the sentence starting with "For the last four questions we ask some questions...".
To Bravo	The sentence was reworded.
Hotel	I would add another sentence about the purpose of the study. Also, I would add a bulleted list of the possible answers rather than having two sentences. Note that the questions do not have an option for NA.
To Hotel	I added another sentence about the purpose, added the bullit list and eliminated the two sentences you refer to. Some questions will have an option for NA but if I find I don't need I will remove in the instructions.
November	Very clear
Sierra	must admit I didn't read the survey instructions first except for the short sentences at the bottom, until after I read through the survey. the instruction about what "my organization" means is important. I would suggest splitting up the first 2 paragraphs for easier attention getting. P1 split at Please review… P2 split at "Please click..." and split again at "For the last four...". There is no "not applicable" choice in the survey, so instructions should say whether respondent should choose "I do not know" or should leave the question unanswered if their response is "not applicable".
To Sierra	All of the suggested changes were made.

Project Success	This section addressed questions 1 through 5. Each question should be understandable and a good measure of project success. If this is not the case please provide comments for the specific survey question(s). Also, please feel free to add a general comment for this section. Specific suggestions to improve would be welcome.
	Your Comments
Question	
1. My last IT project was completed within budget.	
1. My last completed IT project was finished within the final approved budget.	
Bravo	Not sure if Questions 1 and 2 should have the same 5-0 scale - these are fairly objective questions; a project was either within budget and on time or it wasn't. Suggest implementing a 2-0 scale (2-Yes; 1-No; 0-I Don't Know) or modifying the 5-0 scale to reflect the objective nature of the questions (5-Well Within Budget/Ahead of Time; 4-Within Budget/On Time; 3-More or Less Within Budget/On Time; 2-
To Bravo	Please see response below addressed to you and other team members.
Charlie	This is a very subjective question. Budgets and schedules often get renegotiated thoughout a complex project. Does it matter if you are measuring the initial agreements? Should you have followup questions? Eg. If no, what percent over? Was budget re-negotiated? Was scope renegotiated? Could / did "lessons learned" from other projects helped keep project on budget?
To Charlie	If the project budget was changed and approved then that would be the appropriate budget for this research. I reworded the question to reflect this point.
Hotel	Perhaps the strongly agree to strongly disagree scale could be replaced with another scale, like a range of % over budget
To Hotel	Please see response below addressed to you and other team members.
November	Perhaps add approved budget as often initial budget is not the final budget and governance is not always followed for budget adjustments.
To November	I added "approved."
Oscar	This seems like it should be a Yes or No answer since the project was either on or under budget, or over it. And how does the budget issue impact the purpose of the study that I've added above in the instructions? Maybe the choices should be 1) More than 10% under budget, 2) Less than 10% under budget, 3) On budget, 4) Less than 10% over budget, 5) More than 10% over budget, 6) Don't know. You can use whatever percentage makes sense.
To Bravo, Hotel, and Oscar	I modified the scale as suggested. 5 - significantly under budget, 4 - under budget, 3 - within tolerable budget variance, 2 - over budget, and 1 - significantly over budget
Romeo	In many organizations the term "budget" is somewhat elastic. Successful project managers often seek budgets in three phases. Budget for Assessment, Budget for requirements or POC, and then the final budget for development and implementation.
To Romeo	I clarified that the final approved budget or schedule will be the basis of this research.
2. My last IT project was completed on-time.	
2. My last completed IT project was implemented on-time based on the final approved project plan.	
Bravo	See comments on Question 1.
Charlie	Same comment as above relative to scheduling?
To Charlie	I asked question relative to the final approved schedule.
Hotel	Perhaps the strongly agree to strongly disagree scale could be replaced with another scale, like a range of % over budget
November	Completed meaning implemented or through warranty period and post implementation/shut down?
To November	I replace the word "finished" with "implemented."
Oscar	Same comment as #1 above.
Reply to Bravo, Hotel, and Oscar	I modified the scale as suggested. 5 - significantly ahead of schedule, 4 ahead of schedule, 3 - within tolerable schedule variance, 2 - behind schedule, and 1 - significantly behind schedule

Appendix J

Delphi Team Member Questionnaire Round 2, 3, and 4

Identification:							
Survey Instructions	The instructions are clear, simple, and understandable. If this is not the case please comment. Specific suggestions to improve would be welcome. The purpose of this study is to improve our understanding about the interaction between organizational learning, project learning, and project success in information technology organizations. **Please also place an x by the appropriate score for each question:** 5 - Excellent 4 - Good 3 - Ok 2 - Weak 1 – Poor						
Score	X	4	3	2	1		
Comment	SUGGEST THAT BOLDFACE TYPE BE USED FOR THE SENTENCE ON THE SPECIFIC PURPOSE OF THE SURVEY.						
Project Success	This section addressed questions 1 through 5. Each question should be understandable and a good measure of project success. If this is not the case please provide comments for the specific survey question(s). Also, please feel free to add a general comment for this section. Specific suggestions to improve would be welcome. Please also place an x by the appropriate score for each question: 5 - Excellent 4 - Good 3 - Ok 2 - Weak 1 - Poor						
1. My last completed IT project was finished within the final approved budget.							
Score	5	4	X	2	1		
Comment	THIS IS BETTER THAN THE INITIAL DRAFT; HOWEVER, I THINK THE WORD 'SIGNIFICANTLY' IS RATHER AMBIGUOUS WITHOUT BEIN GQUALIFIED. WHAT'S SIGNIFICANT IN OUR ORGANIZATION OR ON ONE PROJECT MAY BE CONSIDERED MERELY UNDER / OVER IN OTHER ORGS OR PROJECTS.						
2. My last completed IT project was implemented on-time based on the final approved project plan.							
Score	5	4	X	2	1		

Comment	SAME AS #1 ABOVE						
3. My last completed IT project was delivered within specifications based on the customer's final approved project charter.							
Score	5	X	3	2	1		
Comment	IS THE TERM 'CHARTER' COMMONLY USED TO DESCRIBE IT PROJECT OBJECTIVES FROM THE CUSTOMER'S PERSPECTIVE?						
4. My last completed IT project was delivered with high quality (e.g. few bugs, good human computer interface, maintainability, reliable data, and/or smooth implementation) based on the customer's final approved project charter.							
Score	5	X	3	2	1		
Comment	SEE #4						
5. My last completed IT project targeted and enabled fulfillment of measureable organizational benefits (e.g. strategic value, financial returns, market share, stronger brand, and/or future capabilities).							
Score	5	X	3	2	1		
Comment	IN A CASE WHERE THE RESPONDENT'S LAST IT PROJECT WAS NOT MEANT TO DELIVER ANY OF THE STATED BENEFITS BUT INSTEAD DELIVERED SOME OTHER BENEFIT, HOW WILL THE RESPONDENT ANSWER THIS QUESTION?						
6. My last completed IT project achieved customer (user) satisfaction based on objective feedback (e.g. survey or user focus group).							
Score	5	X	3	2	1		
Comment							
7. My last completed IT project was an example of strong communications. For example, project goals and performance criteria were clear.							
Score	5	X	3	2	1		
Comment							
8. My last completed IT project included a change control process that was followed.							
Score	5	X	3	2	1		
Comment	I ASSUME EVERY RESPONDENT WILL KNOW WHAT A 'CHANGE CONTROL PROCESS' IS.						
9. My last completed IT project mitigated all significant risks before closure.							
Score	5	4	X	2	1		
Comment	ARE YOU SURE THAT EVERY RESPONDENT WILL INTERPRET THE TERM ' SIGNIFICANT' IN THE SAME WAY?						
Project Success General Comment	SOME OF THE TERMINOLOGY USED SEEMS A BIT AMBIGUOUS OR SUBKECT TO MULTIPLE INTERPRETATIONS TO ME.						

Organizational Learning Factors	This section addresses questions 6 through 17. Each question should be understandable and a good measure of what an organization may do to encourage IT project teams to learn from another project team. If this is not the case please provide comments for the specific survey question(s). Also, please feel free to add a general comment for this section. Specific suggestions to improve would be welcome. Please also place an x by the appropriate score for each question: 5 - Excellent 4 - Good 3 - Ok 2 - Weak 1 – Poor						
10. In my IT organization there is a trusting and supportive culture that enables knowledge sharing.							
Score	5	4	3	2	1		
Comment							
11. In my IT organization senior management actively encourages knowledge sharing.							
Score	X	4	3	2	1		
Comment							
12. In my IT organization there are sufficient resources (e.g. financial, personnel, technology, and/or training) to support knowledge sharing between project teams.							
Score	X	4	3	2	1		
Comment							
13. In my IT organization the staff is effectively trained in knowledge sharing practices (e.g. culture of knowledge sharing, venues available, writing effective content, organizing content for ease of retrieval, and/or set up for global access).							
Score	X	4	3	2	1		
Comment							
14. In my IT organization project teams have access to information systems that facilitate knowledge sharing (e.g. a database or repository that contains helpful lessons learned by other project teams, content management, work-flow, and/or decision support systems).							
Score	X	4	3	2	1		
Comment							
15. In my IT organization one can easily locate a subject matter expert without knowing the person's name or location using a directory or IT system (sometimes called an expert locator or yellow pages).							

Score	X	4	3	2	1		
Comment							
16. In my IT organization the customer and/or business management allows time in the schedule for knowledge sharing.							
Score	5	4	X	2	1		
Comment	IS THE SHIFT FROM SHARING WITHIN THE IT DEPARTMENT TO SHARING BETWEEN THE IT DEPARTMENT AND THE INTERNAL CUSTOMERS INTENDED? SEEMS LIKE THE FORMER RELATES TO TECHNICAL KNOWLEDGE WHILE THE LATTER PERTAINS TO BUSINESS KNOWLEDGE.						
17. In my IT organization project teams are required to conduct post project reviews.							
Score	X	4	3	2	1		
Comment							
18. In my IT organization an effective process is used to facilitate learning between IT project teams.							
Score	X	4	3	2	1		
Comment							
19. In my IT organization employees are given effective incentives or encouraged to share knowledge (e.g. bonuses, promotions, more opportunities, and/or peer recognition).							
Score	5	X	3	2	1		
Comment							
20. In my IT organization there is a business structure that effectively facilitates knowledge sharing between teams (e.g. a project management office, program management organization, knowledge managers/analysts, or project network structure).							
Score	X	4	3	2	1		
Comment							
21. In my IT organization people actively share knowledge through personal communication (communities of practice where people with common interests informally share knowledge, get-togethers, other informal settings, and/or via social media).							
Score	X	4	3	2	1		
Comment							
Organizational Learning General Comment	ASIDE FROM QUESTION 16, ALL OF THESE QUESTIONS SEEM PRETTY STRAIGHTFORWARD AND ADDRESS THE ISSUE OF KNOWLEDGE SHARING WITHIN THE IT DEPARTMENT OR AMONG THE MEMBERS OF THE DEPARTMENT.						

Project Learning Practices	This section addresses questions 18 through 31. Each question is understandable and a good measure of a practice that a new team would employ to learn from another team. If this is not the case please provide comments for the specific survey question(s). Also, please feel free to add a general comment for this section. Specific suggestions to improve would be welcome. Please also place an x by the appropriate score for each question: 5 - Excellent 4 - Good 3 - Ok 2 - Weak 1 – Poor						
22. On my last completed IT project our team benefitted from post-project reviews conducted by other IT project teams.							
Score	X	4	3	2	1		
Comment							
23. On my last completed IT project I used lessons that I learned from earlier projects which helped my performance.							
Score	X	4	3	2	1		
Comment							
24. On my last completed IT project the project team members brought the right skills and experience gained from previous projects (e.g. technical, business, inter-personal, communication, tolerance of ambiguity, and/or project management).							
Score	X	4	3	2	1		
Comment							
25. On my last IT project our team held an effective meeting(s) to review lessons learned by other project teams.							
Score	X	4	3	2	1		
Comment							
26. On my last completed IT project our team effectively networked with others in and out of the organization to learn lessons.							
Score	X	4	3	2	1		
Comment							
27. On my last completed IT project the team effectively learned by sharing stories with others in and out of the organization.							
Score	5	4	X	2	1		

Comment	DON'T UNDERSTAND HOW 'SHARING STORIES' IS FUNDAMENTALLY DIFFERENT FROM 'NETWORKING' (I.E., Q27 VS Q26).						
28. On my last completed IT project resources from outside our team (partners, subject matter experts, knowledge brokers, etc.) enabled our team to benefit from lessons learned by other projects.							
Score	X	4	3	2	1		
Comment							
29. On my last completed IT project we used information systems to facilitate knowledge sharing (e.g. a database or repository that contains helpful lessons learned by other project teams, content management, work-flow, and/or decision support systems).							
Score	X	4	3	2	1		
Comment							
30. On my last completed IT project our team was able to readily locate a subject matter expert(s) without knowing the name or location of the person using a directory or IT system (sometimes called an expert locator or yellow pages).							
Score	5	X	3	2	1		
Comment							
31. On my last completed IT project our team effectively evaluated lessons learned from other IT project teams.							
Score	5	X	3	2	1		
Comment	USE OF TERM 'EFFECTIVELY'						
32. On my last IT project our team applied lessons learned by other IT project teams.							
Score	X	4	3	2	1		
Comment							
33. On my last project we conducted a review of lessons learned from the team's experience on the project?							
Score	X	4	3	2	1		
Comment							
34. On my last project I improved my skills by learning lessons from other projects?							
Score	5	4	X	2	1		
Comment	CAN SOMEONE IMPROVE THEIR TECHNICAL SKILLS FROM LESSONS LEARNED, OR DO THEY LEARN ABOUT WHAT TO AVOID OR HOW TO DO SOMETHING DIFFERENTLY WITHOUT ACQUIRING NEW SKILLS? PERHAPS SOFT SKILLS LIKE COACHING OR FACILITATING						

	COULD BENEFIT, BUT WILL THE RESPONDENT KNOW WHICH SKILLS TO REFERENCE?						
Project Learning General Comment	ASIDE FROM QUESTION 34, ALL OF THESE QUESTION SEEM PRETTY STRAIGHTFORWARD.						
Demographic Questions	This section addresses questions 32 through 35. Each question is understandable a good measure to understand the demographics. If this is not the case please provide comments for the specific survey question(s). Also, please feel free to add a general comment for this section. Specific suggestions to improve would be welcome. Please also place an x by the appropriate score for each question: 5 - Excellent 4 - Good 3 - Ok 2 - Weak 1 – Poor						
35. How many full time IT people including employees, contractors, and consultants were on your last IT project team?							
Score	X	4	3	2	1		
Comment							
36. How long did the IT project last?							
Score	X	4	3	2	1		
Comment							
37. How many years have you managed IT projects?							
Score	X	4	3	2	1		
Comment							
38. How many employees and long term contractors are in your IT organization?							
Score	X	4	3	2	1		
Comment							
39. How would you characterize the degree of innovation?							
Score	X	4	3	2	1		
Comment							
40. How would you characterize the reach of your last completed IT project?							
Score	5	X	3	2	1		
Comment	DOES THE TERM 'SUPPLY CHAIN' APPLY TO EVERY INDUSTRY (E.G., HOW WOULD SOMEONE FROM A FINANCIAL INSTITUTION ANSWER THIS QUESTION)?						

Demographic General Comments	SHOULDN'T THERE BE A HEADING ABOUT THIS SECTION ON THE QUESTIONNAIRE?
Overall Comments	**ASIDE FROM THE AMBIGUITY OF A FEW TERMS AND ASSUMING THESE QUESTIONS WILL PROVIDE YOU WITH THE SPECIFI CINFORMATION YOU ARE SEEKING, I THINK THE MAJORITY OF THESE QUESTIONS CAN BE ANSWERED BY THE RESPONDENTS WITHOUT ANY CONFUSION OVER THE INTENT OF THE QUESTION. ONE ASSUMPTION YOU ARE MAKING ABOUT THE OVERALL SURVEY IS THAT A PROJECT MANAGER CAN HONESTLY RESPOND TO AN EVALUATION OF HIS/HER LAST PROJECT (I.E., SELF-CONDEMN). IS THIS A REASONABLE ASSUMPTION?**

Appendix K

IRB Memorandum of Approval

MEMORANDUM

To: Donald McKay
From: Ling Wang, Ph.D.
Institutional Review Board

Date: July 5, 2011

Re: *The Interactions among Information Technology Organizational Learning, Project Learning, and Project Success*

IRB Approval Number: wang06151101

I have reviewed the above-referenced research protocol at the center level. Based on the information provided, I have determined that this study is exempt from further IRB review. You may proceed with your study as described to the IRB. As principal investigator, you must adhere to the following requirements:

1) CONSENT: If recruitment procedures include consent forms these must be obtained in such a manner that they are clearly understood by the subjects and the process affords subjects the opportunity to ask questions, obtain detailed answers from those directly involved in the research, and have sufficient time to consider their participation after they have been provided this information. The subjects must be given a copy of the signed consent document, and a copy must be placed in a secure file separate from de-identified participant information. Record of informed consent must be retained for a minimum of three years from the conclusion of the study.

2) ADVERSE REACTIONS: The principal investigator is required to notify the IRB chair and me (954-262-5369 and 954-262-2020 respectively) of any adverse reactions or unanticipated events that may develop as a result of this study. Reactions or events may include, but are not limited to, injury, depression as a result of participation in the study, life-threatening situation, death, or loss of confidentiality/anonymity of subject. Approval may be withdrawn if the problem is serious.

3) AMENDMENTS: Any changes in the study (e.g., procedures, number or types of subjects, consent forms, investigators, etc.) must be approved by the IRB prior to implementation. Please be advised that changes in a study may require further review depending on the nature of the change. Please contact me with any questions regarding amendments or changes to your study.

The NSU IRB is in compliance with the requirements for the protection of human subjects prescribed in Part 46 of Title 45 of the Code of Federal Regulations (45 CFR 46) revised June 18, 1991.

Cc: Protocol File

Appendix L

Organizational Learning Factors

OLF Id	OLF Variables	Citations	Articles
OA	In my IT organization there is a trusting and supportive culture that enables knowledge sharing.	29	24
OB	In my IT organization senior management actively encourages knowledge sharing (e.g. knowledge sharing champion, off site meetings, training seminars, special budgets, etc.).	20	20
OC	In my IT organization there are sufficient resources to support knowledge sharing between project teams (e.g. financial, personnel, technology, and training) to support knowledge sharing between teams.	12	11
OD	In my IT organization the staff receives comprehensive training in knowledge sharing practices (e.g. culture of knowledge sharing, venues available, writing effective content, organizing content for ease of retrieval, etc.)	17	12
OE	In my IT organization project teams have access to information systems that facilitate knowledge sharing (e.g. a database or repository that contains helpful lessons learned by other project teams, content management, work-flow, and/or decision support systems).	43	31
OF	In my IT organization one can easily locate an expert without knowing the person's name or location using a directory or information system (sometimes called an expert locator or yellow pages).	11	9
OG	In my IT organization the customer and/or management allows time in the project schedule for knowledge sharing.	8	8
OH	In my IT organization project teams are expected to conduct and document post project reviews.	Delphi	Delphi
OI	In my IT organization a process is used to facilitate learning between IT project teams.	28	23
OJ	In my IT organization employees are encouraged to share knowledge with effective incentives (e.g. bonuses, promotions, more opportunities, and/or peer recognition).	17	16
OK	In my IT organization there is an organizational structure (e.g. project management office, program management, knowledge managers/analysts, project networks) that effectively facilitates knowledge sharing between teams.	15	14
OL	In my IT organization people actively share knowledge through personal communication (communities of practice where people with common interests informally share knowledge, get-togethers, other informal settings, and/or social media).	20	15
12	<<< Count – Total >>>	220	

Appendix M

Project Learning Practices

PLP Id	PLP Variable	Citations	Articles
PA	On my last completed IT project our team benefitted from post-project reviews completed within the same IT organization by other IT project teams.	15	12
PB	On my last IT project I used lessons brought from earlier projects within the same IT organization to help my performance.	3	3
PC	On my last IT project the project team members brought the right skills and experience gained from previous projects and applied them to my project (e.g. technical, business, interpersonal, communication, tolerance of ambiguity, and/or project management).	9	8
PD	On my last completed IT project our team networked with others inside and outside of the organization to gain knowledge applicable to the project.	6	5
PE	On my last completed IT project lessons learned by other project teams were disseminated during the kickoff meeting or other meetings early in the project lifecycle.	4	4
PF	On my last completed IT project resources from outside our team (partners, subject matter experts, knowledge brokers, etc.) enabled our team to benefit from lessons learned by other projects.	8	5
PG	On my last completed IT project we used information systems to facilitate knowledge sharing (e.g. a database or repository that contains helpful lessons learned by other project teams, content management, work-flow, and/or decision support systems)	14	11
PH	On my last completed IT project our team located a subject matter expert(s) within the organization without knowing the name or location of the person by using a directory or IT system (sometimes called an expert locator or yellow pages).	0	0
PI	On my last completed IT project our team evaluated lessons learned by other IT project teams to determine if they were appropriate to apply to my project.	13	9
PJ	On my last completed IT project our team applied lessons learned by other project teams.	11	11
PK	On my last completed IT project we captured lessons learned from the team's experience.	Delphi	Delphi
10	<<< Count – Total >>>	83	

Appendix N

Project Success Variables

PSV ID	PSV Variables	Citations	Articles
PSA	My last completed IT project relative to the final approved budget was within a tolerable budget variance.	11	11
PSB	My last completed IT project was within a tolerable schedule variance.	11	11
PSC	My last completed IT project was delivered within specifications based on the customer's final approved project scope.	3	3
PSD	My last completed IT project was delivered with high quality (e.g. few bugs, good human computer interface, maintainability, reliable data, and/or smooth implementation) based on the customer's final approved project scope.	11	9
PSE	My last completed IT project delivered measureable organizational benefits (e.g. strategic value, financial returns, market share, stronger brand, and/or future capabilities).	12	8
PSF	My last completed IT project achieved customer (user) satisfaction based on objective feedback (e.g. customer satisfaction survey, user focus group, or project lessons review conducted with users).	10	8
PSG	My last completed IT project reflected strong communication between customers and the project team. Examples: (1) The customers' goals and performance criteria were clear to the project team. (2) The project team provided timely and clear status updates to customers.	Delphi	Delphi
PSH	My last completed IT project included a change control process to manage changes to the scope, budget, schedule, technical solution, and so on.	Delphi	Delphi
PSI	My last completed IT project mitigated all risks that were identified to have direct impact on implementation or go-live.	Delphi	Delphi
9	<<< Count – Total >>>	58	

Appendix O

Delphi Team Qualifications

	Candidates	
Criteria for Participation	**A**	**B**
Knowledge and Experience related to the issues being researched	Informed Consent signed	Informed Consent Signed
* Knowledge Management	As a board member of SCORE, an association of retired executivess that counsel new enterpreneurs, develops and implements programs to share knowledge with enterpreneurs and between consultants. Has an interest in organizational learning and innovation. Based on past discussions he is knowledgeable about KM.	This person is a PM for a consulting firm that appears to actively engage in formal knowledge sharing. Managers have a means to benefit from prior projects. This candidate also developed templates/standards for requirements management as a result of lessons learned.
* IT Project Management (3 years experience)	No	Yes
* Surveys	Has led a number of market research studies (surveys and focus groups).	
Effective Communicator	Excellent	Excellent
Academic Experience	University graduate	University graduate
Practitioner	Yes	Yes
KM Expertise	This candiate has practical experience and instinct for knowledge management.	This person will have some knowledge based on practices within the consulting firm.
Decision Maker	As a board member this candidate allocates resources.	
Synthesizer	Candidate is known for an ability to see the whole picture and bring it together.	This candidate has a strong ability to see the whole picture.

	Candidates	
Criteria for Participation	**C**	**D**
Knowledge and Experience related to the issues being researched	Informed Consent signed	Informed consent form signed
* Knowledge Management	This candidate was a portfolio IT director with 30 years experience in IT. IT project managers reported to this position. Within the portfolio this person oversaw knowledge sharing between project teams.	This person is an IT project manager for a marine terminals software development.
* IT Project Management (3 years experience)	Yes	Yes
* Surveys		
Effective Communicator	Excellent	Excellent
Academic Experience	Unknown	University graduate
Practitioner	Yes	Yes
KM Expertise	This person has experience leading many projects and programs simultaneously and has gained practical experience in knowledge sharing.	
Decision Maker	As a senior IT manager this person routinely made decisions about resources and technical design.	This person made decisions related to leading projects and staff within a project team.
Synthesizer	This was part of this candidate's daily work.	This candidate has experience managing the overall issues of a project.

	Candidates	
Criteria for Participation	**E**	**F**
Knowledge and Experience related to the issues being researched	Inform Consent Signed	Informed Consent Signed
* Knowledge Management	This person is an IT project manager with over 25 years experience in Liner shipping and Healthcare. The candidate had a strong interest in learning and helping the project teams under her guidance learn.	This person is an experienced IT project manager for a company that develops software and hardware solutions for dry cleaners. He also led a small team.
* IT Project Management (3 years experience)	Yes	Yes
* Surveys		
Effective Communicator	Excellent	Excellent
Academic Experience	University graduate	University graduate
Practitioner	Yes	Yes
KM Expertise	This person has participated in lessons learned meetings.	
Decision Maker	This person managed an IT department and made decisions within that setting.	This person managed projects throughout the United States and other countries and routinely made decisions on the spot in customer locations.
Synthesizer	This candidate is very meticulous about all aspects of a project.	This candidate is very thorough and has an overview of the organization he works for. Evidenced by his promotion to a director position.

	Candidates	
Criteria for Participation	**G**	**H**
Knowledge and Experience related to the issues being researched	Informed Consent Signed	Said Yes
* Knowledge Management	This person has 30 years experience managing IT project. This person managed a Project Management Office reporting to the CIO.	This person has over 25 years of business experience. This experience includes direct experience in establishing a knowledge management system namely Sharepoint for a $9 billion company. He is also an experienced web master.
* IT Project Management (3 years experience)	Yes	Yes
* Surveys		
Effective Communicator	Excellent	Excellent
Academic Experience	University graduate	University graduate
Practitioner	Yes	Yes
KM Expertise	This person managed lessons learned and knowledge sharing between project teams.	This person established a knowledge management system using MS Sharepoint. This system enables document management and improved means for sharing knowledge throughout the organization.
Decision Maker	Yes this person managed global projects and assigned resources. This person also had some ability to prioritize knowledge sharing work.	
Synthesizer	This candidate managed a $300 million IT strategic development across all business functions.	This person synthesized user requirements and balanced design decision across all divisions for a major coproration.

	Candidates	
Criteria for Participation	**I**	**J**
Knowledge and Experience related to the issues being researched	Informed Consent Signed	Informed Consent Signed
* Knowledge Management	This candidate oversaw all projects within a large IT division (about 300 people). He had an interest in knowledge transfer and did it through staff meetings.	This candidate has worked in consumer goods and marine terminal IT divisions. This candidate is a business analyst and project manager with over 15 years experience.
* IT Project Management (3 years experience)	Yes	Yes
* Surveys		
Effective Communicator	Excellent	Excellent
Academic Experience	University graduate	University graduate
Practitioner	Yes	Yes
KM Expertise	This candidate was a senior manager of which lessons learned would have been a small part of his responsibilities.	This candidate has participated in post project reviews and has completed close out reports that include lessons learned.
Decision Maker	This candidate had direct control over resources and could make decisions to allocate more or less to KM.	This person made decisions related to leading projects and staff within a project team.
Synthesizer	Managing all projects for the common good was this candidate's job.	This person balanced extremely complex designs for leading edge technology in marine terminals using RFID and Optical Character Reading technology in real-time to manage operations.

Appendix P

Final Survey Instrument

Welcome. **The purpose of this study is to improve our understanding about the interaction between organizational learning, project learning, and project success in information technology organizations**. Organizational learning relates to the systems and processes that facilitate individual and project learning. Project learning involves activities to learn from the project team's experience or from other projects. Improving our understanding of the relationship between learning and project success may help practitioners decide if it is worthwhile to consider further investment in resources that support knowledge sharing between IT project teams.

Please review the instructions below and then proceed to the survey. Once you come to the survey you will be advised of your rights and protections to ensure that your privacy is respected. Please indicate at the bottom of the web page if you will grant your consent to take the survey. As you take the survey please reflect on your last completed IT project and the IT division within which the project was undertaken.

There are 38 questions. For all questions please click on the radio button next to the answer that best represents your choice. For questions 1 and 2 you are asked to indicate the actual costs and time taken relative to the final approved budget and schedule. For questions 3 to 32 please indicate your level of agreement with each statement.

Questions 33 through 38 relate to your IT division where the project was undertaken, your last completed project, and your experience. Questions that start with "my last completed IT project" or "on my last completed IT project" ask about the last IT project that you were the project manager for. Questions that start with "in my IT organization" ask you to reflect on practices in the information technology (IT) division or the company if you are in the information technology business. "Our team" is used in many questions and refers to you as the project manager, any member of the team, or all of the team members.

This survey should take about 15 minutes to complete. All responses will be anonymous.
Thank you very much for taking time to answer this survey. If you have any questions or comments about this survey please contact me at donald_mckay@att.net.

Questions Related to Project Success

1. My last completed IT project relative to the final approved budget was:

   Under budget……..4

   Within a tolerable budget variance.……...……3

   Over budget…….2

2. My last completed IT project relative to the final approved schedule was:

   Ahead of schedule……..4

   Within tolerable schedule variance….……3

   Behind schedule…..……2

3. My last completed IT project was delivered within specifications based on the customer's final approved project scope.
   Strongly agree……5

   Agree……..4

   Neither agree nor disagree.……..……..3

   Disagree…….2

   Strongly disagree……1

   I do not know…….0

4. My last completed IT project was delivered with high quality (e.g. few bugs, good human computer interface, maintainability, reliable data, and/or smooth implementation) based on the customer's final approved project scope.

5. My last completed IT project delivered measureable organizational benefits (e.g. strategic value, financial returns, market share, stronger brand, and/or future capabilities).

6. My last completed IT project achieved customer (user) satisfaction based on objective feedback (e.g. customer satisfaction survey, user focus group, or project lessons review conducted with users).

7. My last completed IT project reflected strong communication between customers and the project team. Examples: (1) The customers' goals and performance criteria were clear to the project team. (2) The project team provided timely and clear status updates to customers.

8. My last completed IT project included a change control process to manage changes to the scope, budget, schedule, technical solution, and so on.

9. My last completed IT project mitigated all risks that were identified to have direct impact on implementation or go-live.

Questions Related to Organizational Learning

10. In my IT organization there is a trusting and supportive culture that enables knowledge sharing.

11. In my IT organization senior management actively encourages knowledge sharing (e.g. knowledge sharing champion, off site meetings, training seminars, special budgets, etc.).

12. In my IT organization there are sufficient resources (e.g. financial, personnel, technology, and training) to support knowledge sharing between project teams.

13. In my IT organization the staff receives comprehensive training in knowledge sharing practices (e.g. culture of knowledge sharing, venues available, writing effective content, organizing content for ease of retrieval, etc.).

14. In my IT organization project teams have access to information systems that facilitate knowledge sharing (e.g. a database or repository that contains helpful lessons learned by other project teams, content management, work-flow, and/or decision support systems).

15. In my IT organization one can easily locate a subject matter expert within the organization without knowing the person’s name or location by using a directory or IT system (sometimes called an expert locator or yellow pages).

16. In my IT organization the customer and/or management allows time in the project schedule for knowledge sharing.

17. In my IT organization project teams are expected to conduct and document post project reviews.

18. In my IT organization a process is used to facilitate learning between IT project teams.

19. In my IT organization employees are encouraged to share knowledge with effective incentives (e.g. bonuses, promotions, more opportunities, and/or peer recognition).

20. In my IT organization there is an organizational structure that effectively facilitates knowledge sharing between teams (e.g. a project management office, program management organization, knowledge managers/analysts, or project network structure).

21. In my IT organization people actively share knowledge through personal communication (communities of practice where people with common interests informally share knowledge, get-togethers, other informal settings, and/or via social media).

Questions Related to Project Learning

22. On my last completed IT project our team benefitted from post-project reviews completed within the same IT organization by other IT project teams.

23. On my last completed IT project I used lessons brought from earlier projects within the same IT organization to help my performance.

24. On my last completed IT project the project team members brought the right skills and experience and applied them to my project (e.g. technical, business, interpersonal, communication, tolerance of ambiguity, and/or project management).

25. On my last completed IT project our team networked with others inside and outside of the organization to gain knowledge applicable to the project.

26. On my last completed IT project lessons learned by other project teams were disseminated during the kickoff meeting or other meetings early in the project lifecycle.

27. On my last completed IT project resources from outside our team (partners, subject matter experts, knowledge brokers, etc.) enabled our team to benefit from lessons learned by other projects.

28. On my last completed IT project we used information systems to facilitate knowledge sharing (e.g. a database or repository containing lessons learned by other project teams, content management, work-flow, and/or decision support systems).

29. On my last completed IT project our team located a subject matter expert(s) within the organization without knowing the name or location of the person by using a directory or IT system (sometimes called an expert locator or yellow pages).

30. On my last completed IT project our team evaluated lessons learned by other IT project teams to determine if they were appropriate to apply to my project.

31. On my last completed IT project our team applied lessons learned by other project teams.

32. On my last completed IT project we captured lessons learned from the team's experience.

Questions Related to Demographics

33. How would you characterize the degree of innovation of your last IT project?

    Core competence (this type project was completed often)…….…....……1

    Experienced (this type project was completed before)……..……..2

    Company leader (first time this type was project completed within the company)…….3

    Industry leader (first time this type project completed within the industry)……4

    Pioneer (first time this type project was completed)…...…….....5

    I do not know……..0

34. How would you characterize the scope of your last completed IT project?

    Project supported users within a section of a department……1

    Project supports users within a department of a division……2

    Project supports users within a single division of an organization……..3

    Project supports users across a single organization……..……...4

    Project supports users in multiple organizations…….……5

    I do not know……..……0

35. How many full time IT people including employees, contractors, and consultants were on your last IT project team?

    Less than 10……1

    From 10 to 19……..2

    From 20 to 29……3

    From 30 to 50……4

    More than 50…….5

36. How long did the IT project last?

    Less than 1 year…….…….……1

    From 1+ to 2 years……..……2

    From 2+ to 3 years……..3

    From 3+ to 5 years……..……4

    Over 5 years….……5

37. How many years have you managed IT projects?

Less than 1 year…….1

From 1+ to 3 years……..……2

From 3+ years to 5 years……3

From 5+ years to 20 years……..4

Over 20 years……..…….5

38. How many employees and long term contractors are in your IT organization?

Less than 100…….…….1

From 100 to 299…...……...2

From 300 to 499…...……..3

From 500 to 999…..…..……4

Over 1,000..……..5

Appendix Q

Delphi Team Final Scores

Round 4 Scores												
	Alpha	Bravo	Charlie	Golf	Hotel	Juliett	November	Oscar	Romeo	Sierra	Average	"2" Present
Instructions	5	4	5	5	4	4	4	5	5	5	4.600	
Q1	5	5	4	5	4	3	4	5	5	5	4.500	
Q2	5	5	4	5	4	3	4	5	5	5	4.500	
Q3	5	5	5	5	4	4	4	5	5	4	4.600	
Q4	4	5	5	5	4	4	4	5	5	5	4.600	
Q5	5	4	5	5	4	4	4	5	5	4	4.500	
Q6	5	5	5	5	4	4	4	5	5	5	4.700	
Q7	5	4	5	5	5	3	4	5	5	5	4.600	
Q8	5	4	4	5	5	4	4	5	5	5	4.600	
Q9	5	4	5	5	4	4	4	5	5	5	4.600	
Organizational												
Q10	5	4	5	5	5	4	4	5	5	5	4.700	
Q11	5	4	4	5	5	4	4	5	5	5	4.600	
Q12	5	4	5	5	4	4	4	5	5	5	4.600	
Q13	4	5	5	4	4	4	4	5	5	5	4.500	
Q14	5	5	5	5	4	4	4	5	5	5	4.700	
Q15	5	4	5	5	4	4	4	5	5	5	4.600	
Q16	5	5	5	4	5	4	4	5	5	5	4.700	
Q17	5	5	5	5	5	5	4	5	5	4	4.800	
Q18	4	4	4	5	4	4	4	5	5	5	4.400	
Q19	5	5	5	5	5	4	4	5	5	5	4.800	
Q20	4	5	5	5	5	4	4	5	5	5	4.700	
Q21	4	4	4	5	4	4	4	5	5	5	4.400	
Project												
Q22	3	5	5	5	5	5	4	5	5	5	4.700	
Q23	5	4	5	4	5	5	4	5	5	5	4.700	
Q24	3	4	4	4	4	4	4	5	5	4	4.100	
Q25	4	4	5	5	4	4	4	5	5	5	4.500	
Q26	4	5	4	**5**	5	4	4	5	5	5	4.600	
Q27	5	5	5	5	4	4	4	5	5	5	4.700	
Q28	4	4	5	5	5	4	4	5	5	5	4.600	
Q29	5	4	5	5	5	4	4	5	5	5	4.700	
Q30	5	5	5	5	5	5	4	5	5	5	4.900	
Q31	5	4	5	5	5	4	4	5	5	5	4.700	
Q32	5	4	3	5	5	4	4	5	5	5	4.500	
Q33	4	4	5	5	5	4	4	5	5	5	4.600	
Demographic												
Q34	5	5	5	4	4	4	4	5	5	4	4.500	
Q35	5	5	5	4	4	5	4	5	5	4	4.600	
Q36	5	5	5	5	4	4	4	5	5	5	4.700	
Q37	5	5	5	5	4	4	4	5	5	5	4.700	
Q38	5	5	5	5	4	4	4	5	5	5	4.700	
Q39	5	5	5	5	4	4	4	5	5	5	4.700	

Appendix R

Demographics

Innovation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Core competence	14	14.4	14.6	14.6
	Experienced	49	50.5	51.0	65.6
	Company leader	27	27.8	28.1	93.8
	Industry leader	3	3.1	3.1	96.9
	Pioneer	3	3.1	3.1	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Scope

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Within a section	5	5.2	5.2	5.2
	Within a department	16	16.5	16.5	21.6
	Within a division	13	13.4	13.4	35.1
	For an organization	23	23.7	23.7	58.8
	Across multiple organizations	40	41.2	41.2	100.0
	Total	97	100.0	100.0	

Project Team Size

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 10	40	41.2	41.7	41.7
	From 10 to 19	27	27.8	28.1	69.8
	From 20 to 29	10	10.3	10.4	80.2
	From 30 to 50	9	9.3	9.4	89.6
	More than 50	10	10.3	10.4	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Project Duration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than one year	56	57.7	58.3	58.3
	From 1+ to 2 years	29	29.9	30.2	88.5
	From 2+ to 3 years	9	9.3	9.4	97.9
	From 3+ to 5 years	1	1.0	1.0	99.0
	Over 5 years	1	1.0	1.0	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	1	1.0	1.0	1.0
	From 1+ to 3 years	9	9.3	9.3	10.3
	From 3+ to 5 years	12	12.4	12.4	22.7
	From 5+ to 20 years	50	51.5	51.5	74.2
	Over 20 years	25	25.8	25.8	100.0
	Total	97	100.0	100.0	

No. of employees

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 100	34	35.1	36.2	36.2
	From 100 to 299	22	22.7	23.4	59.6
	From 300 to 499	9	9.3	9.6	69.1
	From 500 to 1,000	10	10.3	10.6	79.8
	Over 1,000	19	19.6	20.2	100.0
	Total	94	96.9	100.0	
Missing	System	3	3.1		
Total		97	100.0		

Appendix S

Descriptive Statistics for OLFs, PLPs, and PSVs

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Budget	97	2	4	3.10	.568
Schedule	97	2	4	2.98	.629
Specifications	97	1	5	4.11	.967
Quality	97	2	5	3.97	.895
Benefits	94	2	5	4.14	.946
Customer Satisfaction	95	1	5	3.93	.890
Communication	96	1	5	4.04	.928
Change Control	97	1	5	3.74	1.083
Risks	96	1	5	3.53	1.123
Trust	97	1	5	3.75	1.061
Sr. Management	97	1	5	3.44	1.199
Resources	97	1	5	2.99	1.150
Training	96	1	5	2.75	1.170
Information Systems	97	1	5	3.27	1.177
Expert Locator	96	1	5	2.53	1.178
Time	96	1	5	2.82	1.124
Conduct Post Project Reviews	96	1	5	3.50	1.170
Process	96	1	5	3.04	1.045
Incentives	97	1	5	2.46	1.128
Organizational Structure	96	1	5	2.96	1.132
Personal Communication	97	1	5	3.57	1.089
Other Post Project Reviews	93	1	5	3.03	1.088
Used LL from Other Projects	97	1	5	3.85	.972
Right Skills	97	1	5	3.94	.814
Networked with Others	96	1	5	3.94	.792
Kick Off Meetings	95	1	5	2.92	1.155
External Resources	96	1	5	3.17	1.149
Used Information Systems	95	1	5	3.06	1.174
Used Expert Locator	95	1	5	2.37	1.185
Evaluated Lessons Learned	93	1	5	2.74	1.151
Applied Lessons Learned	95	1	5	3.11	1.115
Captured Lessons Learned	96	1	5	3.55	1.113
Valid N (listwise)	74				

Appendix T

Organizational Learning

Trust

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	2.1	2.1	2.1
	Disagree	15	15.5	15.5	17.5
	Neither agree nor disagree	12	12.4	12.4	29.9
	Agree	44	45.4	45.4	75.3
	Strongly agree	24	24.7	24.7	100.0
	Total	97	100.0	100.0	

Sr. Management

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	6	6.2	6.2	6.2
	Disagree	19	19.6	19.6	25.8
	Neither agree nor disagree	18	18.6	18.6	44.3
	Agree	34	35.1	35.1	79.4
	Strongly agree	20	20.6	20.6	100.0
	Total	97	100.0	100.0	

Resources

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	9	9.3	9.3	9.3
	Disagree	30	30.9	30.9	40.2
	Neither agree nor disagree	18	18.6	18.6	58.8
	Agree	33	34.0	34.0	92.8
	Strongly agree	7	7.2	7.2	100.0

Resources

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	9	9.3	9.3	9.3
	Disagree	30	30.9	30.9	40.2
	Neither agree nor disagree	18	18.6	18.6	58.8
	Agree	33	34.0	34.0	92.8
	Strongly agree	7	7.2	7.2	100.0
	Total	97	100.0	100.0	

Training

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	12	12.4	12.5	12.5
	Disagree	37	38.1	38.5	51.0
	Neither agree nor disagree	17	17.5	17.7	68.8
	Agree	23	23.7	24.0	92.7
	Strongly agree	7	7.2	7.3	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Information Systems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	5.2	5.2	5.2
	Disagree	30	30.9	30.9	36.1
	Neither agree nor disagree	8	8.2	8.2	44.3
	Agree	42	43.3	43.3	87.6
	Strongly agree	12	12.4	12.4	100.0
	Total	97	100.0	100.0	

Expert Locator

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	19	19.6	19.8	19.8
	Disagree	40	41.2	41.7	61.5
	Neither agree nor disagree	6	6.2	6.3	67.7
	Agree	29	29.9	30.2	97.9
	Strongly agree	2	2.1	2.1	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	11	11.3	11.5	11.5
	Disagree	31	32.0	32.3	43.8
	Neither agree nor disagree	24	24.7	25.0	68.8
	Agree	24	24.7	25.0	93.8
	Strongly agree	6	6.2	6.3	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Conduct Post Project Reviews

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	5.2	5.2	5.2
	Disagree	19	19.6	19.8	25.0
	Neither agree nor disagree	14	14.4	14.6	39.6
	Agree	39	40.2	40.6	80.2
	Strongly agree	19	19.6	19.8	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		

Conduct Post Project Reviews

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	5.2	5.2	5.2
	Disagree	19	19.6	19.8	25.0
	Neither agree nor disagree	14	14.4	14.6	39.6
	Agree	39	40.2	40.6	80.2
	Strongly agree	19	19.6	19.8	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Process

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	5.2	5.2	5.2
	Disagree	28	28.9	29.2	34.4
	Neither agree nor disagree	28	28.9	29.2	63.5
	Agree	28	28.9	29.2	92.7
	Strongly agree	7	7.2	7.3	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Incentives

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	18	18.6	18.6	18.6
	Disagree	42	43.3	43.3	61.9
	Neither agree nor disagree	16	16.5	16.5	78.4
	Agree	16	16.5	16.5	94.8
	Strongly agree	5	5.2	5.2	100.0
	Total	97	100.0	100.0	

Other Post Project Reviews

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	7	7.2	7.5	7.5
	Disagree	26	26.8	28.0	35.5
	Neither agree nor disagree	23	23.7	24.7	60.2
	Agree	31	32.0	33.3	93.5
	Strongly agree	6	6.2	6.5	100.0
	Total	93	95.9	100.0	
Missing	System	4	4.1		
Total		97	100.0		

Personal Communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	4	4.1	4.1	4.1
	Disagree	17	17.5	17.5	21.6
	Neither agree nor disagree	12	12.4	12.4	34.0
	Agree	48	49.5	49.5	83.5
	Strongly agree	16	16.5	16.5	100.0
	Total	97	100.0	100.0	

Appendix U

Project Learning

Other Post Project Reviews

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	7	7.2	7.5	7.5
	Disagree	26	26.8	28.0	35.5
	Neither agree nor disagree	23	23.7	24.7	60.2
	Agree	31	32.0	33.3	93.5
	Strongly agree	6	6.2	6.5	100.0
	Total	93	95.9	100.0	
Missing	System	4	4.1		
Total		97	100.0		

Used LL from Other Projects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	3.1	3.1	3.1
	Disagree	8	8.2	8.2	11.3
	Neither agree nor disagree	12	12.4	12.4	23.7
	Agree	52	53.6	53.6	77.3
	Strongly agree	22	22.7	22.7	100.0
	Total	97	100.0	100.0	

Right Skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	1.0	1.0	1.0
	Disagree	5	5.2	5.2	6.2
	Neither agree nor disagree	14	14.4	14.4	20.6
	Agree	56	57.7	57.7	78.4
	Strongly agree	21	21.6	21.6	100.0
	Total	97	100.0	100.0	

Networked with Others

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	1.0	1.0	1.0
	Disagree	2	2.1	2.1	3.1
	Neither agree nor disagree	21	21.6	21.9	25.0
	Agree	50	51.5	52.1	77.1
	Strongly agree	22	22.7	22.9	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Kick Off Meetings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	9	9.3	9.5	9.5
	Disagree	32	33.0	33.7	43.2
	Neither agree nor disagree	20	20.6	21.1	64.2
	Agree	26	26.8	27.4	91.6
	Strongly agree	8	8.2	8.4	100.0
	Total	95	97.9	100.0	
Missing	System	2	2.1		
Total		97	100.0		

External Resources

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	7	7.2	7.3	7.3
	Disagree	25	25.8	26.0	33.3
	Neither agree nor disagree	19	19.6	19.8	53.1
	Agree	35	36.1	36.5	89.6
	Strongly agree	10	10.3	10.4	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Used Information Systems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	9	9.3	9.5	9.5
	Disagree	28	28.9	29.5	38.9
	Neither agree nor disagree	13	13.4	13.7	52.6
	Agree	38	39.2	40.0	92.6
	Strongly agree	7	7.2	7.4	100.0
	Total	95	97.9	100.0	
Missing	System	2	2.1		
Total		97	100.0		

Used Expert Locator

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	23	23.7	24.2	24.2
	Disagree	41	42.3	43.2	67.4
	Neither agree nor disagree	9	9.3	9.5	76.8
	Agree	17	17.5	17.9	94.7
	Strongly agree	5	5.2	5.3	100.0
	Total	95	97.9	100.0	
Missing	System	2	2.1		
Total		97	100.0		

Evaluated Lessons Learned

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	13	13.4	14.0	14.0
	Disagree	32	33.0	34.4	48.4
	Neither agree nor disagree	19	19.6	20.4	68.8
	Agree	24	24.7	25.8	94.6
	Strongly agree	5	5.2	5.4	100.0
	Total	93	95.9	100.0	
Missing	System	4	4.1		
Total		97	100.0		

Applied Lessons Learned

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	6	6.2	6.3	6.3
	Disagree	27	27.8	28.4	34.7
	Neither agree nor disagree	22	22.7	23.2	57.9
	Agree	31	32.0	32.6	90.5
	Strongly agree	9	9.3	9.5	100.0
	Total	95	97.9	100.0	
Missing	System	2	2.1		
Total		97	100.0		

Captured Lessons Learned

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	5.2	5.2	5.2
	Disagree	15	15.5	15.6	20.8
	Neither agree nor disagree	15	15.5	15.6	36.5
	Agree	44	45.4	45.8	82.3
	Strongly agree	17	17.5	17.7	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Appendix V

Project Success

Budget

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Over Budget	11	11.3	11.3	11.3
	Within a Tolerable Variance	65	67.0	67.0	78.4
	Under Budget	21	21.6	21.6	100.0
	Total	97	100.0	100.0	

Schedule

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Behind Schedule	20	20.6	20.6	20.6
	Within a tolerable variance	59	60.8	60.8	81.4
	Ahead of Schedule	18	18.6	18.6	100.0
	Total	97	100.0	100.0	

Specifications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	2.1	2.1	2.1
	Disagree	7	7.2	7.2	9.3
	Neither agree nor disagree	7	7.2	7.2	16.5
	Agree	43	44.3	44.3	60.8
	Strongly agree	38	39.2	39.2	100.0
	Total	97	100.0	100.0	

Quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	10	10.3	10.3	10.3
	Neither agree nor disagree	10	10.3	10.3	20.6
	Agree	50	51.5	51.5	72.2
	Strongly agree	27	27.8	27.8	100.0
	Total	97	100.0	100.0	

Benefits

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	9	9.3	9.6	9.6
	Neither agree nor disagree	9	9.3	9.6	19.1
	Agree	36	37.1	38.3	57.4
	Strongly agree	40	41.2	42.6	100.0
	Total	94	96.9	100.0	
Missing	System	3	3.1		
Total		97	100.0		

Customer Satisfaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	1.0	1.1	1.1
	Disagree	7	7.2	7.4	8.4
	Neither agree nor disagree	14	14.4	14.7	23.2
	Agree	49	50.5	51.6	74.7
	Strongly agree	24	24.7	25.3	100.0
	Total	95	97.9	100.0	
Missing	System	2	2.1		
Total		97	100.0		

Communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	1.0	1.0	1.0
	Disagree	4	4.1	4.2	5.2
	Neither agree nor disagree	21	21.6	21.9	27.1
	Agree	34	35.1	35.4	62.5
	Strongly agree	36	37.1	37.5	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

Change Control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	3.1	3.1	3.1
	Disagree	14	14.4	14.4	17.5
	Neither agree nor disagree	12	12.4	12.4	29.9
	Agree	44	45.4	45.4	75.3
	Strongly agree	24	24.7	24.7	100.0
	Total	97	100.0	100.0	

Risks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	1.0	1.0	1.0
	Disagree	23	23.7	24.0	25.0
	Neither agree nor disagree	18	18.6	18.8	43.8
	Agree	32	33.0	33.3	77.1
	Strongly agree	22	22.7	22.9	100.0
	Total	96	99.0	100.0	
Missing	System	1	1.0		
Total		97	100.0		

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