LEARNING WITHIN AND DURING IT/IS PROJECTS: ITS PROCESS, ANTECEDENTS, AND OUTCOMES

by

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Dedication

To my nieces and nephews. May you know by my example that it is never too late to pursue your dreams.

To Dan, the wind beneath my wings, thank you for your unconditional love and support throughout this process.

Table of Contents

List of Tables

List of Figures

Acknowledgments

"Alone we can do so little, together we can do so much." — Helen Keller

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Learning within and during IT/IS Projects: Its Process, Antecedents, and Outcomes

Abstract

by

TARINA S. PETTIWAY

Learning through and from information technology/information systems (IT/IS) projects is key for organizations to execute on their strategic plans. Corporations utilize IT/IS projects to implement their strategic plans with the goal of increased revenue, enhanced competitive advantage, and increased operational efficiencies and to comply with governmental regulations. Projects and project teams can also serve as a medium to facilitate organizational learning. Learning is an essential characteristic of any project given project team members are tasked with developing new products and/or implementing new technical solutions to business problems. Studies have been performed to propose and test hypotheses related to frameworks for team learning in a variety of settings (e.g. construction, education, medical, manufacturing), but there are limited studies that present research on the antecedents for learning that occurs in the IT/IS project setting. Through this research, I seek to create the narrative of IT/IS projects as vehicles for learning within organizations. This study adopts a sequential exploratory mixed methods approach.

In Study 1, I explored how project post-mortems contribute to organizational learning. My findings suggest that post-mortem practices can facilitate organizational learning, however, I found the lack of incentives to use the data, opportunities and weak mechanisms for sharing post-mortem knowledge are key barriers for using project-generated information for improved learning during post-mortems.

In the second study, I sought to understand the antecedents to project team member learning during IT/IS projects. The results of the analysis show that risk management and project complexity have a direct positive impact on project team member learning, whereas the effect of innovativeness is fully mediated by autonomy.

In the final study, I evaluated the effect of learning as part of an IT/IS project on the innovativeness of the organization. I found that both learning and team communication have significant direct effects on innovativeness and project complexity does not. The results also show that learning mediates the relationship between team communication and innovativeness as well as the relationship between project complexity and innovativeness.

Keywords: team learning; project-based learning; organizational learning; knowledge transfer; knowledge retention; knowledge creation; project post-mortems; innovativeness

CHAPTER 1: INTRODUCTION

"There is only one thing more painful than learning from experience and that is not learning from experience." — Archibald MacLeish

Introduction

The Project Management Institute (PMI) defines a project as temporary task unit in that it has a definitive beginning and end with a definitive scope and resource allotment (PMI, 2018). PMI further states that a project is unique in that it is not a routine operation, but a specific set of operations designed to accomplish a specific goal and a project team often includes people who do not usually work together—sometimes from different organizations and across multiple geographies. Learning through and from information technology/information systems (IT/IS) projects is becoming increasingly important. Corporations can utilize IT/IS projects to implement their strategic plans with the goal of increased revenue, enhanced competitive advantage, and increased operational efficiencies and to comply with governmental regulations (Edmondson, Dillon, & Roloff, 2007; Kayes, Kayes, & Kolb, 2005; Sessa, London, Pingor, Gullu, & Patel, 2011). During such processes, projects and project teams also serve as a medium that facilitates organizational learning. Learning is also an essential characteristic of a project in that project team members are charged with the task of developing a new product and/or implementing a technical solution to a business problem. Knowledge related to such outcomes is created by experience, here task execution experience, and the process of creating the solution facilitates learning. In order to compete in the marketplace and to grow their business, organizations must successfully run and continually improve upon their business operations with IT/IS projects. This improvement is fueled by learning as part of the process.

Organizational learning in organization theory is viewed as routine-based, history dependent, and target-oriented. Organizations learn by encoding inferences from history into routines that guide their future behavior (Levitt & March, 1988). Much of the information from which organizations learn in IS projects is readily available as part of the current project or previous experience with the IT/IS projects. Team learning occurs in such settings when "individual team members create, acquire, and share unique knowledge and information" (Sessa et al., 2011: 147). Studies around team learning have been conducted in a variety of settings (e.g., construction, education, medical, manufacturing), but there are limited studies that present research on the process, antecedents, and outcomes (Akgün, Lynn, Keskin, & Dogan, 2014; Williams, 2008) for learning that occurs in the IT/IS project setting.

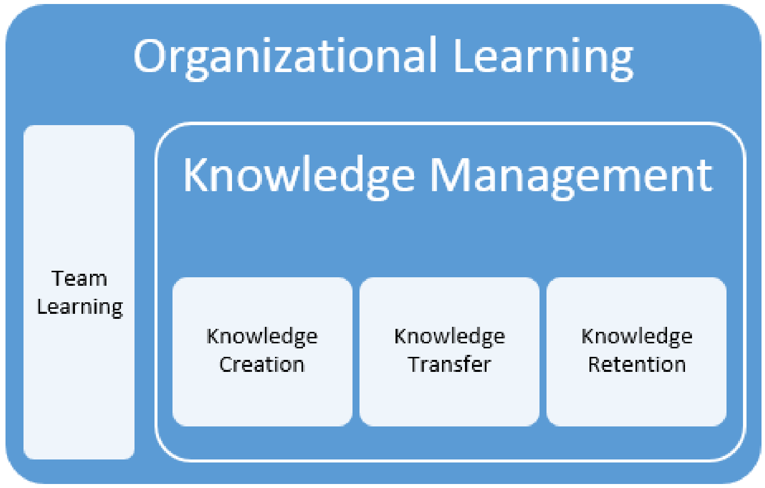
The Spiceworks 2018 annual report on IT budgets and tech trends projects (1) that close to half of the companies surveyed (44%) expect that their IT budgets for 2018 will increase and (2) that more than 60% of companies with 500+ employees expect to increase IT staff while 70% of large enterprises (5000+) report they'll hire more IT pros in 2018 (Spiceworks, 2018). With the increase in IT spending, organizations are likely to benefit by having proper learning routines in place that effectively move their organizations and projects forward. By mastering the learning cycle of knowledge creation, knowledge transfer and retention in IT/IS project settings, organizations can increase the likelihood of project success and improve the probability of producing higher quality products (Edmondson et al., 2007; Schindler & Eppler, 2003).

Through this research, I aim to use the findings to create a shift in how IT/IS projects are viewed. I seek to create the narrative of IT/IS projects as vehicles for learning within organizations and to create a knowledge management framework for successfully incorporating learning into IT/IS project routines and processes to facilitate sustained IT/IS project success. Next, I formulate a theoretical framework that provides the foundation on which I build my analysis followed by a review of prior research around project-based learnings. Lastly, I provide an overview of the research goals, research questions, research design and a summary of the study.

Theoretical Framing

The theoretical base (Figure 1) for this research is founded on key concepts of theories of Organizational Learning, Knowledge Management, which focus on processes of Knowledge Creation, Knowledge Transfer and Knowledge Retention, Team Communication and Team Trust. The selection of this theoretical base is informed by a review of prior empirical research on project-based/team learning. The key themes were chosen for their "conceptual attention to one or more of the key issues represented" in my topic area (Greene, Caracelli, & Graham, 1989). Additionally, I explore literature related to Risk Management, a key project routine that draws upon past learning and results in learning outcomes and Project Complexity, a characteristic of the project environment which requires learning and shapes characteristics of learning processes and outcomes. I also review literature related to innovation as one of the goals of learning is to promote novelty—a key aspect of innovation processes and outcomes.

Figure 1. Theoretical Framework



Organizational Learning

Organizational learning can be simply defined as a change in the organization that occurs as the organization acquires experience (Argote & Miron-Spektor, 2011). Organizations learn through individuals acting as agents for learning. The individuals' learning, in turn, is facilitated or inhibited by an ecological system of factors often called organizational learning system (Argyris, 1977). Organizations learn from direct experience or from the experience of others (Levitt & March, 1988). Huber (1991) suggests further that organizations learn by congenital learning, experiential learning, vicarious learning, grafting and searching or noticing. Congenital knowledge is a combination of knowledge inherited at the organization's origination and the additional knowledge acquired prior to its start; whereas experiential learning is knowledge gained through direct experience resulting from intentional, systematic efforts (Huber, 1991). Vicarious learning is done through acquiring second-hand experience or knowledge of what another organization is doing and grafting is increasing knowledge by acquiring new members who possess the needed knowledge (Huber, 1991).

Team learning builds upon and complements organizational learning concepts and the concept of team learning stems from the premise that in addition to an individual, organized collectives have the ability to learn (Edmondson et al., 2007). The increasing use of teams and projects created the need to understand the factors that facilitate team effectiveness including the team's ability to learn (Bartsch, Ebers, & Maurer, 2013; Druskat & Kayes, 2000; Edmondson et al., 2007; Fong, 2003; Sessa et al., 2011; Swan, Scarbrough, & Newell, 2010). Per Levitt and March (1988), we can describe team learning as an outcome of a change in the team's knowledge. Some define it as a process of knowledge-based reflection and adjustment (Edmondson, Bohmer, & Pisano, 2001). For the purposes of this study, I adopt Druskat and Kayes' (2000) definition as "team members acquiring and sharing unique knowledge and information and examining what is helping and hurting team performance to continually improve as a unit" (p. 33).

IT/IS projects provide the proper environment for learning to occur. When projects are initiated, resources are assigned to the project team, who bring with them congenital knowledge gained from prior codified project experiences and the teams combine it with the information shared as part of the project startup. This knowledge lays the foundation for the project outcomes. As project team members interact with one another they participate in vicarious learning. Additionally, as project resources are on-boarded on and subsequently transitioned off the project, the team has an opportunity to increase their knowledge by grafting given that the resources are added based on a particular skill necessary to complete project tasks. All diligent projects managers facilitate also routine project meetings as to monitor the status of the project and to address issues preventing the project from moving forward, which provide a setting for experience-based learning. The different types of learning and how they connect to the project setting are listed in Table 1.

Table 1. Learning Methods alignment with Project Settings

Learning Method	**Description**	**Project Setting**
Congenital	Using existing knowledge (inherited knowledge) to create new knowledge	Project member knowledge based on prior project experience
Experiential	Acquiring knowledge through direct experience	Project members learn through their project task experience
Vicarious	Learning derived from indirect sources such as hearing or observation, rather than direct, hands-on, instruction.	Interaction and collaboration among project members
Grafting	Increasing the store of knowledge by acquiring and attaching on new members who possess knowledge not previously available within the organization	Resources with specific skills are added to the project teams as needed

Team members learn also from their individual experience as a specific member of the IT/IS project. Learning takes place between individual project team members through sharing their collective experience during the project. The concept of social learning takes into consideration interactions between any two parties within a project setting and per Hartmann and Dorée (2015) such learning emerges from collective actions and knowledge that is enacted through the participation in social processes. Overall, organizational learning is shaped by knowledge management processes, which are organizational programs, policies, technologies and practices, which enable any form of learning in organizational settings.

Knowledge Management

Argote and Miron-Spektor (2011) define three primary processes of organizational learning: knowledge creation, knowledge transfer, and knowledge retention. Collectively they call these activities as knowledge management (Argote, McEvily, & Reagans, 2003; Kasvi, Vartiainen, & Hailikari, 2003). Knowledge management hence consists of activities by which the knowledge gained via the learning processes such as congenital learning, experiential learning, vicarious learning, etc., are harvested and disseminated. Knowledge management aims at the effective dissemination and leverage of knowledge to enhance effective organizational performance (Lyles & Easterby-Smith, 2003). Different from learning process where knowledge is created, knowledge management provides an organizational framework for how organizations mobilize for learning and store, organize and retrieve knowledge serving for different learning outcomes such as created vicarious learning and grafting. As Argote (1999) suggests this process of knowledge management has wider effects: "task performance experience is converted into knowledge through organizational learning processes. Task performance experience interacts with the context to create knowledge. The knowledge flows out of the organization into the environment and also changes the organization's context which affects future learning" (p. 32).

Learning from experience relies on information being created and shared by one party and received by a second party (Argote & Ingram, 2000; Argote, Ingram, Levine, & Moreland, 2000; Levitt & March, 1988). This sharing between parties is referred to as knowledge transfer. Knowledge retention focuses on the stocks and flows of knowledge that build up the organization's memory. Effective knowledge management overall involves creation, capture, storage, and transfer of knowledge including the sharing of knowledge by organizational members. In many cases, effective knowledge management depends on the employee's ability and willingness to share their organizational and work-related knowledge (Dunham & Burt, 2011). For IT/IS project teams, this calls for sharing the congenital knowledge that the team starts the project with and leveraging experience gained during project activities through routine meetings and/or project post-mortems as to facilitate learning via the other learning processes (Huber, 1991).

Knowledge management in project-based organizing faces many unique challenges. As projects differ substantially from one another and face significant discontinuities in flows of personnel, materials, and information; it is more difficult to develop steady routines that create an appropriate flow of knowledge and capture learning from one project, or project setting to the next (Bresnen, Edelman, Newell, Scarbrough, & Swan, 2003). Crucially, problems of cross-project or intra-project learning have wider implications for processes of organizational learning. Not surprisingly, therefore, developing capabilities to manage knowledge within and across projects is seen as an important source of competitive advantage (Bresnen et al., 2003).

Prior Research

Prior empirical research on project-based learning has sought to explore the antecedents of team learning in project settings as well as outcomes of such learning. Research has been performed to explore frameworks for learning in a team/project setting as well as the challenges of doing so. Table 2 synthesizes and summarizes these key findings from this research as well as key gaps in past research.

Table 2. Summary of Prior Research

Learning Processes and Outcomes

Reference	Research Question	Method	Finding	Gaps
Fong Boh, Slaughter, and Espinosa (2007)	Examines whether individuals, groups, and organizational units learn from experience in software development and whether this learning improves productivity.	Quantitative	Individual level specialized experience has the greatest impact on individual productivity and at the group and organizational level, diverse experience in related systems had a more significant impact	Focus is on the developer's experience and productivity as an outcome Sample focused on telecommunications industry
Söderlund (2008)	Examines learning processes in project-based organizations	Exploratory multiple-case study	Identified three learning processes: shifting, adapting and leveraging.	Learning process similar to knowledge creation, knowledge transfer and knowledge retention
Williams (2008)	Examines current practices as well as "best" practices for lessons learned	Literature Review and Quantitative	Processes to assist the lessons learn process exist only in project management mature organizations and the transfer of lessons from project team to the organization is a challenge.	Participants limited to project managers and project management
Decuyper, Dochy, and Van den Bossche (2010)	Presents an integrative model of team learning that sought to answer the following questions: 1) what are team learning processes, 2) what are team learning outcomes and 3) what influences team learning?	Literature Review	Developed a systemic, cyclical and integrative team learning model that organizes and combines team learning processes, outputs, inputs and catalyst emergent states and time-related variables into a coherent whole.	Antecedents to individual learning
Swan et al. (2010)	Why don't or do organizations learn from projects?	Qualitative	(1) What is learnt in a project goes no further than the project itself, or (2) is transferred through individuals moving on to new projects or through personal networks and (3) Only occasionally does learning from projects lead to more institutionalized levels of organizational learning.	Sample specific to Design and Engineering
Lyytinen, Rose, and Yoo (2010)	Examines how software development organizations (SDO) would respond to the learning challenges of a hyper-competition and disruptive technology innovations	Exploratory, theory-building case study	SDOs enacted routines involving distributed gate-keeping and external brokering for broad, flexible, fast exploration; and simple rules, simple design artifacts, and peer and mentoring networks for fast and efficient exploitation.	Specific learning environment. Focus limited to organizational learning
Hannes, Raes, Vangenechten, Heyvaert, and Dochy (2013)	Integrates findings on experiences of employees with team learning	Qualitative evidence synthesis	Communication, boundary crossing, and knowledge sharing coupled with an enabling environment stimulates team learning	Vocational work setting

Arumugam, Antony, and Kumar (2013)	Examines the impact of technical resources and psychological safety on learning	Quantitative	Psychological safety affects project performance through know how and the impact of technical resources on project performance is mediated by knowing what and know how	Limited to Six Sigma teams
Akgün et al. (2014)	Examines the antecedents and consequences of team learning, which is composed of information acquisition, dissemination, and implementation, in information technology (IT) implementation projects	Quantitative	(1) Information acquisition and information dissemination have a positive impact on project outcomes, such as speed-to-users, lower implementation cost, and operational effectiveness, and (2) Team behavior and enabler variables, such as teamwork, team communication, interpersonal trust between team members, team commitment, and senior manager support, positively influence team learning. We also found that team anxiety moderates the relationship between team learning and project outcomes.	Focus is on the impact to speed, cost and quality variables

Based on the review of project-based learning, we know a lot about the processes through which learning occurs in teams. In line with cycles of knowledge creation, knowledge transfer and knowledge retention (Argote & Miron-Spektor, 2011) learning processes have been posited to include steps of the shifting, adapting and leveraging knowledge or related information acquisition and information dissemination processes. We also know that the social aspects facilitate team learning. Psychological safety, higher levels of team communication and higher trust among team members were shown to be significant antecedents to learning (Edmondson & Nembhard, 2009; Levin & Cross, 2004; Park & Lee, 2014). Additionally, the literature identifies several challenges to learning. For instance, the learning is likely to stay within the project which does not allow the organization as a whole to benefit from the learning. It was also shown that learnings are transferred based on current relationships among the project team members and the interaction and communication associated with the project-based activities (e.g., routines project meetings) due to the lack of formal mechanisms within the organization that facilitate the knowledge transfer and retention.

We know much less how learning occurs within the context of IT/IS projects. Many of the studies were conducted in industries other than IT/IS such as design, engineering, nursing, and new product development. None of the studies explored how the characteristics of IT/IS projects (e.g., project complexity) and IT/IS project routines such as risk management influence learning within IT/IS projects. Additionally, the studies related to IT/IS used learning to explain outcomes related to the triple goals of projects-scope, quality, and budget which are aligned with the current narrative associated with IT/IS projects. The gap that I seek to address with this research is to explore in depth the process, antecedents and outcomes of project-based learning within the context of IT/IS projects by examining the effects of the project environment, characteristics and routines. As one of the goals of this study is to expand the narrative related to IT/IS projects, I also seek to understand how learning during IT/IS projects influences innovativeness.

Next, I introduce the concepts pertinent to the theoretical framework driven by the results of prior studies and the gaps in the literature.

Team Communication

Learning as defined above is fundamentally a social process (Hartmann & Dorée, 2015). It is facilitated by interactions that occur among project team members and between the team members and outside environment. Communication—exchange of ideas and information with others with the goal of informing, building relationships and creating a shared understanding on a certain topic—is hence fundamental foundation for learning (Barczak, Lassk, & Mulki, 2010; Lee, Park, & Lee, 2015; Leeuwis & Aarts, 2011; Littlejohn & Foss, 2008). The communication process includes frequent symbolic interactions and forms a critical antecedent for the knowledge transfer (Park & Lee, 2014). As part of IT/IS projects, team members communicate frequently formally as part of routine project meetings such as status updates, requirements and design sessions. They also communicate informally through co-location or social bonding and friendships. Effective communication in such settings promotes learning whereby useful, reliable and appropriate information is shared among team members in relation to their current tasks or related coordination needs (Lee et al., 2015).

Team Trust

One condition required for several learning processes is that team members are not only knowledgeable but they are also *willing* to share their knowledge (Hartmann & Dorée, 2015). Prior research suggests that favorable social conditions and related positive intra-group relations facilitate knowledge exchange by expanding and deepening it and thus enhancing learning (Barczak et al., 2010; Bartsch et al., 2013; Druskat & Kayes, 2000; Jewels & Ford, 2006; Swan et al., 2010). A key element of such intra-team conditions is trust, which has been found to be a critical antecedent to individual's willingness to share knowledge (Bourdieu, 2011; Coleman, 1988; Li, 2005; Nahapiet & Ghoshal, 1998). Trust in our context exists when one project member has confidence that the result of the actions of another project member will be reliable (Dirks & Ferrin, 2001; Li, 2005; Nahapiet & Ghoshal, 1998). Per McEvily, Perrone, and Zaheer (2003), trust "creates or enhances the conditions, such as positive interpretations of another's behavior that are conducive to obtaining organizational outcomes like cooperation and higher performance" (p. 91). IT/IS projects are fluid, interdisciplinary and temporary which can potentially make it challenging for project team members to identify with and trust each other. Trust emerges through experience-based changes in the relations among persons (Coleman, 1988). I can also posit that the creation/existence of such trust among IT/IS project team members will facilitate learning.

Project Complexity

Characteristics of the environment where the learning takes place are important in understanding the antecedents and effects of learning. Hence characteristics of the project environment such as its complexity will play an important role in how learning takes place in IT/IS projects. Baccarini (1996) defines project complexity as "consisting of many varied interrelated parts and can be operationalized in terms of differentiation and interdependency" (p. 202). He proposes two types of project complexity; one being organizational complexity which refers to the number of, and relationships between, hierarchical levels, formal organizational units and specializations; the second one being technological complexity which refers to the number of, and relationships between, inputs, outputs, tasks, and technologies. The level of complexity associated with the project is likely to impact the level and outcomes of learning. Generally, the more complex the project, the more project team members need to coordinate, communicate and collaborate as to arrive at a solution. Higher levels of complexity require cause that is more salient and effect relationships to be identified and encoded which can lead to improved experiential learning. Project team members need to construct knowledge that is more extensive when solving complex problems and it often involves collaborating with other team members and leveraging multiple sources of information (Blumenfeld et al., 1991). Roberts, Cheney, Sweeney, and Hightower (2004) indeed found that interactions within IT/IS project teams was different in moderately complex projects when compared opposed highly complex projects.

Risk Management

One effective strategy for handling complexity in IT/IS projects is the use of risk management strategies. These can be defined as planning, identification and preparation for project risks which stem from increased project complexity and related uncertainty (Boehm, 1991; Raz, Shenhar, & Dvir, 2002; Tummala, Leung, Mok, Burchett, & Leung, 1997). Some scholars, therefore, note that risk management offers "considerable hope in improving the performance of software development" because it offers better ways to "identify, analyze and tackle software risks" (Lyytinen, Mathiassen, & Ropponen, 1996: 53). The main reason is that risk management activities facilitate the development of organizational knowledge and promotes related learning which helps an organization to address a wider range of risks (and related complexities) (Lyytinen, Mathiassen, & Ropponen, 1998). As part of the process of managing risk project teams search for the unknowns and attempt to control variance (and learn about the project system) thereby generating new knowledge. This results in project managers learning new knowledge, which is codified in new heuristics, to routinely use to master the complex project environment (Lyytinen et al., 1998).

The project management methodology chosen to guide the project builds hence routines that lend themselves to promote project-based learning. Project routines that call project team members to leverage congenital knowledge as to assist with the identification and resolution of project tasks facilitate also learning. In this context project post-mortems, which are deemed also as a central risk management technique in harnessing and codifying knowledge related to management of project complexity, is one such routine dedicated specifically to learning. In this regard, project post-mortems were identified as one of the key means for mitigating future projects risk because they provide the opportunity for project team members to create learn by codifying heuristics based on their project experience. The post-mortem of failed IT projects facilitate the identification of early warning signs of imminent project failure (Kappelman, McKeeman, & Zhang, 2006: 31). The literature, both practitioner and academic, speak clearly of the benefits of capturing and acting on lessons learned from post-mortems as a means to improve IT/IS project learning and related outcomes (Anbari, Carayannis, & Voetsch, 2008; Duffield & Whitty, 2015; Hartmann & Dorée, 2015; Lyytinen et al., 1996; Verner, Sampson, & Cerpa, 2008a). The main reasons for conducting project post-mortems are: 1) people do not automatically learn from their professional experience, the learning exercise needs to be prompted; 2) the valuable experience in a software project is dispersed among several people; and 3) it is essential to air project experiences, reflect upon them, and evaluate them as to create conditions for learning whereby the organization can avoid repeating the same mistakes (Anbari et al., 2008). At the same time, the literature on post-mortems is highly prescriptive (Anbari et al., 2008; Collier, DeMarco, & Fearey, 1996; Duffield & Whitty, 2014) but there is little research on whether learning and project improvement actually occurs during and after project post-mortems.

Innovation

Innovation is a continuous process of creating new value for the organization by identifying new ways of completing tasks (Miller & Brankovic, 2011) and according to Gieskes (2001) the relationship between learning and innovation has been theorized in two different ways. The first theory posits that learning influences innovation and studies have shown learning to be an antecedent to innovation (Alegre & Chiva, 2008; Harkema, 2003; Jiménez-Jiménez & Sanz-Valle, 2011; Sarin & McDermott, 2003). The influence of learning on innovation emanates from the creativity associated with the identification of new solutions. The learning associated with the failure or success of a project enables process improvement within organizations which can lead to innovation (Harkema, 2003).

The second hypothesis states that innovation is a natural learning process that starts with an idea that is carried forward and developed which leads to learning as an outcome. The process of innovation is stimulated by communication and trust among individuals (Lee et al., 2015; Park & Lee, 2014) and a culture that is open to innovation (Hurley & Hult, 1998). Per Hurley and Hult (1998), the innovativeness of an organization requires a culture that includes communication, a lean towards learning and development, collaboration and a tolerance for conflict and risk. It is the hypothesis of this study that IT/IS projects possess those characteristics. IT/IS projects are charged with identifying and implementing solutions to business problems and are therefore suitable environments for innovation to facilitate learning in addition as well as for innovation to be an outcome of learning. This study will test the mutual impact of innovativeness and learning.

Research Goals and Questions

I posit that learning during IT/IS projects can occur at the individual level (e.g., project managers, developers, etc.), at the team level (project team as a whole) and at the organizational level. Learning is also impacted by the context in which it occurs. It is my belief that establishing a sustainable process for including learning as part of IT/IS projects across all levels will help to improve the execution of and outcomes of IT/IS projects. To that end, the goal of this research is to explore constructs at multiple levels as part of this study. Hackman (2003) refers to this as bracketing in which conceptual and empirical analyses constructs that exist one level lower and one level higher than the main focus of the study are included. The many benefits of bracketing includes: "(1) enriching the understanding of one's focal phenomena; (2) helping to discover non-obvious forces that drive those phenomena; (3) surfacing unanticipated interactions that shape an outcome of special interest; and (4) informing the choice of constructs in the development of actionable theory" (Hackman, 2003: 907).

The primary question for this study is: What facilitates project-based learning during IT/IS projects and what are the outcomes of these learnings? In order to answer that question, I developed next a research framework focused on understanding the factors that facilitate knowledge creation, retention and transfer within and across IT/IS projects. I also seek to understand how learning can lead to innovativeness within the organization. The following series of questions have been developed in order to address the goal and answer the primary research question:

1. What are the outcomes and barriers of team level learning?
2. What are the factors that influence individual learning in teams?

3. How are learning outcomes used within the organization?

Based on the review of the prior research on project-based/team learning, I will explore the concepts of team communication and team trust in addition to theories of organizational learning, team learning, and knowledge management. Additionally, I will leverage the concepts of project complexity and risk management and explore innovativeness as an outcome of learning as part of this research.

Research Design and Methodology

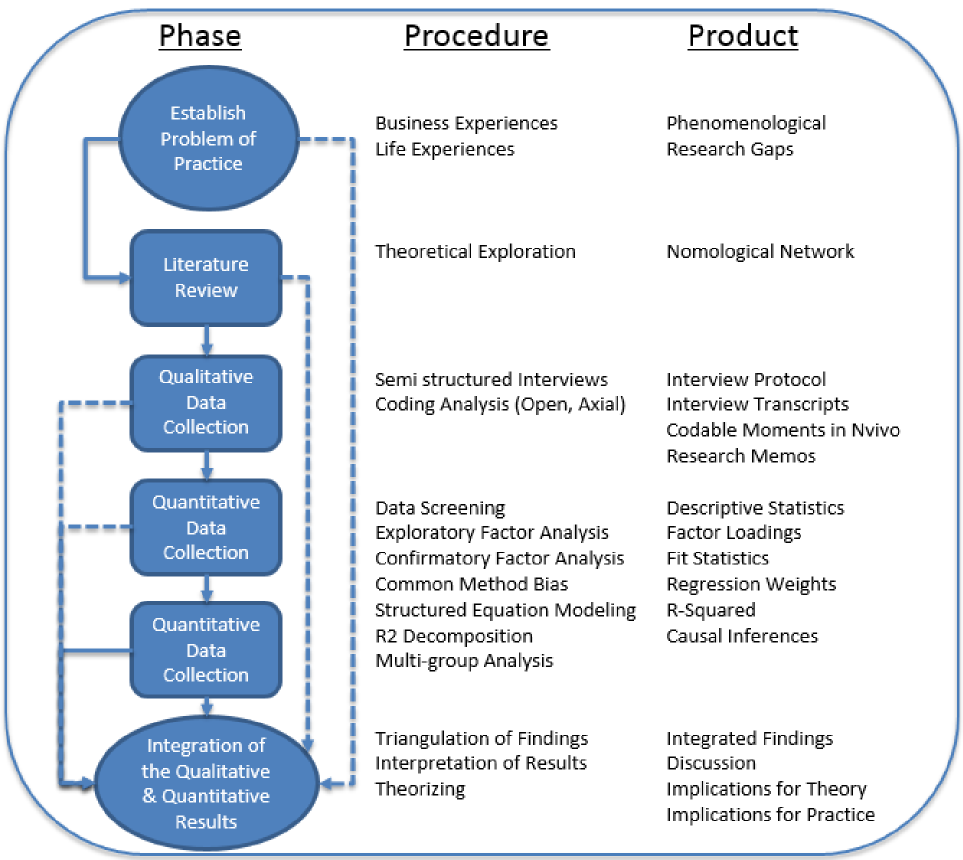
The overall design for this research study utilizes an exploratory sequential mixed methods approach (Creswell & Plano Clark, 2011; Teddlie & Tashakkori, 2009). Prior studies of project-based learning have only focused on one aspect (e.g., the antecedents, the process or the outcome). The goal of my study is to explore holistically factors central to the learning within the context of IT/IS projects by answering multiple research questions as identified above. Therefore a mixed method research design was chosen to gain a breadth and depth of understanding of my phenomena and to obtain more complete and corroborated results (Creswell & Plano Clark, 2011). The exploratory sequential design is a three-phase (qualitative→quantitative→quantitative) mixed methods design that starts with the collection and analysis of qualitative data, followed by quantitative phases. The advantage of this particular mixed methods design is the ability to focus on and explore the phenomenon of interest as well as the ability to leverage the findings from the qualitative phase to generate hypotheses that are tested in the subsequent quantitative phases. See Figure 2 for an overview of the mixed methods design.

In the first study, the qualitative method was used to help theorize about barriers and outcomes of team level learning. To that end, I sought to understand the mechanisms and effects of project post-mortems towards organizational learning. As stated earlier, project post-mortems are project routines that are used for learning from the project experience. During the project post-mortem process, the project team members identify and document the aspects of the project that went well as well as those that did not go so well. By exploring the role of project post-mortems, I sought to understand how learning occurs by project teams. Semi-structured interviews were conducted with twenty-three project and project managers and two Chief Technology Officers with the goal of understanding the participants experience leveraging learnings from prior project experiences.

The second study explored the antecedents and role of mediators on individual project team member learning. Study 2 employed a quantitative approach and broadened the scope to include all information IT/IS project team members (e.g., project managers, software developers, business analysts, and testers). I explored individual learning within project teams as opposed to project team learning. If the individual project team members are not learning—creating knowledge—then organizations are not learning. Per Smith and Young (2009), "Individual learning and organizational learning are intertwined as organizations depend on the knowledge of their employees" (p. 329). The findings from the qualitative study along with prior literature were used to develop a hypothesized model and survey instrument for this phase of the study. The survey instrument was used to collect data from 647 IT/IS professionals with experience participating as a member of a project team responsible for the end-to-end implementation of an IT/IS project.

In the final study—a second quantitative study—I seek to understand the outcomes of individual-level learning as part of an IT/IS project. Specifically, I examine the role of learning on organization innovativeness. Additionally, I explore the mediating role of learning on the relationship between team communication and innovativeness as well as the relationship between project complexity and innovativeness. I also examine the mediating role of team trust on the relationship between learning and innovativeness and the relationship between team communication and innovativeness. Finally, I explore the moderating effect of project role (leader vs. staff) on project member learning and innovativeness. This study leverages the data set collected during the second phase of this study to perform the analysis.

Figure 2. Mixed Methods Study Design



Summary of Study Results

In Study 1, I explored how project post-mortems contribute to organizational learning. My findings suggest that post-mortem practices can facilitate organizational learning, however, I found the lack of incentives to use the data, opportunities and weak mechanisms for sharing post-mortem knowledge are key barriers for using generated project information for improved learning during post-mortems. I also found that Project and Program Managers retained the information captured in the post-mortem for their own personal use and the level and quality of knowledge created was related to the project management methodology used by the project team.

In the second study, I sought to understand the antecedents to project team member learning during IT/IS projects. The results of the analysis show that risk management and project complexity have a direct positive impact on individual learning, whereas the effect of innovativeness is fully mediated by autonomy.

The final study evaluated the effect of learning as part of an IT/IS project on the innovativeness of the organization. I found that both learning and team communication have significant direct effects on innovativeness and project complexity does not. The results also show that learning mediates the relationship between team communication and innovativeness as well as the relationship between project complexity and innovativeness. Team trust mediates the relationship between team communication and innovativeness but does not mediate the relationship between learning and innovativeness. Lastly, there was no difference in the relationship between learning and innovativeness for project team leaders in comparison to project staff.

Collectively, the findings from this research has led to the creation of the profile for the learning IT/IS project. Learning opportunities are inherent within IT/IS projects. However, these opportunities should include problem solving tasks that require the individual project team member to develop new knowledge and skills. Additionally, the project team and project environment have to be constructed in a way that facilitates strong interpersonal connections and lastly.

Structure of Remaining Chapters

The remaining chapters in this dissertation are structured as follows. Chapters 2 through 4 cover each of the empirical studies which are included in their entirety as individual chapters. Chapter 2 covers Study 1, which is the qualitative study focused on the role of project post-mortems in organizational learning. Chapter 3 includes Study 2, the first quantitative study which explores the factors that influence learning as part of an IT/IS project. Chapter 4 includes Study 3, the second quantitative study which examines innovativeness as an outcome of learning as part of an IT/IS project. Chapters 2, 3, and 4 were written as stand-alone research papers suitable for publication in academic journals. As such, some repetitions in the dissertation are unavoidable. Chapter 5, the final chapter in this dissertation, presents the integrated findings and discussion as well as the implications for practice and limitations.

CHAPTER 2: HOW DO PROJECT POST-MORTEMS CONTRIBUTE TO ORGANIZATIONAL LEARNING?

Introduction

Project post-mortems are an important means of learning and can play a critical role in improving an organization's system work. Project post-mortems aim to capture information about project events and conditions and build local causal-effect models of factors and events that lead to specific outcomes. By doing so, they seek to synthesize 'lessons learned' in forms that are transferable to other projects and thus facilitate continuous improvement (Kappelman et al., 2006; Lyytinen et al., 1996; The Standish Group, 2013; Verner et al., 2008a). There is little understanding, however, "how" organizations can successfully gather and leverage information of a project's performance. Therefore, organizations are unable to apply the lesson learned because they lack ways of conceptualizing project events and making them actionable. Generally, project-based learning encodes inferences from history into routines that guide future behaviors (Levitt & March, 1988) and this takes place either by learning, doing or grafting from other's experience (Epple, Argote, & Devadas, 1991; Levitt & March, 1988).

While the literature provides several guidelines of how to conduct project post-mortems (Anbari et al., 2008; Duffield & Whitty, 2015; Hartmann & Dorée, 2015; Schindler & Eppler, 2003) there is little understanding how an organization can effectively harness such information for learning and knowledge transfer. As a result, data reviewed during project post-mortems such as project status updates or risk analyses fail to improve the project performance. One reason is that project post-mortems and related practices routinely fail to account for and interpret such data systematically.

Rather, project post-mortems are conducted as rituals to 'finish' the project. Therefore, organizations ultimately fail to learn from their experience (Lyytinen & Robey, 1999; Verner et al., 2008a: 72).

In this study, I address this gap and seek to understand how the information captured as part of project post-mortems is leveraged to facilitate organizational learning and what factors thwart such efforts. This is accomplished by interviewing 25 project and program managers responsible for managing technology projects. The question the study seeks to answer is: What role do project post-mortems play in organizational learning about project performance and what factors influence their success?

Literature Review

What are Project Post-Mortems

Project post-mortems have long been considered to be a 'best practice' for organizational learning as to improve project performance (Verner et al., 2008a). During post-mortems, participants collect information on events and conditions during the project and determine what went well or poorly to identify reasons for observed outcomes. Knowledge is generally identified in terms of rough cause-effect relationships and is expected to provide opportunities for process improvement in future projects. There is general positive sentiment related to the value of post-mortems. For example, Anbari et al. (2008) summarize extensively reasons for conducting post-mortems: (1) people do not necessarily learn from their experience. Structured learning exercises need to be prompted to make the experience meaningful; (2) the knowledge of what occurred in a project is dispersed among several people and can only be made visible and explicit through post-mortems; and (3) consequent writing and disseminating of the lessons learned helps build reflective approach to project experience that avoids repeating the same mistakes (Anbari et al., 2008: 634).

Organizational Learning

Post-mortems are an instance of experience-based organizational learning i.e., they seek to generate change in behaviors while the organization acquires more experience (Argote & Miron-Spektor, 2011). Post-mortems have all characteristics of experience-based learning: They are routine-based, history dependent, and target-oriented; they are focused on encoding inferences from history into routines that guide future behaviors (Levitt & March, 1988: 319). Organizations also learn based on the experience of others (Epple et al., 1991; Levitt & March, 1988);[1] therefore, post-mortems form an important means of grafting that results in sharing knowledge within the organization. These two experience-based learning modes run parallel in the context of post-mortems. During post-mortems, the organization engages in novel and local knowledge creation by seeking to generate knowledge that is new to it through experimentation and reflection. After the post-mortems, the organization seeks to rely on information collected, interpreted and shared during post-mortem by making it accessible to external actors (Argote & Ingram, 2000; Argote et al., 2000; Levitt & March, 1988). Argote et al. (2000) refer to the latter process as knowledge transfer while others call it grafting. Hence, knowledge transfer is as important in organization's use of post-mortems as learning from local experience. Organizations that transfer post-mortem knowledge

[1] Both these activities call for knowledge retention which focuses on stocking knowledge in the organization's memory and enabling related flows (Argote, Ingram, Levine, & Moreland, 2000).

effectively from one project to another are likely to be more productive than those that are less adept in such activity (Argote & Ingram, 2000: 3).

Knowledge acquired by either way of learning becomes embedded in and changes the organization's context. Knowledge is embedded in the context by influencing the participants, changing tools and tasks, or reconfiguring related social or technology networks. Knowledge is also embedded over time in organization's latent elements such as its culture (Weber & Camerer, 2003). In this regard, the purpose of project post-mortems is to engage the organization in learning from experience by creating novel knowledge that captures, given the evidence and related inferences, the most effective and successful way of accomplishing a given set of project tasks. The data collected during the project post-mortem was shared with other project members and made available for use by others involves knowledge transfer. The transfer happens through tools, guidelines, repositories, networks or shaping the culture.

Knowledge Creation and Learning

During learning knowledge originates from experience (Argote, 1999; Argote & Miron-Spektor, 2011; Huber, 1991; Levitt & March, 1988; Nonaka, 1994) which is converted through specific symbolic or cognitive processes that result in specific learning outcomes like causal frames, evidence, or awareness. In this regard, project post-mortems serve as a means to capture the information about the projects symbolically and make inferences about that information towards generalizable, more abstract knowledge. Specifically, project post-mortems seek to influence process improvement by evaluating execution tactics of successful and unsuccessful interventions during the project. The knowledge is articulated in the form of cause-effect models and retained in organizational memory. This process, though necessary for learning, is not easy. Lyytinen and Robey (1999), for example, report three cases where the organizations failed to learn from their project experiences and as a result learned to fail. This results in what Weick, Sutcliffe, and Obstfeld (1999) call mindlessness: when few cognitive processes related to experience get activated and less often, the resulting state is that of mindlessness characterized by reliance on past categories, acting on “automatic pilot,” and fixating on a single perspective without awareness that things could be otherwise (Weick et al., 1999). Therefore, one important goal of conducting project post-mortems is to improve situational awareness and switch project members to become more mindful that can solicit conflicting input from multiple perspectives. This process needs to be repeated for interpreting post-mortem information as to yield multiple, alternative ways of interpreting the project information.

Knowledge Transfer & Retention during Learning

Knowledge transfer relies on the effectiveness of the organization’s knowledge management capabilities in storing and transferring knowledge across temporal (from one project to next) and organizational boundaries (from one project context to another project context). Knowledge management in project-based context faces many challenges due to the fluidity of organizational boundaries and shifting temporal boundaries. Projects differ from one another, and knowledge transfer from one project to another can involve discontinuities in tasks, personnel, technologies and domain knowledge. Therefore it is difficult to develop stable routines that can maintain the flow of knowledge between the projects and can capture learning from one project and transfer it to the next one (Bresnen et al., 2003). Such problems in cross-project learning have also wider implications for organizational learning outcomes. Not surprisingly, developing the capability to manage knowledge across temporal and organizational project boundaries is seen as an important source of competitive advantage (Bresnen et al., 2003).

Knowledge created as part of the project post-mortem process becomes first shared and reviewed by the project team members. The information collected from each individual is captured into a shared document, reviewed, and discussed by team members. The goal of this review is to generate and make transferable the knowledge among project members. Conducting a ‘history’ session provides next an opportunity for the project members to hear the voice and experience of others and to learn from them. Upon completion of the review, the lessons learned are finalized and stored in a project data repository. Organizations retain this data in order to allow team members from other projects to access the information. Surprisingly, there is little research in the literature about how knowledge created gets further disseminated, assimilated and retained within the organization and what mechanisms apply under different conditions in avoiding repetition of past mistakes (see, e.g., Neustadt & May, 1986) or adopting successful practices (Day, 1994). A widely recognized belief is that the acquisition and retrieval of knowledge from repositories during knowledge transfer will automatically influence subsequent individual behavior which is most likely a moot assumption (Reder & Anderson, 1980; Walsh & Ungson, 1991: 58)

Research Design

Methodology

The study sought to understand what roles project post-mortems play in organizational learning in the context of information technology projects. How the information is captured and deployed as part of the project post-mortem process so that it facilitates organizational learning and improves project performance? To answer these questions, I sought to capture lived experience of program and project managers responsible for leading IT projects. The expectation is that such study will solicit and help theorize about the mechanisms and effects of project post-mortems towards organizational learning. Due to the little-established theory and research in the area, the study applied grounded theory. Such approach is ideal when one seeks to discover theory from qualitative data using systematic inductive coding and analysis (Glaser & Strauss, 1967). Specifically, I sought to uncover how the information captured via project post-mortems is leveraged by project members and managers to improve future project management tasks. Semi-structured interviews were used to capture project and program manager's experiences about conducting and using post-mortems as part of project management work. The interviews were systematically coded and analyzed using grounded theory approach (open, axial, selective coding). This ultimately led to uncovering novel conditions under which project post-mortems are likely to facilitate organizational learning. Through my analysis, I was exploring and grafting theory. The findings from this study will be used later to inform a mixed method study with the aim to develop and validate a theory of project-based learning within IT/IS projects.

Sample

I sampled using purposeful sampling. I sought to include in my sample experienced project and program managers who would have experience of project work and post-mortem practices (See Appendix A). To qualify for the study, participants were required to have worked as a project or program manager. All interview participants had experience leading IT projects of varying sizes (small, medium and large). The participants were not pre-screened to confirm prior participation in a project post-mortem as it was the goal of the researcher to understand all methods by which learning from a prior project experience is identified and leveraged. Personal networks and snowballing were used to identify and list study subjects. The final sample included 25 IT professionals. To reduce contextual impact, the sample represented ten companies across several industries including Financial Services, Document Services, Healthcare, Education, and Technology. One participant had less than five years of project/program management experience, eight had five to ten years of experience, eleven had ten to fifteen years of experience, and five had fifteen or more years of experience. Six of the participants were male, and nineteen were female.

Data Collection

Data was collected over a six-month period from April 2015 through September 2015. Semi-structured interviews were used to gather the data and followed a detailed interview protocol (See Appendix B). The interviews focused on the participant’s experience as a project or program manager including their experiences leveraging learnings from prior projects. Open-ended questions were asked, and probing questions were used to clarify and to expand upon the responses. The interviews lasted on average 60 minutes but no longer than 90 minutes. Eleven of the interviews were done in person, and the remaining fourteen were conducted via telephone. Additionally, at the conclusion of each interview, the researcher captured non-verbal data and key themes from the interview in a memo note. To facilitate the data collection process, the interviews were recorded upon receiving permission from the participant. Interviews were transcribed verbatim from digital recordings. All transcripts were checked with the interviewees for accuracy prior to analysis.

Data Analysis

Data was analyzed continually starting from the first interview and continued throughout the data collection period. One of the researchers listened to each interview several times and read each interview transcript repeatedly. Per tenets of grounded theory, the data analysis started by separating, sorting and synthesizing the data through open coding where each transcript was coded following the three stages of coding (Corbin & Strauss, 2008). During the first stage, the researcher sought to identify topics of particular interest or what Boyatzis (1998) refers to as codable moments resulting in 1,762 codes. The codes were next sorted and assigned to higher-level categories that included fragments with similar meaning. Next, I conducted axial coding (Saldaña, 2013) where the goal is to reassemble data that were “split” or “fractured” during the initial coding (Saldaña, 2013). The axial coding process resulted in 32 broad, theme-focused codes. The final coding step involved selective coding also referred to as theoretical Coding (Saldaña, 2013). During this phase, I focused on identifying key themes and cause-effect patterns in the coded material as to explain how post-mortems influence organizational learning (see Figure 3).

Figure 3. Coding Summary

Initial/Open Coding Sample - 1762 Codes

Access Limited to Team
Access to Only Your Project
Big Lessons Learn - Goes Up to Exec
Build Relationships
Changes Implemented Immediately
Collected & Reviewed Weekly
Communicate Via Transition Plan
Completed as A Formality
Conduct Daily Status Calls
Consensus Required to Apply Change
Considered a Project Artifact
Contacted Other PMs
Correct Mistakes and Keep Improving
Critical Component If Shared
Daily Retrospective
Everybody's Busy
Everyone Invested In Effort
Follow-up with Those Responsible for Taking Action
Hard to Condense from Multiple Teams
Hardly Conduct Lessons Learn
Implement Project Hand-Offs
Implemented PM On-Boarding
Included In PM Performance Plan
Issues Assigned to Responsible Party
Learn from Co-worker Experience
Learn from teammates
Lessons Learned Captured at Global Level
Lessons Learned Not Important Today
Lessons Learned Not Required
Leverage Friends for Support
Limited Use of LL Data
Made Available to All Partners
Make Information Available for Other PMs
Mentor Project Managers
Motivated to Learn to be Successful
Moved On After Project Ended
Moving Too Fast to Look Back
Nice to Have
No Active Analysis of LL
No Expectations Of Process
No Search Capability
Occur 60 Days After Project
Personal Approach to Learning
Personal Benefit
Personally Motivated to Leverage Experience
PM Meeting to Review Findings
PMO Can Access Department Projects
PMO Conducts Knowledge Sharing
Project Gets Better as Relationships Grow Stronger
Relationships Impact Feedback
Repositories Lay Dormant
Required to Store Lessons Learned
Retrofit Every Two Weeks
Review at End
Share In Program Manager Meeting
Share Lessons from Successful Projects
Share LL at Team Meetings
Shared with Project Manager
Sharing Experiences With Team
Used at Project Start-Up
View as Worthwhile Process
Wanted it to Be Over

→

Second/Axial Coding
32 Codes

Accountability
Assessment Throughout
Changed Role/Moved On
Communications
Company Culture
Compliance
Continuous Process Improvement
Driver for Change
Driver for Lesson Learn
Engagement
Formal Lessons Learn
Goal of Lesson Learn
Immediate Impact
Informal Lesson Learn
Input to Lesson Learn
Issue/Risk Management
Leadership Effectiveness
Leadership Engagement
Management Engagement/Support
Next Project
Organizational Change/Culture
Personal Development
Personal Motivation
PM Knowledge Share
Process Awareness/Education
Relationships
Role Clarity
Scalability
Stakeholders
Storage/Access
Team Cohesion
Teamwork

→

Third/Selective Coding
9 Codes

Accessibility
Communications
Improvement
Organization Culture
Personal Growth
Process
Project Issues
Relationships
Roles & Responsibility
Teamwork
Value

→

Emergent Themes

Opportunity
Incentive
Shared Vision

Findings

My findings suggest that the process and the effect of post-mortem practices on organizational learning are impacted largely by the lack of incentives to use the data, opportunities and weak mechanisms for sharing post-mortem knowledge. All these factors influence how project related knowledge is created, retained and transferred within and between IT projects.

Knowledge Creation

Conduct of post-mortems assumes that new knowledge is being created about project performance. Without any such knowledge to harvest, project post-mortems are deemed ineffective. However, knowledge is only created when there is sufficient opportunity to do so. Each participant recounted at least one experience in participating or facilitating a project post-mortem. Participants shared that project post-mortems occurred in various forms such as formal lessons learned sessions, informal lessons learned sessions, after action reviews, stakeholder analysis, and retrospectives. Lessons were captured related to the project budgeting process, project communications, training, requirements management, timeline, and resources. This suggests that there is sufficient opportunity for knowledge to be created and harvested if post-mortems are conducted diligently. The findings also suggest that significant challenges remain with regards to the amount of and quality of the knowledge created. Specifically, I observed a lack of incentives to harvest and use the information and poor timing of the project post-mortems that influences the overall quality and quantity of knowledge.

Finding 1: No Incentive to Use the Information Captured

Fourteen out of the twenty-five research participants noted that there is relatively limited value in the ‘recorded’ lessons. The activity was mostly completed ritually because it was an obligatory part of the project management process and the post-mortem was conducted just to “check the box.” The information created was not viewed valuable to the organization, and therefore, limited energy was put into the process. Mostly redundant or already known knowledge was recorded as part of a project ‘ritual’ with no intention of future use. One participant stated eloquently:

> “Honestly, it felt more of a waste of time, because you knew no one's ever going to view this document again and the project's already been implemented at that point, so the work's done. No one's ever going to use the document you're creating. It's almost a waste of time, which I think is why people aren't focusing on getting it done today.” (PM C Transcript, pp. 6–7)

Additionally, none of the organizations had systematic routines to use the information once it was captured during the project post-mortem. This resulted in the situation that occasionally valuable information was not used when new projects were started. Sixteen out of the twenty-five research participants shared that there was no requirement in their organization to share the information. Beyond the requirement to complete the project post-mortem, project members were not expected to go back to review the information collected from past projects. Additionally, the respondents indicated that there was no mechanism that would facilitate the transfer of the information collected. One reason is that most project and program managers are evaluated on whether or not they completed all project tasks on time. If there is no incentive in the project management methodology or within the organization to utilize the knowledge created as in other project steps, then little value is gained from the gathered information. Most of these used resources were wasted, and the learning was curtailed for future process improvement. One participant stated:

> "There is no edict that says every lesson, every project lessons learned needs to roll to the next project or the next set of projects, and the project manager's, program managers or portfolio leads need to incorporate those as part of their new projects." (PM E Transcript, p. 8)

Another participant shared the following:

> "However, we never put any mechanism in place that utilizes lessons learned. Basically, we put it on a shelf, and it collected dust because nobody looked at it ever again." (PM U Transcript, p. 8)

Finding 2: Timing – Project Post-Mortems are Conducted at the End of the Project

The formal post-mortems were always conducted at the end of the project. Most projects run by the project managers were twelve months or more in duration. Throughout this time, project team members come and go as they complete their assigned tasks. This resulted in low participation from project team members in the final post-mortem. Given that project team members typically engage only for the time required to complete their assigned task, many critical members were no longer available to participate in the project post-mortem. At the same time, remaining project team members did not remember all lessons that had been identified throughout the project. This impacted the project team's ability to create the sufficient knowledge to facilitate organizational learning. Nineteen out of the twenty-five people cited the timing of post-mortem as a barrier to the effectiveness of creating novel insights. One participant shared:

> "You'll lose the impact of what you learn when it's been nine to twelve months before you reviewed it, but if it's something where you can go back to and easily access, it could be valuable to success, whether it's a project or an entrepreneurial endeavor." (PM C Transcript, p. 11)

Another participant stated:

> "Everyone is tired, exhausted at each of those phases. You have a lot of people that feel like the project is in control because if you're doing a Lessons Learned, obviously, you have accomplished something. They really don't feel the urge to attend the meetings, so you tend to have a smaller audience and the audience that does attend, they may or may not pay attention or really be involved in the conversation." (PM D Transcript, p. 3)

Knowledge Retention

Organizations are expected to have a strategy for how the new knowledge created is made available for others. All of the study participants indicated that the project post-mortem documents were normally stored on some sort of project repository. However, most indicated that were challenges to access the post-mortem documents because they were not organized, indexed or annotated. Another finding is that the project and program managers often retain 'on the side' personal information about the project (in the form of notes, diaries, or memos) as to facilitate their own personal development.

Finding 3: Inaccessibility Limits Use

Global access to the lessons learned was rarely made available to others through an accessible document repository. Project team members were only granted access to the data repository for their specific project instead of global access to all projects. When asked about access to lessons learned from other projects, a research participant stated:

> "It's new and you upload your lessons learned to this document repository. Do you have access to see everybody's lessons learned document or just your project? Just my project or I would have to request access from the PM that owns another project to get that information." (PM G Transcript, p. 9)

Additionally, the data was not stored in a format that would allow for easy search and retrieval of specific information. Seventeen out of the twenty-five research participants noted inaccessibility to the lessons learned documents. This lack of access impacted the organization's ability for the knowledge transfer across project teams. One research participant shared:

> "…the challenge is finding a better way to really house that knowledge on a shared site or some type of document management site…" (PM D Transcript, p. 10)

Finding 4: Project and Program Managers Retain Information to Enhance Their Personal Learning

Project and Program Managers benefited most from project post-mortem exercises. In their role, they were held accountable that the project post-mortem was completed as part of the project management process. As a result, they became intimately familiar with the lessons captured during the process. This knowledge, however, was mostly used personally and the knowledge was personally invested and interpreted. Thirteen out of twenty-five research participants indeed mentioned that retaining the information captured as part of the lessons learned was used for their own personal development and growth. One participant shared:

> "Basically, at the end of projects, you have your lessons learned best practices session. What I would do, if there was something that was a best practice I would make sure I leveraged it for a new project. For instance, if conducting biweekly meetings was a best practice and my team seem to be engaged or it was better for their schedules, I would leverage that in a new project." (PM A Transcript, p. 3)
>
> Another respondent shared:
>
> "For me, it was imperative for me to learn and stack the types of things that I was learning on top of one another, so that I could be successful each time around, for each project. I think, to answer that question, for me, it was critical to take as much as I could from a previous project and use it in the current role to continue that process going forward" (PM C Transcript, p. 3)

Knowledge Transfer

Finding 5: Relationships and Project Narratives Facilitate Informal Learning through Post-Mortems

Knowledge transfer related to post-mortems occurred mostly through informal processes that relied on project manager's personal networks within the organization. Within these informal networks project managers shared a common vision for their project management team and peer groups and sought to work together to identify opportunities for improvement. In this regard, project managers shared their lessons with other project managers through informal knowledge dissemination activities such as ad hoc knowledge sharing sessions organized by the program management office or one one-on-one sessions with other project managers. Twenty out of the twenty-five participants reported participating in informal knowledge sharing sessions during which they shared the key lessons captured as part of the project post-mortems for the projects that they managed. During these sessions, the project managers also gained insights from the project post-mortem examples shared by other project managers within their team. One participant shared:

> "What I try to do in my team huddle/my direct meeting for my PM is talk about challenges and lessons learn that they have come across with their project. If I bring it up to my meeting, I have my project manager share their challenges of lessons learned in our meeting. That's how we leverage what we have today. Then, of course, the PMs, what they do is they actually use it towards this other project because our PMs carry anywhere between 5 to 10 projects at one time." (PM K Transcript, p. 13)

Additionally, some respondents noted that they often sought contextual and informal input from other project managers. This was driven by their personal desire to grow professionally and learn. They asked for feedback and guidance on how to solve specific issues that the other project manager had experienced and solved. One participant stated:

> "Say for instance I'm picking up a new group and I know the person who used to support them from a projects perspective, I would go talk to him. "Okay, I need to know what are your concerns? What issue did you see? What worked well?" Try to find someone if they're available to give you some information beforehand." (PM Y Transcript, p. 9)

Finding 6: Project Methodology Accentuates Learning

To what extent 'lessons learned' are interpreted and integrated into system work and how was primarily driven by the deployed project methodology. The few respondents who were involved in projects (2/25) that leveraged an agile methodology where port-mortems were a systematic part of each 'sprint' reported that lessons captured as part of their 'project post-mortem' were immediately integrated into their next round of project routines. For the agile projects, project post-mortems took the form of project retrospectives which were conducted every two weeks as part of sprints. They included feedback from the managers and project team members. A two week cycle of organizational learning rather than 12-month learning cycle resulted in continuous and fast-paced learning in which the knowledge was created, transferred and retained constantly via the project retrospectives. Action items were assigned to individual team members in which they were required to make the changes described in the lessons learned. Follow-ups to confirmed the resolution of each action item that was identified during the retrospective. The item stays on the agenda until it is resolved. In this approach, the team learns immediately from their past experience and implements corrective action immediately. One participant stated:

> "What we normally do is we have action items on the areas that we discussed that could be areas for improvement. We actually work out a plan.

> How could we have done it better? What could you guys have done to make it better? We assign action items to each individual that it's related to. When we have our next Retrospective, we discuss. We pull in the details from a previous meeting each time we discuss how well we applied those action items and those areas for improvement." (PM N Transcript, p. 5)

Discussion

Our findings contradict the widely held belief that project post-mortems are not conducted (Verner et al., 2008a). Through the interview of 25 project and program managers, 46 examples of project post-mortems were shared. Project teams perform project post-mortems as prescribed by the used development methodology. Project and program managers also identify lessons learned through their personal experiences and the personal experience of their peers. This contradicts what is identified through the literature where formal mechanisms are emphasized. Overall, the results of this study highlight the fact that outside the project and program manger's personal desire to learn from prior experience, organizational learning from project post-mortems is impacted by the lack of the infrastructure and incentives that would facilitate learning.

For such organizational learning to occur, outputs of project post-mortems need be embedded in the epistemological forms and artifacts that sustain concrete knowledge and behaviors embedded in project settings such as the maps, stories, and programs (Argyris & Schön, 1996). Implementation of such forms calls the organization to create and provide the motivations and the opportunities to learn from the information collected during project post-mortems (Argote & Miron-Spektor, 2011); this demands creating a context, which amplifies the organization's member's abilities, motivations and opportunities to engage in post-mortems and learn from them. Without the proper motivation to actually generate and use the information collected, project post-mortems will continue to be viewed as ‘check the box’ activities.

The opportunity to leverage the information collected as part of the project post-mortem must be available within the organization. “Members opportunities are affected by the organization’s structure and social network” (Argote, 1999: 40). Project and program managers can create opportunities to leverage the information based on their personal networks. However, this opportunity must exist within the larger organization. One step forward is that information collected should be made available to everyone and not just team members. Additionally, the project management approaches and development methodologies should be revised to incorporate continuous activities that facilitate the review and use of information collected as part of the project process. These changes would facilitate knowledge transfer and knowledge retention related to project execution.

Limitations and Implications for Future Research

As with any qualitative study, the research has limitations. First, though the information collected from the sampled population was rich and I reached empirical saturation, a more diversified sample across types of projects and settings might have resulted in more nuances. A large portion of the research participants (twenty out of twenty-five) worked in the financial services industry. Thus, not all findings may be generalizable to other project settings. Second, the study participants were limited to project and program managers. Learning within IT organizations involves several other stakeholders such as business analysts, software developers, and test leads. Including all team members in the sample and critical stakeholders within the respective organizations such as method and project management experts, heads of system development, tool specialists and so on would have helped obtain data on organizational learning in other relevant contexts as it relates to post-mortems.

This study contributes to the organizational learning literature by providing lived experience of project and program managers responsible for leading IT projects. I note that there are few incentives for project teams to leverage the detailed information collected during the process. A study to consider why organizations do not explicitly require the use of the information harvested will help understand reasons why project management practices do not change and how information is actually deployed in such contexts. Additional research on specific learning routines associated with project conduct across organizational settings that perform the same types of functions for information gathering, assimilation, interpretation, and deployment would extend this research by providing a richer perspective on what routines lead to the garnering and deployment of specific types of information. Understanding at more detailed level mechanisms that influence how post-mortem information is shared via informal channels would help organizations to improve learning contexts and provide opportunities that can significantly improve their project performance. Finally, I need to study individual and project level factors that influence to what extent project team members learn during the project as part of their project experience. This could provide a better understanding of how knowledge is identified and created in software projects and would help organizations establish better protocols for leveraging information for learning.

Conclusion

The urge to deliver information technology projects faster, cheaper and with higher quality demands organizations to engage in new technology projects that align with their operational or strategic objectives. This demands organizations to engage in a continuous learning process of how to execute and manage projects effectively. I found that lack of incentives, opportunities and weak mechanisms for sharing post-mortem knowledge are key barriers to generating and using project information for improved learning. These topics highlight the pivotal challenges related to learning during and from project post-mortems. I surmise that these topics will remain on the research agenda for a while as organizations continue to struggle to improve their project performance.

CHAPTER 3: WHAT EXPLAINS LEARNING DURING PROJECT EXECUTION IN INFORMATION TECHNOLOGY? A FIELD STUDY

Introduction

Learning through and from projects is increasingly important to an organizations' sustainability and competitive success (Brady & Davies, 2004; Sense, 2003). With many organizations relying on the deployment of IT/IS projects to further their strategic and organizational goals, it is critical for organizations to view IT/IS projects as a vehicle for learning. Learning as part of an IT/IS project aids in the development of the flexibility and adaptability organizations need in order to adjust to the environmental challenges in today's complex business world (Sense, 2003). Learning can lead to improvements in future project performance, better risk management and personal development and growth for project team members (Anbari et al., 2008; Kappelman et al., 2006; Lyytinen et al., 1996; Pinto & Mantel, 1990; The Standish Group, 2013; Verner, Sampson, & Cerpa, 2008b). In order for the learning to occur within the organization, project team members have to be viewed as a "learners as well as project task achievers" (Sense, 2003: 5).

By mastering the project learning cycle, companies could save on the costs associated with rework and the increase in time and effort due to the repetition of mistakes (Schindler & Eppler, 2003). To do so, they must rely on the individuals within the organization to create the knowledge from which they can benefit (Argote & Miron-Spektor, 2011; Becerra-Fernandez & Sabherwal, 2001; Dodgson, 1993; Nonaka, 1994). Accordingly, the prime movers in the process of organizational knowledge creation are the individuals who are committed to recreating the world in accordance with their own perspectives (Nonaka, 1994). Consequently, the organizational environment has to be structured in ways that encourage individuals to develop professionally and create knowledge. Dodgson (1993) suggests that an organization can facilitate individual learning by creating a climate in which its members are encouraged to learn and to develop their full potential.

The aim of this study is to investigate factors that facilitate individual project team member learning during IT/IS projects. Most of the literature related to knowledge and learning in IT/IS projects has been focused on the methods by which knowledge created on projects is harvested and less on whether project team members are actually learning (Anbari et al., 2008; Duffield & Whitty, 2015; Hartmann & Dorée, 2015; Schindler & Eppler, 2003). Project post-mortem practices, a method used to harvest project knowledge, have been considered the best practice for organizational learning in project contexts (Anbari et al., 2008; Duffield & Whitty, 2015; Hartmann & Dorée, 2015; Lyytinen et al., 1996; Verner et al., 2008b). However, even these project post-mortem practices are dependent upon the individual project member's effort to create the knowledge and learn. Prior research has shown that the key contributors to project post-mortem practices are the project and program managers (Pettiway & Lyytinen, 2017). In order for all project team members to contribute to the learning routines within a project, it is important that we understand what conditions facilitate knowledge creation and learning among all of the individual project team members. Our hypothesis is that the characteristics of the IT/IS project and the project team environment are significant in explaining how project team members are likely to learn. The specific research question that I explore in this study is: What explains the extent to which project team members learn while executing IT/IS projects?

Theoretical Background and Hypotheses

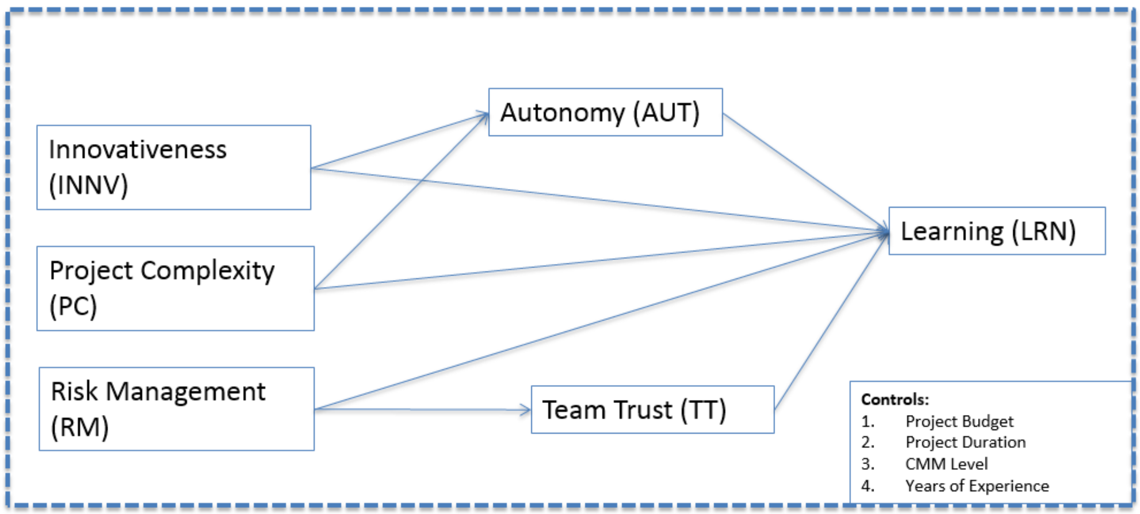
Argote and Miron-Spektor (2011) define organizational learning as “a change in the organization as the organization acquires experience” (p. 1124). This knowledge can manifest itself in changes in cognition or behavior and includes both explicit and tacit or difficult-to-articulate components. Argote and Miron-Spektor’s (2011) framework embodies a process that occurs over time via an on-going cycle through which task performance experience is converted into knowledge that in turn changes the organization’s context and affects future experience and performance (Argote & Miron-Spektor, 2011). Per Argote and Miron-Spektor (2011), experience interacts with the active and latent context as to create knowledge. The active context includes members, tools, and tasks and forms the context in which learning occurs. The nature of the IT/IS project tasks will dictate whether project team members learn by relying on and developing existing knowledge through process refinement or by developing new ideas which occur via experimentation, grafting and creative idea generation (March, 1991). The latent context influences the active context and includes psychological factors such as trust, feeling safe within a team, or autonomy (Argote & Miron-Spektor, 2011; Levin & Cross, 2004; Nonaka, 1994). Elements of the latent context in which members trust each other and have a positive perception of the team climate have been found to promote organizational learning (Argote & Miron-Spektor, 2011; Edmondson, 1999). In some cases, this will be the first and only time that the individual team members will work with each other. Therefore, it is important that there is a level of trust as the team members will be required to share responsibilities and work together to complete project tasks. Autonomy, another factor that forms the latent context, may be impacted by the prescriptive nature of the project management methodology chosen for the project. Hackman and Oldham (1975) as reported by Breaugh (1985: 553), define autonomy as "the degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out" has been shown to improve work performance. Innovation, another latent factor, is a way of thinking demonstrated through learning (Harkema, 2003) and is focused on generating new knowledge.

I posit that IT/IS project team members acquire and develop knowledge because of their project experience. The characteristics of the project and project team form the active context in which the project team executes the project and has the opportunity to learn. IT/IS projects are often described in terms of the project scope, project duration, project budget, the level of complexity and the associated routines. They involve the use of hardware, software, and networks in order to create a product or service (Schwalbe, 2015), the combination of which contributes to the level of complexity associated with the project.

Project complexity can have either a negative effect or a positive effect on the project, depending on the scope or aspects of the project that cannot be understood or the emergence of new opportunities (Vidal & Marle, 2008). Risk Management has been identified as a key factor in explaining improved project performance (Lyytinen et al., 1996) and is a standard IT/IS project management routine focused on identifying and mitigating project risks. The key impact of software risk management is to identify and heed on factors that influence adversely on project performance and thus provide techniques that help the project team to deal with them (Boehm, 1991; Lyytinen et al., 1996).

Given this backdrop of research and research question, I will frame the research model followed in this study as shown in Figure 4. The rationale supporting the hypothesized relationships between these model constructs is explained next.

Figure 4. Hypothesized Research Model



Effect of Innovativeness on Learning

Per Bates and Khasawneh (2005), both Kanter (1983) and Van de Ven (1986) we see IT/IS related project innovation as a process of generating, developing, and implementing new knowledge for the purpose of specific problem-solving in the context of project work. Working in a more innovative environment provides the project team members with the opportunity to create novel and new solutions for completing project tasks. This will require them to approach their tasks using trial and error deploying alternative strategies, or grafting in their search for a new solution strategy (Young, 2009). Being able to work in an environment supportive of innovation will provide the opportunity for the individual project team member to develop new knowledge.

Hypothesis 1a. Innovativeness (INNV) has a positive effect on Learning (LRN).

Effect of Project Complexity on Learning

Projects have certain critical characteristics that determine the appropriate actions to manage them. One of them is project complexity—organizational, technological, informational, etc.—consisting of many varied interrelated parts that have complicated, involved, intricate relationships and emergence (Baccarini, 1996). The level of complexity influences the selection of the expertise and experience requirements of project personnel. Complex projects are typically characterized by new and unfamiliar functional requirements that are difficult to implement and involve multiple technologies and technology groups creating opportunities for deeper learning of them. In complex projects, individual team members need to develop additional skills to overcome the challenges associated with the project complexity by performing a variety of tasks where some tasks have significant variation from previously performed tasks. Research suggests that increased task variety and variation lead to enhanced learning (Fong Boh et al., 2007; Schilling, Vidal, Ployhart, & Marangoni, 2003). Therefore, it is hypothesized that the complexity of the project has a positive effect on individual team member learning.

Hypothesis 1b. Project complexity (PC) has a positive effect on Learning (LRN).

Effect of Risk Management on Learning

Risk management involves the identification and mitigation of events and factors that influence negatively project performance. It is one of the key tactics employed by project teams to ensure improved project performance (Boehm, 1991; Chapman, 1997;

Raz et al., 2002; Tummala et al., 1997; Ward & Chapman, 1995). Even well planned, projects will face unforeseen issues and challenges that the project team must be prepared to manage. To successfully mitigate a project risk, however, the project team members must identify the appropriate strategy to mitigate the uncertainty (Chapman, 1997). This requires research and analysis and trial and error learning to select an appropriate risk mitigation strategy (Young, 2009). By participating in this process, the individual project team member is likely to broaden his or her knowledge not only as it relates to their project task, but also to tasks performed by others and their dependencies. This process exposes the individual project team member to multiple new ways of solving problems as diverse ideas are identified and tried out to reduce or eliminate the likelihood of the risk occurring. As the project seeks to mitigate project risks, the individuals are able to learn new concepts, theories, and skills related to project behaviors.

Hypothesis1c. Risk Management (RM) has a positive effect on Learning (LRN).

Mediating Role of Trust

One of the keys to improved project performance and the success of an end-to-end information technology project is the ability to coordinate effectively with the horizontal resources. To work effectively together, depends on the amount of trust that exist among team members. Learning is a collaborative process and relies on frequent social interactions among two or more parties through which knowledge is created and shared (Hartmann & Dorée, 2015). Under conditions of uncertainty and complexity (which is the case for many projects), requiring mutual adjustment, sustained effective, coordinated action is only possible when there is mutual confidence and/or trust (McAllister, 1995). "Trust enables people to take risks" (McAllister, 1995: 25) and risk-taking provides the individual project team members with an opportunity for internal growth which is aided by the social interactions with other members of the IT/IS project team. Therefore, it is hypothesized that trust partially mediates the effect of the relational climate on individual project team member learning.

Hypothesis 2. Team Trust (TT) partially mediates the positive effect of Risk Management (RM) on Learning (LRN).

Mediating Role of Autonomy

Autonomy, having the ability to originate and to some extent develop the ideas, processes, and procedures with which they work, allows individual team members to not only consider the use of predefined methods but also think creatively in their pursuit of solutions (Abbey & Dickson, 1983; Moore, 2000; Siegel & Kaemmerer, 1978). Allowing project members to act autonomously increases the possibility of conceiving unexpected outcomes which increases the possibility that individuals will create new knowledge (Nonaka, 1994). If the team has a high degree of autonomy over project decisions, team members are reliant upon themselves for task decisions, which will likely increase the sharing of information as well as the coordination of task activities horizontally within the team. Whereas without autonomy, team members' willingness to fully contribute their knowledge to the problem-solving process will likely decrease (Hoegl & Parboteeah, 2006).

Hypothesis 3a. Autonomy (AUT) partially mediates the positive effect of Innovativeness (INNV) on Learning (LRN).

Hypothesis 3b. Autonomy (AUT) partially mediates the positive effect of Project Complexity (PC) on Learning (LRN).

Research Design and Analysis

A quantitative study was designed to validate the research model of Figure 1 as to understand the impact of the innovativeness, project complexity, risk management, team trust and autonomy on individual project member learning. Our specific goal is to understand how these factors influences the individual project team member's ability to create knowledge as a result of their experience on an information technology project.

Measures

I identified scales to measure the constructs in the study using validated measures from the academic literature. These were adapted for the context of the study. All constructs are reflective with the exception of project complexity (Diamantopoulos & Siguaw, 2006; Diamantopoulos & Winklhofer, 2001; Jarvis, MacKenzie, & Podsakoff, 2003). The complete listing of the construct items and scales are provided in Appendix C. The definitions and measurements for learning, team trust, project complexity, risk management, innovativeness, and autonomy are introduced next.

Learning

Individual knowledge acquired during the project was measured by a 4-item scale answering the question: How do you rate the project and the software that was delivered on each of the following: knowledge of key technologies, knowledge of development techniques, knowledge about supporting user's business and overall knowledge? For our study, I adapted the questions to assess the extent of the increased knowledge as a result of working on the project. The answers range from "none at all" to "a great deal," and the information helps provide insight into the project performance as a measure of the learning that was acquired during the project (Nidumolu, 1995). The original Cronbach's alpha was 0.76.

Risk Management

The risk management 5-item scale taps into the extent of usage of risk management techniques including risk identification, probabilistic risk analysis, planning for uncertainty and trade-off analysis (Raz et al., 2002). The items measured these aspects on a 5-point scale ranging from "none at all" to "a great deal." The Cronbach's alpha value for the multi-scale risk management items exceeded 0.70.

Project Complexity

The Complexity scale measures the four dimensions of information systems development project (ISDP) complexity (Xia & Lee, 2005). I leveraged the scales measuring structural organizational complexity (SORG) and structural IT complexity (SIT) for my study. SORG is defined as the multiplicity and interdependency of organizational elements of an ISDP and SIT refers to the multiplicity and interdependency of technological elements. The composite reliability for the SORG scale was reported as 0.68 and 0.76 for the SIT scale. The scale contained 4 items for SORG and 2 items for SIT.

Innovativeness

Innovativeness captures the openness to new ideas as an aspect of the project performance (Hurley & Hult, 1998). This construct was measured using a 5-item scale employed by Hurley and Hult. The items are measured on a 7-point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (7). The Cronbach alpha equal 0.82.

Trust

The Interpersonal Trust scale measures the level of team trust and includes demographic items, dyadic trust items, and items assessing the focal employee's performance. Specifically, McAllister's (1995) five items measuring affect-based trust (e.g., "We have a sharing relationship; we can share our ideas, feelings, and hopes") and six items measuring cognitive-based trust (e.g., "This person approaches his/her job with professionalism and dedication") were used to assess the focal employee's trust level of his or her supervisor and co-workers. For the purpose of our study, I focused on the six items measuring cognitive-based trust. The items are measured on a 7-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7). McAllister (1995) reported a reliability estimate (Cronbach's alphas) for cognitive-based trust of .91 which is above the recommended limit of 0.70 (Hair, Black, Babin, & Anderson, 2010).

Autonomy

Autonomy is assessed by a four-item scale used by Younts and Mueller (2001). This scale provides insight into the degree of autonomy allowed project team members on the job. The items are measured on a 7-point Likert scale ranging from "strongly disagree" to "strongly agree." Younts and Mueller (2001) reported a reliability estimate (Cronbach alpha) for the scale at .82.

Controls

I used several controls including years of experience, project duration, project budget and the Capability Maturity Model Level (CMM) of the project. Years of experience was operationalized as the number of years the project team member has worked in their role (e.g., project manager, business analyst, developer). Project duration reflected the length of the current project in terms of months. Project budget represented the project budget in U.S. dollars. The CMM level relates to the degree of formality and optimization of processes from ad hoc practices to formally defined steps, to managed result metrics, and to active optimization of the processes (Herbsleb, Zubrow, Goldenson, Hayes, & Paulk, 1997; Paulk, Curtis, Chrissis, & Weber, 1993). All measures of IT project team members are self-reports which do not always provide valid and reliable results due to the presence of social and selection biases. To address this concern, I added social desirability questions, which were later used as a marker variable in measuring the level common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Instrument Development

To validate and refine the survey instrument, I conducted a Q-Sort (Nahm, Rao, Solis-Galvan, & Ragu-Nathan, 2002). Construct items were randomly presented to a panel of five participants to evaluate whether the items would be grouped in the manner suggested by the scale originators. Based on the results of the Q-sort and the noted occurrence of cross-loadings of items I refined and removed several items from the original scale. The first round achieved a hit ratio of 71.1%. A total of six items were removed (six items from Project Complexity) due to the cross loading onto other constructs. The second and final round achieved a hit ratio of 94% for all items for all constructs across the five-panel participants. Following the Q-sort, I conducted a pre-test using an online survey, which was distributed through Qualtrics to a five-person panel. The participants included professionals with experience working on information technology projects. I reviewed the instrument as well as the respondent answers to ensure understanding of the questions matched our construct goals (Schwarz, 1999). The respondents provided feedback relating to the wording of the questions and sequencing. Based on the results I made wording changes to improve the clarity. For the four questions related to the Learning construct, I modified the questions to start with "To what extent did your knowledge…" instead of starting with "How do you rate the project on the knowledge you acquired about…" Additionally, I modified the question related to project duration to have the participants select the duration from a scale instead of allowing free-form entry of the answer. Similarly, I modified the question related to project budget to have the participants select from a range of options instead of allowing free-form entry of the answer. Other changes included bolding the consent question to indicate importance and starting a new page for each group of questions.

Data Collection

Qualtrics tool (Link to Qualtrics: https://www.qualtrics.com/) was used to collect the data for this study. The survey was directed towards professionals who worked as members of a project team responsible for the end-to-end implementation of an information technology project. Participants were identified via the personal network of the primary researcher utilizing social media such as LinkedIn and Facebook. Skip logic was used to screen out respondents who did not meet the criteria and a forced response logic was used to reduce opportunities for respondents missing questions. Distribution of the survey to contacts in the primary researcher's personal network netted 65 responses. To supplement this dataset, Qualtrics online panel services was used to target participants who met the criteria of the study. Qualtrics administrators were responsible for eliminating respondents who did not match the target sample group, as well as omitting participants who failed to complete the survey or failed the attention check questions. Out of the 1,449 respondents surveyed by Qualtrics, there were 313 who failed the attention checks, 28 who did not consent to the survey, 483 who did not meet the criteria, two who completed the survey too fast and 23 who attempted to complete the survey after the quota had been met. Overall, I reached a total of 600 project team members who successfully completed the survey which resulted in a total sample of 665 surveys. Study participants included project managers, business analysts and project developers. There were 366 male participants and 234 female participants. The participants were all twenty-five and over and had a variety of experience. See Table 3 for the demographic details of the study participants.

Table 3. Demographics of Study Participants

Demographics	Category	Number	Percentage
Gender	Male	389	60%
	Female	258	40%
Age	< 25	20	3%
	25 - 34	207	32%
	35-44	189	29%
	45-54	142	22%
	55-64	76	12%
	> 65	13	2%
Education	< High School	1	0%
	High School Graduate	21	3%
	Some College	39	6%
	2 Year Degree	36	6%
	4 Year Degree	344	53%
	Master's Degree	186	29%
	Doctorate	20	3%
Role	Project Manager	289	45%
	Business Analyst	73	11%
	Software Developer	220	34%
	Other	65	10%
Experience	< 5	115	18%
	5-10	198	31%
	10-15	154	24%
	15-20	87	13%
	20-25	50	8%
	> 25	43	7%

To ensure the compatibility of the data collected via the Qualtrics panel and the data collected via the researcher's personal network, I conducted a Levene's Homogeneity of Variance Test. A variable was created to represent the two groups of data collected (1=Qualtrics Panel and 2=Personal Network). Using SPSS 24.0, I conducted the Levene's test to determine if the distribution of variables differed across the two groups. The results of the test indicated the samples are the same with the exception of only one variable LRN_2 (p-value = .042) being different between the two groups. See Appendix D for the complete results.

I screened the data for missing data, unengaged responses, outliers, and normality (skewness and kurtosis) using IBM SPSS 24.0 and Microsoft Excel. The dataset was examined for missing data and outliers (Hair et al., 2010). There were eighteen responses with more than 20% of the questions left unanswered. Those responses were deleted which left us with a final data set of 647 responses. One variable (PC1) had two values missing in this set which were imputed using the median values of nearby points in SPSS (Hair et al., 2010). A visual inspection of data did not identify any patterns of unengaged responses within the data set, and skewness and kurtosis tests revealed no skewness or kurtosis.

Measurement Model

An Exploratory Factor Analysis (EFA) was conducted (Hair et al., 2010) through several iterations resulting in the expected five-factor pattern matrix. The final pattern matrix was achieved by using Maximum Likelihood extraction, Promax rotation and evaluating the eigenvalues greater than 1.0. The solution explained approximately 61.15% of the variance, a Bartlett's test (Chi-Square 7452.947, df 210, p = .000) and a

KMO of 0.923 were acceptable. The reproduced matrix had 0 (0.0%) nonredundant residuals with absolute values greater than 0.05. All factor loadings were greater than 0.611 demonstrating convergent validity and all inter-factor correlations were less than 0.7 (Hair et al., 2010) demonstrating discriminant validity. The Cronbach's alpha for each factor was above 0.70 (Cronbach, 1951) which is an indication of high reliability. One item with a negative loading (TT_6) was removed. The final pattern matrix and Cronbach-alpha scores are included in Appendix E.

A Confirmatory Factor Analysis (CFA) was conducted using IBM SPSS AMOS version 24 using the EFA solution as the input. The CFA model had excellent fit with X^2=328.646, df=179, CMIN/DF=1.836 (Kline, 1998), CFI=0.980 (Byrne, 1994; Hu & Bentler, 1998), RMSEA=0.036 and PCLOSE=1 (Hu & Bentler, 1998) and SRMR=0.0348 (Hair et al., 2010). Table 2 summarizes average variance extracted and construct reliability. All factors exceed the threshold (> .50) for AVE (Hair et al., 2010) which is evidence of convergent validity. All composite reliability (CR) values exceed 0.7 (Hair, 2010). The AVE for each factor was greater than the inter-construct squared correlations estimates (Hair et al., 2010) which is evidence of discriminant validity.

Table 4. Construct Validity and Reliability

	CR	AVE	MSV	AUT	TT	RM	LRN	OI
AUT	0.803	0.507	0.456	**0.712**				
TT	0.884	0.606	0.361	0.588	**0.778**			
RM	0.879	0.593	0.359	0.274	0.385	**0.770**		
LRN	0.855	0.595	0.359	0.344	0.374	0.599	**0.772**	
OI	0.903	0.756	0.456	0.675	0.601	0.461	0.435	**0.870**

Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV)

Because project complexity was formative, I created a separate proxy variable (PC_Proxy) to represent project complexity. I added the items related to SORG and SIT (PC1 – PC6) to generate the proxy variable.

I tested for common method bias by examining a common latent factor (CLF) impact on model invariance. The CLF model was also augmented with Social Desirability items as a marker variable. A X^2 difference test between the unconstrained common latent factor model (X^2=466.658; df =258) and a fully constrained (zero constrained) common latent factor model (X^2=676.657; df = 284) were significantly different suggesting significant shared variance. Therefore, I retained the common latent factor in the structural model by imputing composite factor scores to the final model.

Finally, multicollinearity was evaluated by generating values for tolerance and its inverse, the variance inflation factor (VIF). Tolerance values below 0.2 and VIF values above 3 are viewed to indicate the presence of multicollinearity (Hair et al., 2010). All values of tolerance and VIF values were well within acceptable limits.

Structural Model

The hypothesized relationships were tested using covariance-based structural equation modeling. I created three structural models using the common method bias-adjusted factor values based on our research model. Our initial model (M1) included the control variables with the goal of understanding the effect on our dependent variable. In order to achieve a model with good model fit, the path between Prj_Budget and Learning was trimmed. The effect was not significant (p-value = 0.055) and trimming the path allowed us to gain an additional degree of freedom (df). The resulting model achieved adequate model fit (X^2=3.681; df=1; CMIN/DF=3.681; CFI=0.986; RMSEA=0.064;

PCLOSE=0.259 and SRMR=0.0167). The second model (M2) included the direct effects along with the controls and had a good model fit (X^2=0.513; df=1; CMIN/DF=0.513; CFI=1; RMSEA=0; PCLOSE=0.734 and SRMR=0.0030). The final model (M3) included the controls, direct effects, and mediators. This initial model (M3) did not demonstrate adequate model fit and an assessment of the modification indices indicated a need to co-vary the errors terms between Team Trust and Autonomy and articulate a new model specification to regress Team Trust on Innovativeness resulting in a good model fit (X^2=14.495; df=5; CMIN/DF=2.899; CFI=0.994; RMSEA=0.054; PCLOSE=0.362 and SRMR=0.0140). M3, the mediated model, produced the best model fit and represents a model that best explains the variance of learning. This model was to test all of the hypotheses.

Table 5 reflects the regression coefficients, significances, variance explained, and model fit for each model.

Table 5. Multiple Regression Analysis

Hyp.	Variables		Learning (LRN) M1	M2	M3
	Controls				
		Prj_Budget	Trimmed	N/A	N/A
		Prj_Duration	0.174***	0.038 (ns)	0.038**
		CMM Level	-0.108**	0.058 (ns)	0.056 (ns)
		Yrs_Exp	-0.175***	-0.102***	0.111***
	Direct Effects				
H1a	Innovativeness	INNV		0.164***	0.044 (ns)
H1b	Project Complexity	PC		0.073*	0.067*
H1c	Risk Management	RM		0.53***	0.538***
	Indirect Effects				
H2	Team Trust Mediates RM --> LRN	RM -> TT -> LRN			0.006 (ns)
H3a	Autonomy Mediates Innv --> LRN	INNV -> AUT -> LRN			0.069**
H3b	Autonomy Mediates PC_Proxy --> LRN	PC_Proxy -> AUT -> LRN			0.001 (ns)
		R^2	0.072	0.428	0.449
		ΔR^2		0.356	0.021
				Model Fit	
		X^2	3.681	0.513	14.495
		df	1	1	5
		CMIN	3.681	0.513	2.899
		CFI	0.986	1	0.994
		RMSEA	0.064	0	0.054
		Pclose	0.259	0.734	0.362
		SRMR	0.0167	0.003	0.014

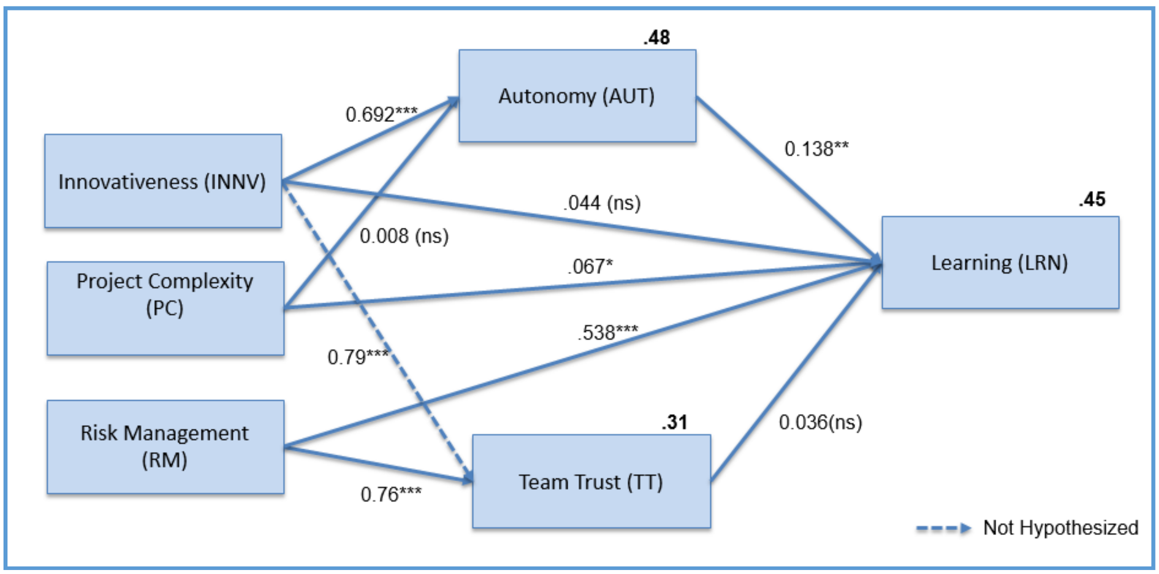
*p=<.05; **p=<.01; ***p=<.001; ns=not significant

To test for mediation, I utilized the user-defined estimand found on Gaskination's Statwiki (Gaskin, 2016) to test if there was a significant indirect effect between the path from RM→TT (which I labeled A in the estimand) and the path from TT→LRN (which I labeled B in the estimand) (Falk & Biesanz, 2016). Bootstrapping was used along with the user-defined estimand. The number of bootstrap samples was set to 2000 and I opted for bias-corrected confidence intervals. The confidence level was set to 90. The results of the analysis showed that TT did not mediate the positive effect between RM and LRN with a p-value=0.349 and β=0.006. Using the same approach as described above, I found that AUT mediates the positive effect of INNV on LRN with a p-value=0.003 and β=0.069 and that AUT does not mediate the relationship between PC and LRN (p-value=0.629 and β=0.001).

Findings

The findings of SEM analyses are presented below and are interpreted from the mediated model (M3). The structural equation model with the estimates is reflected in Figure 5 below.

Figure 5. Structural Equation Model



Direct Effects

Hypothesis 1 which asserts that Innovativeness has a positive effect on learning is **not supported** (β=0.044, p-value=0.311). **Hypothesis 2**, which posits that Project Complexity has a positive effect on learning is **supported** (β=0.067, p-value=0.033). **Hypothesis 3**, which asserts that the Risk Management has a direct effect on Learning was **supported** (β= 0.538, p-value < 0.001).

Table 6. Hypothesized Direct Effects

Hypothesized Direct Effects - Results

Hypothesis	Evidence	Supported
Hypothesis 1a: Innovativeness (INNV) has a positive effect on Learning (LRN)	Direct: 0.044 (ns)	No
Hypothesis 1b: Project complexity (PC) has a positive effect on Learning (LRN).	Direct: 0.067*	Yes
Hypothesis 1c: Risk Management (RM) has a positive effect on Learning (LRN).	Direct: 0.538***	Yes

***p=<.05; **p=<.01; ***p=<.001; ns=not significant**

Mediating Effects

Hypothesis 2 (Team Trust (TT) partially mediated the relationship between Risk Management (RM) and Learning (LRN)) was **not supported** (β=0.006, p-value=0.349) and **Hypothesis 3b** (Autonomy (AUT) partially mediated the relationship between Project Complexity (PC) and Learning (LRN)) was **not supported** (β=0.001, p-value=0.629). **Hypothesis 3a** (Autonomy (AUT) partially mediated the relationship between Innovativeness (INNV) and Learning (LRN) was **supported**. The results showed that AUT fully mediated the relationship (β=0.069, p-value=0.003) as Innovativeness (INNV) did not have a significant direct effect (β=0.044, p-value=0.311).

Table 7. Mediating Effects

Mediating Effects - Results

Hypothesis	Evidence	Supported
Hypothesis 2: Team Trust (TT) partially mediates the positive effect of Risk Management (RM) on Learning (LRN).	Indirect Effects: 0.006 (ns)	No
Hypothesis 3a: Autonomy (AUT) partially mediates the positive effect of Innovativeness (INNV) on Learning (LRN).	Indirect Effects: 0.069**	Yes - Full Mediation
Hypothesis 3b: Autonomy (AUT) partially mediates the positive effect of Project Complexity (PC) on Learning (LRN).	Indirect Effects: 0.001 (ns)	No

***p=<.05; **p=<.01; ***p=<.001; ns=not significant**

Years of Experience (Yrs_Exp) was shown to have significant effects on Learning (LRN) (β=-0.111, p-value<0.001). Project Duration (Prj_Duration) (β=0.038, p-value=0.217) and the Capability Maturity Level (CMM_LVL) (β=0.056, p-value=0.069) were both shown to have an insignificant effect. The impact of the controls is summarized in Table 5 above.

Discussion

The goal of this study is to contribute to the literature on organizational learning and identify factors that facilitate project member learning within the context of IT/IS projects given organizational and individual learning is frequently mentioned in the literature as a key to increased organizational success. This study focused specifically on understanding what factors facilitates learning among project team members responsible for the end-to-end implementation of an IT/IS project. As suggested by Argote and Miron-Spektor (2011), project team members are learning because of their task performance experience.

One of the most surprising results of this study is that Innovativeness (H1a) was not shown to have a significant impact on project team member learning. In a culture that is open to and receptive to innovation, resources are encouraged and empowered to explore new and original ways of completing their work, which includes instances of trial and error from which learning can occur. Post-hoc analysis on a multi-group level between project management methodology and project duration found there to be no difference in the effect of Innovativeness on Learning across the groups. Autonomy (H3a), however, was found to fully mediate the relationship between innovativeness and learning. This has key implications for management of IT/IS projects. Understanding that resources need to have the freedom to explore options for completing assigned tasks which can, in turn, lead to learning can help inform decisions regarding how prescriptive the work should be. Post-hoc analysis on a multi-group level between project duration found the relationship between AUT and LRN to be stronger for projects that were longer than a year, which suggests that projects that are shorter in length may not be the ideal environment to facilitate learning.

Project Complexity (H1b) was shown to have a small but significant impact on project team member learning. Complexity has to be addressed throughout the life of the project and can manifest in a variety of different forms. In some instances, factors that were initially perceived to be complex are easily resolved which does not result in a learning opportunity. Autonomy (3b) partially mediates the relationship between Project Complexity Management and learning. Trial and error learning has been identified as a method for addressing project complexity (Sommer & Loch, 2004) and with the unplanned nature of trial and error activities; autonomy empowers the resources to address the complexity.

The research empirically supports the argument that Risk Management (H1c) has a positive impact on project team member learning. Not surprising, is that the impact of this independent variable on the dependent variable was the strongest. Risk management is one of the key project management routines and the activities span the life of the project. This would suggest that project team members would learn because of engaging in this process. Typically, project post-mortems are used to harvest project learnings (Pettiway & Lyytinen, 2017); however, the results would suggest that the information documented and tracked as part of the risk mitigation plans should also be harvested and mined for key learnings from projects.

What is particularly interesting is that the data did not support the argument that Team Trust (H2) mediates the relationship between risk management and project team member learning. This contradicts what I found in the literature that suggests that trust is central to an effort that requires collaboration and the sharing of knowledge such as risk management (Barczak et al., 2010; Park & Lee, 2014). However, risk management routines are highly visible and are managed with a high degree of rigor which may reduce the importance of trust that is required.

Limitations and Future Research

The overall goal of this study was to identify the factors that facilitate learning while implementing a project—specifically, an IT/IS project. Although there were significant findings, there are limitations that should be taken into consideration. First, a proxy variable was created to measure the formative construct of project complexity. The use of a reflective measure to assess project complexity may have generated different results. Secondly, this study is not longitudinal and does not measure cognitive or behavioral changes in the participant over time. The only assessment of whether learning has occurred is the participant's response to the questions related to learning on the survey. I have no way of knowing if the participants were honest in their responses.

The study took into consideration all project team members. Future research could focus on understanding if there is a project team role that learns more than the other and if the project management methodology influences learning. This could be a function of the type of tasks that some project team members are asked to perform versus the others.

Another item to consider is to evaluate what additional IT/IS project activities would facilitate learning (e.g., requirements definition, high and low-level design, testing etc.). This study only focused on Risk Management.

The context of this study was IT/IS projects. Additional studies could focus on projects outside of this space (e.g., marketing, human resources). There is the potential that environmental factors within a different domain could have a different impact on project member learning.

Conclusion

Information Technology has long been searching for the silver bullet to being able to deliver projects on time, on budget and per specification. The literature often cites organizational learning and leveraging lessons from experiences as the key to process improvement and continued sustainable success. However, the key to being able to successfully capture lessons from experiences requires that all members of the project team are learning as part of the process. This study evaluated the antecedents to learning as part of an IT/IS project in an attempt to provide insight that would be helpful to technology leadership and management teams. Risk Management and Project Complexity were shown to have a direct impact on project team member learning whereas the impact of Innovativeness was mediated by autonomy. Autonomy was also shown to partially mediate the effect of Project Complexity. With Autonomy mediating the relationship between learning and two of the antecedents (innovativeness and project complexity), organizations and management of IT/IS project teams should consider whether or not their organizational culture encourages autonomy among project resources. While the results and findings can help with a better understanding of ways to structure the work environment and project activities, it is our hope that this research will serve as a platform for future research in the area of learning while implementing IT/IS projects.

CHAPTER 4: DOES LEARNING PROMOTE INNOVATION DURING IT/IS PROJECTS?

Introduction

Innovation is considered essential to organizational competitiveness and survival (Harkema, 2003; Hogan & Coote, 2014; Koberg, Detienne, & Heppard, 2003; Sarin & McDermott, 2003; Timmermans, Van Linge, Van Petegem, Van Rompaey, & Denekens, 2012b; Zheng, 2010). Generally, it involves identifying and employing new ways of organizing and accomplishing a task (Timmermans et al., 2012b). With the increased competition that organizations face across industries, innovation allows organizations to increase and maintain their competitive edge (Damanpour & Schneider, 2006; Koberg et al., 2003). The innovativeness of an organization depends on a large number of environmental and organizational characteristics (Bates & Khasawneh, 2005; Damanpour & Schneider, 2006; Hogan & Coote, 2014; Hurley & Hult, 1998; Miller & Brankovic, 2011). For example, Hurley and Hult (1998) studied 9,648 employees from 56 professions within a large research and development agency in the US federal government and found that learning and development were significant factors influencing the innovativeness of a group. Learning as part of a project team includes completing project tasks and moreover taking time to reflect and adjusting processes. This can result in the team improving upon an existing process or creating an entirely new way of accomplishing a task. This change, either radical or incremental, in the process is considered an innovation (Harkema, 2003). In my 2017 research, I found that all project team members experienced learning as part of an IT/IS project (Pettiway, 2017). However, learning as part of a project team can occur at different levels for project team members and it is significantly influenced by the project team leaders given they help to create the work climate and influence the behavior of the individual team members (Sarin & McDermott, 2003). As the key informants on a project (Bartsch et al., 2013) and as a result of having the overall responsibility for the project, project leaders are viewed as having the most in-depth knowledge about the project content and outcomes and are better positioned to facilitate project to organization innovation (Akgün, Dayan, & Di Benedetto, 2008; Damanpour & Schneider, 2006).

Multiple studies have discussed the value of learning during IT/IS projects and the processes through which learning takes place and related challenges (Decuyper et al., 2010; Edmondson & Nembhard, 2009; Pettiway, 2017; Pettiway & Lyytinen, 2017; Van der Haar, Segers, & Jehn, 2013). Studies have also discussed outcomes of project-based learning such as project performance and team satisfaction (Arumugam et al., 2013; Edmondson & Nembhard, 2009; Nembhard & Tucker, 2011). Many of these studies have been conducted within the context of new product development (Akgün et al., 2008; Edmondson & Nembhard, 2009; Sarin & McDermott, 2003), healthcare (Edmondson, 2003; Nembhard & Tucker, 2011), ERP (Yeh & Chou, 2005), nursing (Timmermans, Van Linge, Van Petegem, & Denekens, 2012a) and electronic vehicles (Midler & Beaume, 2010). Innovation has also been considered an outcome of project-based learning (Harkema, 2003; Lynn, Skov, & Abel, 1999; Timmermans et al., 2012a; Timmermans et al., 2012b). Sarin and McDermott (2003) empirically show that learning as part of new product development teams increases the capacity of the team to improve the level of innovation. I am particularly interested in this outcome as it pertains to IT/IS projects as limited research has considered innovation as an outcome to learning within the context of IT/IS projects.

In addition to learning as part of the IT/IS project, the characteristics of the project and the environment in which the project unfolds influences the level of innovativeness that exits within the organization. Project complexity is associated with one of four project characteristics including size, variety of project system, interdependence and context is another environmental factor that has an influence on innovation (Vidal & Marle, 2008).

Innovation is an outcome of multiple and frequent exchanges among project team members during which knowledge is shared and studies show effective communication is the fuel for those interactions. In addition to facilitating the exchange of information, team communications help to increase the degree of knowledge sharing in IT/IS projects (Lee et al., 2015). Trust is also another factor in the team interactions and knowledge sharing. Park and Lee (2014) found that team members share their knowledge when there is trust among their team.

The goal of this study is to examine the effect of learning as part of a project on innovativeness within the context of IT/IS projects. Our hypothesis is that the characteristics of an IT/IS project and the environment in which the project is executed can facilitate innovation. The specific research question that I explore in this study is: What impact does learning as part of an IT/IS project have on the level of innovativeness that exist within the organization? Next, I present the theoretical background and hypotheses that guide the analysis of the questions that this study seeks to answer. The hypothesized model that reflects the relationships between innovativeness and learning, team communication, team trust and project complexity is presented followed by a discussion on the measures used as part of the survey and the data collection. The results of the quantitative analysis are detailed followed by a discussion including study limitations and implications for practice.

Theoretical Background and Hypotheses

Innovation can be defined as the adoption of an idea, knowledge, and behavior or practice new to the organization (Bates & Khasawneh, 2005; Damanpour & Schneider, 2006; Harkema, 2003: 216; Hurley & Hult, 1998). For the purposes of this study, I define innovation as “an ongoing process involving numerous people, and a means of value creation that relies on a system-wide approach to new ways of doing business” (Miller & Brankovic, 2011: 52). This study draws upon the work of Hurley and Hult (1998) that says a learning-oriented culture, which places an emphasis on individual learning and development, promotes a receptivity to new ideas and innovation as part of an organization's culture. The study also shows that a supportive and collaborative culture promotes innovation by helping to reduce fear and to increase openness, which encourages new ideas and risk-taking. More recently, Hogan and Coote (2014) found in their study of 100 principals within law firms, those cultural norms that include expectations of open communication and co-operation support innovation. Miller and Brankovic (2011) interviewed Chief Innovation Officers (CIOs) at 22 multinational corporations to learn what they identified as antecedents to innovation. Their findings include sharing and exchanging ideas as a key antecedent. They also found trust to be a key factor in getting people to cooperate on innovation. “Trust is an expectation that others will behave as expected…” (Barczak et al., 2010: 334) and when trust is present it increases the willingness of team members to confidently share knowledge with one another (Maurer, Bartsch, & Ebers, 2011; Park & Lee, 2014). In this way, trust increases knowledge transfer which contributes to innovation (Barczak et al., 2010; Lee, Park, & Lee, 2013; Maurer et al., 2011; Miller & Brankovic, 2011; Newell, Tansley, & Huang, 2004).

I posit that IT/IS projects are well suited to encourage and promote innovation. IT/IS projects involve heterogeneous teams consisting of groups of individuals each with a unique and diverse skill set (Newell et al., 2004) that are brought together to create value for an organization following a project management methodology. Innovation in the IT/IS project can take the form of a new product, service, process, policy, structure or a new technology (Damanpour & Schneider, 2006; Harkema, 2003). Accordingly, IT/IS project teams are charged with creating new products or services for the organization's customers and in many instances also new processes are created during the project (Newell et al., 2004).

Effect of Learning on Innovativeness

Learning has been shown to be an antecedent to innovation (Alegre & Chiva, 2008; Harkema, 2003; Jiménez-Jiménez & Sanz-Valle, 2011; Sarin & McDermott, 2003). Harkema (2003) argues that learning forms an essential mechanism contributing to innovation given that learning increases the creativity and knowledge of employees. In a 2011 study that included a sample of 1600 firms in the southeast region of Spain with more than 15 employees, Jimenez-Jimenez & Sanz-Valle (2011) found that organizational learning has a positive effect on innovation. IT/IS project teams are routinely assembled to develop and deploy solutions aligned to one or more of the corporate strategies. Resources with specific skills are assembled into a team tasked with creating and implementing the solution required. As part of this process, team members leverage their existing knowledge to complete the tasks assigned to them as well as develop and learn new skills to complete their tasks which in turn result in the development of novel ideas and minor as well as major changes in the way the project team approach IT/IS projects.

Hypothesis 1a. Learning (LRN) has a positive direct effect on Innovativeness (INNV).

Effect of Team Communication on Innovativeness

On-going communication has been identified as a facilitator of learning, innovation and promoting the propensity to innovation. Effective communication among team members increases collective understanding and leads to increases in knowledge and in knowledge sharing (Lee et al., 2015). Leeuwis and Aarts (2011) suggest that we should not look at communication as a means to transfer and effectuate knowledge and innovation from the top down, but also look at its potential and characteristics in the process of constructing innovations as an outcome of ongoing societal interaction (p. 4). Communication is dependent on interactions among parties and occurs as part of one of the many meetings that occur during IT/IS projects. IT/IS project team members meet routinely to discuss the status of the project, review project artifacts and resolve project issues and risks.

Hypothesis 1b. Team Communication (TC) has a positive effect on Innovativeness (INNV).

Effect of Project Complexity on Innovativeness

Project complexity manifests the ways in which many varied interrelated parts influence one another during a project execution (Baccarini, 1996) and is measured in terms of differentiation and interdependency, affects the project team’s ability to innovate. Project complexity can be associated with the number of and relationships between organizational units involved in the project and/or the number of systems and technologies. Sommer and Loch (2004) argue that trial and error learning, an unplanned adjustment in response to emerging information, is one such method used by project teams to manage complexity. The more complex the project, the more project team members are required to coordinate, communicate and collaborate as to arrive at a solution which in turn can lead to or promote innovation (Sommer & Loch, 2004). Therefore, it is hypothesized that project complexity has a positive effect on Innovativeness.

Hypothesis 1c. Project Complexity (PC) has a positive effect on Innovativeness (INNV).

Mediating Role of Learning

Innovation includes the process of learning and serves to explain the relationship between certain variables and increased performance (Kalmuk & Acar, 2015). To that end, learning not only has a direct positive effect on innovativeness, learning also serves as an intervening variable between project complexity and innovativeness as well as team communication and innovativeness. Learning helps organizations to build the knowledge and skills necessary to address complexity. In a study of 32 new product development (NPD) participants, Kim and Wilemon (2007) found that the participants learned when examining ways to address complexity. Central to this process is the communication that takes place among the team which involves creating and sharing of information for the purpose of increasing the level of shared understanding among project team members (Lee et al., 2015).

Hypothesis 2a. Learning (LRN) partially mediates the positive effect of Team Communication (TC) on Innovativeness (INNV).

Hypothesis 2b. Learning (LRN) partially mediates the positive effect of Project Complexity (PC) on Innovativeness (INNV).

Mediating Role of Trust

"Innovation requires acquiring knowledge and sharing it within an organization" (Kalmuk & Acar, 2015: 167). Knowledge sharing is heavily dependent on the frequent and effective communication among IT/IS project team members. This communication occurs as part of project team meetings, email exchanges or as part of the review of project artifacts created by individual team members (e.g. requirements, design, test plans, etc.). Over time, project team members can come to either have confidence in the information shared or will question the information being shared. With confidence in the information being communicated, project team members come to develop trust in the knowledge and skill set of others on the team. In project teams, both affective trust (the confidence one places in a team member based on one's feelings of caring and concern illustrated by that co-worker) and cognitive trust (based on one's willingness to rely on a team member's expertise and reliability) increases the team's ability to work together (Barczak et al., 2010). "Trust enables people to take risks" (McAllister, 1995: 25) and risk-taking provides the project team the opportunity to explore a variety of alternatives in their quest to implement a solution. This results in the team identifying and creating innovative ways to meet the demands of their project.

Hypothesis 3a. Team Trust (TT) partially mediates the positive effect of Learning (LRN) on Innovativeness (INNV).

Hypothesis 3b. Team Trust (TT) partially mediates the positive effect of Team Communication (TC) on Innovativeness (INNV).

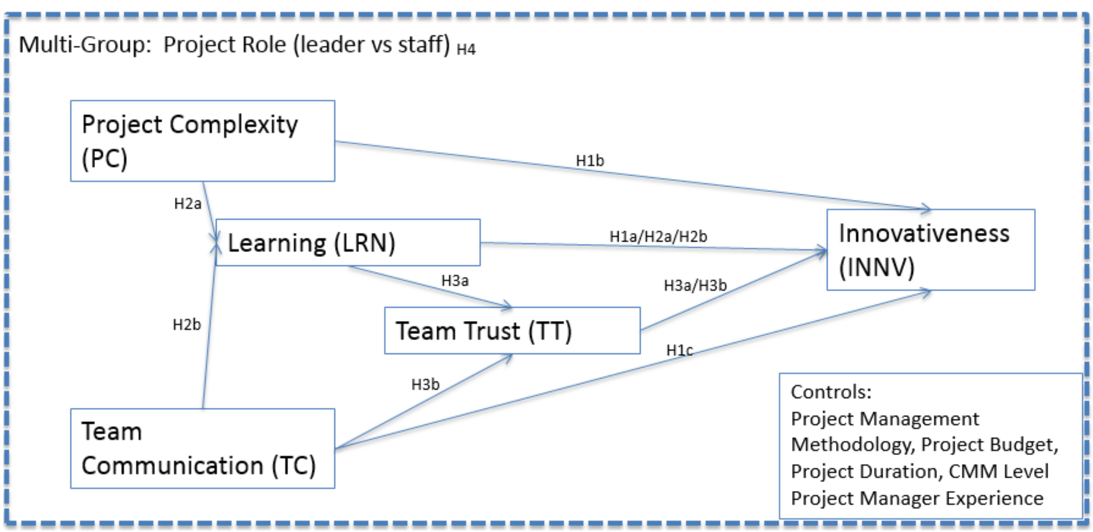
Moderating Role of Project Member Role (Leadership vs. Staff)

Research has shown that leaders play a pivotal role in influencing organizational capabilities such as innovation (Akgün, Lynn, & Yılmaz, 2006; Damanpour & Schneider, 2006; Sarin & McDermott, 2003). Not only do leaders play a huge role in setting the culture and establishing the capacity for innovation within an organization, they must actively participate in the process. By actively participating, project leaders must participate in the learning process that occurs within the team. Substantial innovation requires there to be significant learning as innovation is considered an outcome of the learning process (Sarin & McDermott, 2003). In order to effectively influence innovation within the project and at the organization level, project leaders are expected to possess the most complete knowledge about the project and the innovations that originate within the project.

Hypothesis 4. The positive relationship between Learning (LRN) and Innovativeness (INNV) is strengthened for IT/IS project leaders compared to IT/IS project staff resources.

The hypothesized research model (Figure 6) is reflected.

Figure 6. Hypothesized Research Model



Research Design and Analysis

The goal of this study is to evaluate innovation as an outcome to learning as part of an IT/IS project. To understand the relationship between team communication and innovation, learning and innovation and project complexity and innovation, I designed a quantitative survey to capture feedback from professionals who work as part of an IT/IS project.

Measures

I searched the literature to find previously validated scales to operationalize the key constructs in my study. Some of the scales were used as-is and others were adapted for the purposes of this study through slight modifications. The constructs included in this study are Team Communication, Project Complexity, Learning, Team Trust, and Innovativeness. Project Complexity is the only scale that is formative, all others are reflective in that they are interchangeable and have a common theme (Diamantopoulos & Siguaw, 2006; Diamantopoulos & Winklhofer, 2001; Jarvis et al., 2003). Formative constructs are a composite of multiple measures and changes in the formative measures cause changes in the underlying construct (Jarvis et al., 2003; Petter, Straub, & Rai, 2007). A summary of the constructs is included in Appendix F.

Team Communication

The scale used to measure Team Communication was adapted from Watson and Michaelsen (1988) who studied group interaction behaviors that affect group performance. The scale measures whether team members feel that they can state their opinions, thoughts, and feelings without fear. The questions were modified to read "every project team member" instead of "everyone" and was measured on a 7-point Likert scale ranging from ‘strongly disagree’ (1) to ‘strongly agree’ (7). Watson and Michaelsen (1988) measured the five-item scale on a 5-point Likert scale with Cronbach’s alpha of 0.77.

Project Complexity

Project Complexity is defined as the multiplicity and interdependency of technological elements of an information systems development project (Xia & Lee, 2005) and the Complexity scale measures the key dimensions of information systems development project (ISDP) complexity including structural organizational complexity, structural IT complexity, dynamic organizational complexity, and dynamic IT complexity. For the purposes of this study, I leveraged the six items used to measure structural organizational complexity (SORG) and structural IT complexity (SIT). The composite reliability for the SORG scale was reported as 0.68 which is close to the minimum reliability of 0.70 (Hair et al., 2010). However, the composite reliability for the SIT scale was reported as 0.76.

Learning

Individual knowledge acquired by project team members during the execution of the IT/IS project was measured using a scale adapted from Nidumolu (1995). The four questions were modified to assess the extent of the increased knowledge as a result of working on the project. The answers range from “none at all” to “a great deal,” and the information helps provide insight into the project performance as a measure of the learning that was acquired during the project (Nidumolu, 1995). The original Cronbach’s alpha was 0.76.

Team Trust

The Interpersonal Trust scale (McAllister, 1995) measures individual beliefs about peer reliability and dependability. The questions were modified to assess the team versus the individual. Instead of phrasing the questions in terms of "this person," the questions were adjusted to state "project team." The six items are measured on a 7-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7). McAllister (1995) reported a reliability estimate (Cronbach's alphas) for cognitive-based trust of .91 which is above the recommended limit of 0.70 (Hair et al., 2010).

Innovativeness

Innovativeness captures the openness to new ideas as an aspect of the project performance (Hurley & Hult, 1998). The scale was adapted to be measured on a 7-point Likert scale as opposed to a 5-point Likert scale. The five-item scale asked, "if the organization readily accepted innovation, if management actively sought innovative ideas, if innovation was readily accepted and if people were penalized for new innovative ideas that didn't work." The responses ranged from 'strongly disagree' (1) to 'strongly agree' (7). The Cronbach alpha equal 0.82.

Controls

The Project Management Methodology used to manage an IT/IS project has been shown to influence the project and project outcomes (Charvat, 2003). The survey participants were asked to select the Project Management Methodology used to manage their project one of four options listed.

Project Budget, Project Duration and Years of experience data was collected. Project Budget was reported in terms of the seven ranges presented to the survey participants. Participants were asked to select the Project Duration in terms of months from the scale that was provided. Years of experience was operationalized as the number of years the project team member has worked in their role (e.g., project manager, business analyst, developer).

CMM Level, the level relates to the degree of formality and optimization of processes from ad hoc practices to formally defined steps, to managed result metrics, and to active optimization of the processes (Herbsleb et al., 1997; Paulk et al., 1993) was included as a control as well. Participants were asked to select the CMM level for their organization from five options ranging from 1 being the lowest of maturity, to 5 being the highest level of maturity.

Self-reported measures, as in the case of the IT/IS project team members, are vulnerable to social and selection biases, which can lead to invalid and unreliable results. A social desirability construct was included in order to address this concern and during the data analysis, this construct was used as a marker variable to assess the level of common method variance (Podsakoff et al., 2003).

Instrument Development

Prior to launching the data collection, the survey instrument was tested to ensure the survey was designed to capture the data needed for the study. We conducted a Q-Sort and the survey was pre-tested. For the Q-Sort, I enlisted a panel of five participants to sort the questionnaire items according to different constructs (Nahm et al., 2002). A hit ratio of 71.1% was calculated for the first round and a hit ration of 94% was calculated for the second and final round. The results of the first round displayed cross-loadings, which led to the removal of several items.

I conducted a pre-test as the next step in testing the instrument. Using Qualtrics software, I distributed the online survey to a panel of five participants who were familiar with and had experience working on IT/IS projects. Feedback from the panel provided guidance on how to edit the survey in order to ensure the participants understanding of the questions would match the construct definition (Schwarz, 1999). To refine the survey, I edited the framing of questions and bolded the survey consent question in order to make it stand out.

Data Collection

Data was collected using Qualtrics software (Link to Qualtrics: https://www.qualtrics.com/). Professionals in the IT/IS field who had experience as a member of an IT/IS project team. The survey was launched via direct emails to qualified participants in the primary researcher's personal network and via the primary researcher's social media accounts on LinkedIn and Facebook. Sixty-five survey responses were received as a result of the personal outreach. In order to reach the desired sample size, additional study participants were obtained by using Qualtrics online panel services. Qualtrics administrators identified, screened and managed the data collection from 1,449 respondents. Responses from participants who did not meet the criteria for the survey and from participants who did not complete the survey or who failed the attention checks were excluded. The resulting number of quality surveys obtained via Qualtrics panel surveys totaled 600, which brought the overall total to 665. See Table 8 for the demographic details of the study participants.

Table 8. Demographics of Study Participants

Demographics	Category	Number	Percentage
Gender	Male	389	60%
	Female	258	40%
Age	< 25	20	3%
	25 - 34	207	32%
	35-44	189	29%
	45-54	142	22%
	55-64	76	12%
	> 65	13	2%
Education	< High School	1	0%
	High School Graduate	21	3%
	Some College	39	6%
	2 Year Degree	36	6%
	4 Year Degree	344	53%
	Master's Degree	186	29%
	Doctorate	20	3%
Role	Project Manager	289	45%
	Business Analyst	73	11%
	Software Developer	220	34%
	Other	65	10%
Experience	< 5	115	18%
	5-10	198	31%
	10-15	154	24%
	15-20	87	13%
	20-25	50	8%
	> 25	43	7%

Given that I collected data across two different groups, a Levene's Homogeneity of Variance test was performed to assess the equality of variances for the variables calculated for the two groups. A variable was created to represent the two groups of data collected (1=Qualtrics Panel and 2=Personal Network) and the test was performed using SPSS 24.0. The results indicate there is one variable (LRN_2 p-value = .042) that violates the homogeneity of variance assumption. See Appendix G for the complete results.

Data Screening

I began our data analysis by first screening the data to ensure completeness. Using IBM SPSS 24.0. and Microsoft Excel, I checked for missing data, unengaged responses, outliers, and normality (skewness and kurtosis) (Hair et al., 2010). Eighteen responses were deleted from the dataset due to having more than 20% of the questions left unanswered, which is above the standard of 10% or more (Hair et al., 2010). The new total for our sample is 647. In inspecting for missing data in columns, I identified the variable PC_1 as having two missing values. The missing values were imputed using the median values of nearby points in SPSS (Hair et al., 2010).

I tested for skewness and kurtosis and identified two variables as having kurtosis values greater than the standard of 2 (George & Mallery, 2016). PC_1 had a value of 3.263 and TC_5 had a value of 3.692. However, given the size of our dataset, 647 items, I opted to monitor those items rather than transform data for our measurement model test (Hair et al., 2010).

Exploratory Factor Analysis (EFA)

For the next step in our analysis, I used IBM SPSS 24.0 to perform an Exploratory Factor Analysis (EFA) to determine the correlation among the variables and to obtain a factor structure (Costello & Osborne, 2005; Hair et al., 2010). The specifications for our EFA included Maximum Likelihood extraction and Promax rotation. After four iterations, I obtained the expected four-factor pattern matrix that produced acceptable values for the Bartlett's test ($X^2 = 6116.892$, df 120, p = .000) and KMO (0.918) and all communalities were greater than 0.30 which demonstrated adequacy. The resulting four factors all had eigenvalues greater than one and the Total

Variance Explained equaled 64.18%. The reproduced matrix had 0 (0.0%) nonredundant residuals with absolute values greater than 0.05. Convergent validity was evident with all factor loadings being greater than 0.5 and discriminant validity was evident with there being no strong cross-loadings (Hair et al., 2010). The Cronbach's alpha for each factor was above 0.70 (Cronbach, 1951) which is an indication of high reliability. Four items were removed during the analysis. TT_6 was removed due to a negative loading, TC_5 was removed due to cross loading and OI_4 and OI_5 were removed due to loading on a separate factor from the other items in the construct. The final pattern matrix and Cronbach-alpha scores are included in Appendix I.

Project complexity. In order to include our only formative construct project complexity, in the SEM analysis, a proxy variable was created. To calculate the proxy value, the values for PC_1, PC_2, PC_3, PC_4, PC_5, and PC_6 were added together to get the PC_Score.

Confirmatory Factor Analysis (CFA)

A Confirmatory Factor Analysis (CFA) was conducted using IBM SPSS AMOS version 24 using the resulting pattern matrix from the EFA. The results of the CFA revealed that the model had adequate fit with X^2=191.041, df=98, CMIN/DF=1.949 (Kline, 1998), CFI =0.985 (Byrne, 1994; Hu & Bentler, 1998), RMSEA=0.038 and PCLOS =0.992 (Hu & Bentler, 1998) and SRMR=0.0307 (Hair et al., 2010).

Validity and reliability. Convergent validity and discriminate validity was demonstrated by the average variance extracted (AVE) for all factors being > .50 and the AVE for each factor being greater than the inter-construct squared correlations estimates (Hair et al., 2010). All factors have a composite reliability (CR) value that exceeded 0.7

which confirmed reliability (Hair et al., 2010). Table 9 summarizes the validity and reliability results.

Table 9. Construct Validity and Reliability

	CR	AVE	MSV	TC	TT	LRN	INNV
TC	0.869	0.625	0.561	**0.791**			
TT	0.885	0.606	0.561	0.749	**0.778**		
LRN	0.835	0.628	0.194	0.362	0.367	**0.792**	
INNV	0.903	0.756	0.364	0.592	0.603	0.441	**0.870**

Composite Reliability (CR), Average Variance Extracted (AVE) - # in bold on the diagonal is square root of AVE

Maximum Shared Variance (MSV)

Invariance. I performed a configural invariance test by analyzing a freely estimated model across the two groups included in our casual model (leaders vs. staff). The model had adequate model fit (X^2=353.046, df=196, CMIN/DF=1.801 (Kline, 1998), CFI=0.974 (Byrne, 1994; Hu & Bentler, 1998), RMSEA=0.035 and PCLOSE=1 (Hu & Bentler, 1998) and SRMR=0.0411 (Hair et al., 2010) and obtained adequate goodness of fit when analyzing a freely estimated model across our two groups (leaders vs. staff). Next, I conducted a metric invariance test by constraining the two models to be equal and performed a chi-square difference test between the unconstrained and fully constrained models. I found the models to be variant as a result of a significant p-value (0.003). I checked the path differences and identified LRN_3 as the path with the largest difference. LRN_3 was removed from the model and the metric invariance test was conducted again and the models were found to be invariant (p-value=0.458). The final model had acceptable fit (X^2=166.214, df=84, CMIN/DF =1.979 (Kline, 1998), CFI = 0.986 (Byrne, 1994; Hu & Bentler, 1998), RMSEA=0.039 and PCLOSE=0.983 (Hu & Bentler, 1998) and SRMR=0.0302 (Hair et al., 2010).

Common method bias. A test for common method bias was conducted by examining a common latent factor (CLF) model augmented with a Social Desirability construct as a marker variable. A X^2 difference test between the unconstrained common latent factor model where variables were allowed freely estimate (X^2=253.800; df=140) and a fully constrained common latent factor model where all variables were set to zero (X^2=429.101; df=160) were significantly different suggesting significant shared variance. Therefore, I retained the common latent factor in the structural model by imputing composite factor scores to the final model.

Multicollinearity. Multicollinearity, which is the extent to which a variable can be explained by another variable in the analysis, was evaluated by generating values for tolerance and its inverse, the variance inflation factor (VIF). Tolerance values below 0.2 and VIF values above 3 are viewed to indicate the presence of multicollinearity (Hair et al., 2010). All values of tolerance and VIF values were well within acceptable limits.

Table 10. Multicollinearity Analysis on Predictor Variables

	Collinearity Statistics	
Predictor	Tolerance	VIF
TC	0.497	2.012
LRN	0.908	1.101
TT	0.500	1.998
PC_Score	0.937	1.067

Structural Model

Next, in our analysis, I sought to explore the hypothesized relationships depicted in our model using covariance-based structural equation modeling. Using the common method bias-adjusted factor values, I created four structural path models. The first model (M1), included only the control variables and the second model (M2), included only the direct paths. M1 was created to determine what effect our control variables had on our dependent variable. M2 was used to evaluate how the independent variables impacted our dependent variable. The third model (M3) included the direct effects along with the control variables. M3 was used as the base for the last model (M4). This model included the direct effects, controls and the mediator to test for mediation.

To test for mediation, I utilized the user-defined estimand created by James Gaskin of Statwiki (Gaskin, 2016) to test if there was a significant indirect effect between the path from TC→LRN (which I labeled A in the estimand) and the path from LRN→INNV (which I labeled B in the estimand) (Falk & Biesanz, 2016). Bootstrapping was used along with the user-defined estimand. The number of bootstrap samples was set to 2000 and I opted for bias-corrected confidence intervals. The confidence level was set to 90. The results of the analysis showed that LRN mediates the positive effect between TC and INNV with a p-value=0.006 and β=0.044. Using the same approach as described above, I found that LRN mediates the positive effect of PC on INNV with a p-value=0.002 and β=0.021 and that TT mediates the relationship between TC and INNV (p-value=0.012 and β=0.205). However, the results showed that there was not a significant indirect effect between the path from LRN→TT and the path from TT→INNV (p-value=0.082 and β=0.015).

Using the mediated model (M4), I next conducted a multi-group analysis to determine if the effect of LRN on INNV was different for project leaders as opposed to project staff. I conducted a chi-square difference test in which I compared an unconstrained model to a model with the path between LRN and INNV set equal across the two groups. The results indicated that the model is no different between the two groups (X^2=0.079, df=1, p-value=0.779).

The mediated model (M4) represents a model that best explains the variance of innovation and the model with the best model fit with (X^2=7.768, df=4, CMIN/DF =1.942 (Kline, 1998), CFI=0.996 (Byrne, 1994; Hu & Bentler, 1998), RMSEA=0.08 and PCLOSE =0.63 (Hu & Bentler, 1998) and SRMR=0.0109 (Hair et al., 2010). The model fit for models M1, M2 and M3 was not accessed as there were no degrees of freedom.

Findings

The findings of SEM analyses are presented below and are interpreted from the mediated model (M4). See Appendix I for the structural equation model with the estimates.

Direct Effects

Two of the three direct effects hypotheses were supported by the analysis. **Hypothesis 1a**, which asserts that Learning (LRN) has a positive direct effect on Innovativeness (INNV) was **supported** (β=0.175, p-value < 0.001). **Hypothesis 1b**, which posits Project Complexity (PC) has a positive direct effect on Innovativeness (INNV) is **not supported** (β=0.005, p-value=0.888). **Hypothesis 1c** asserted that Team Communication (TC) has a positive direct effect on Innovativeness (INNV) is **supported** with a β=0.255 and p-value less than 0.001.

Table 11. Hypothesized Direct Effects

Hypothesized Direct Effects - Results

Hypothesis	Evidence	Supported
Hypothesis 1a. Learning (LRN) has a positive effect on Innovativeness (INNV).	Direct: 0.175***	Yes
Hypothesis 1b. Project Complexity (PC) has a positive effect on Innovativeness (INNV).	Direct: 0.005 (ns)	No
Hypothesis 1c. Team Communication (TC) has a positive effect on Innovativeness (INNV).	Direct: 0.255***	Yes

***p=<.05; **p=<.01; ***p=<.001; ns=not significant**

Mediating Effects

I found **support** for **Hypothesis 2a** (Learning (LRN) partially mediated the relationship between Team Communication and Innovativeness (INNV) (β=0.044, p=0.006) and **Hypothesis 3b** (Team Trust (TT) partially mediated the relationship between Team Communication (TC) and Innovativeness (INNV) (β=0.205, p=0.012). **Hypothesis 2b** (Learning (LRN) partially mediated the relationship between Project Complexity (PC) and Innovativeness (INNV)) was **supported and the analysis** showed that Learning (LRN) fully mediated the relationship (β=0.021, p=0.002) as Project Complexity (PC) did not have a significant direct effect (β=0.005, p=0.888) on Innovativeness (INNV). **Hypothesis 3a** was **not supported**. Team Trust (TT) was shown to not have a significant indirect effect on the relationship between Learning (LRN) and Innovativeness (INNV) (β=0.015, p=0.082).

Table 12. Mediating Effects

Mediating Effects

Hypothesis	**Evidence**	**Supported**
Hypothesis 2a. Learning (LRN) partially mediates the positive effect of Team Communication (TC) on Innovativeness (INNV).	Indirect Effects: 0.044**	Yes
Hypothesis 2b. Learning (LRN) partially mediates the positive effect of Project Complexity (PC) on Innovativeness (INNV).	Indirect Effects: 0.021**	Yes; Full Mediation
Hypothesis 3a. Team Trust (TT) partially mediates the positive effect of Learning (LRN) on Innovativeness (INNV).	Indirect Effects: 0.015 (ns)	No
Hypothesis 3b. Team Trust (TT) partially mediates the positive effect of Team Communication (TC) on Innovativeness (INNV).	Indirect Effects: 0.205*	Yes

***p=<.05; **p=<.01; ***p=<.001**

Hypothesis 4 posited that the relationship between Learning (LRN) and Innovativeness (INNV) was stronger for IT/IS project leaders compared to IT/IS project staff resources. This hypothesis was **not supported** per the results of the chi-square difference test (X^2=0.079, df=1, p-value=0779).

Table 13. Multi-Group Analysis

Multi-Group

Hypothesis	**Evidence**	**Supported**
Hypothesis 4. The relationship between Learning (LRN) and Innovativeness (INNV) is strengthened for IT/IS project leaders compared to IT/IS project staff resources.	ΔX^2=0.079; p-value=0.779 (ns)	No

***p=<.05; **p=<.01; ***p=<.001**

The only control which was shown to have a significant impact was Prj_Mthd (β= 0.103, p-value < 0.003). The remaining controls, Prj_Duration, CMM_Level, and Yrs_Experience were shown to have insignificant effects on INNV. The impact of the controls and the changes in R^2 are summarized in Table 14.

Table 14. Controls and R^2 Summary

	Innovativeness			
Controls	**M1**	**M2**	**M3**	**M4**
Prj_Mthd	0.097 (ns)		0.102**	0.103**
Prj_Budget	0.004 (ns)		-0.009 (ns)	-0.01
Prj_Duration	0.055 (ns)		0.036 (ns)	0.048 (ns)
CMM Level	-0.086*		-0.05(ns)	-0.055 (ns)
Yrs_Exp	-0.049 (ns)		-0.039 (ns)	0.039 (ns)
R^2	0.021	0.243	0.257	0.284
ΔR^2		0.222	0.014	0.027

***p=<.05; **p=<.01; ***p=<.001; ns=not significant**

Discussion

The goal of this study is to contribute to the literature on project-based learning by studying innovation as an outcome to project learning within the context of IT/IS projects.

The value of project-based learning and team learning as a form of organizational learning has been frequently mentioned in the literature (Decuyper et al., 2010; Kim & Wilemon, 2007; Pettiway, 2017), which has consistently referenced innovation as the key to an organization maintaining a competitive edge. This study focused specifically on understanding what factors facilitate innovation as part of an IT/IS project. Prior literature has shown that project learning, communication and trust were antecedents to innovation in other contexts (Hogan & Coote, 2014; Lynn et al., 1999; Sarin & McDermott, 2003; Timmermans et al., 2012b). I posited that the same would hold true for IT/IS projects.

The analysis showed that learning and team communication had a significant positive direct effect on innovativeness. This is consistent with the literature (Barczak et al., 2010; Park & Lee, 2014) that includes communication and trust among the antecedents for knowledge transfer, which leads to innovation. Team communication was shown to have the largest impact on innovativeness, which is not surprising given the frequency in which IT/IS project teams engage in interactions by way of status meetings, design sessions, and risk management routines. The impact of learning on innovativeness in IT/IS projects is again consistent with that of prior research conducted in different contexts. As IT/IS project teams identify solutions to problems that have not been previously encountered, they work to identify the solution which can involve learning a new skill or process.

The results of our study show that project complexity does not have a significant direct effect on innovativeness. Rather, the effect is fully mediated by learning, thereby suggesting that if there is no learning from solving the project issues related to complexity, there is no impact on innovation. This is one of the most salient findings of this study given that prior literature (Ashby, 1956; Van de Ven, 1986) has identified complexity as a key source for innovation. Project resources are assigned to projects based on a match between the skills the project requires and the skills that they possess. Thus, in some instances, complexity may not lead to an opportunity to learn as the knowledge that is needed to address the issues resulting from the project complexity, may already be contained within the team.

One of the most surprising results of this study is that there is no difference in the effect of learning on innovativeness for project leaders when comparing to project staff. It was my hypothesis that the impact would be stronger for project leaders due to their responsibility for the overall IT/IS project and their being involved in every aspect of the project. The results do not support this argument and challenge the literature that suggests project leadership have more of an influence on innovativeness (Damanpour & Schneider, 2006). While the result is surprising, this is a very useful fact for organizations. This suggests that organizations should expand who they look to for creating, gathering and harvesting project knowledge. Organizations should look equally to all IT/IS project team members as the source of new knowledge and promoters of innovation.

Limitations and Future Research

The overall goal of this study was to identify the impact of learning as part of an IT/IS project on innovativeness. Although the results support the argument that learning as part of IT/IS projects can promote innovation, the study did not measure the amount or type of innovation that occurs. Rather, the study measured whether or not innovation was part of the culture in which the IT/IS project was executed. Another limitation of the study is that not all components of an IT/IS project were considered. This study focused only on communication, trust, learning, and complexity. Other components of an IT/IS project such as risk management should be studied as well.

This study also sought to understand if the effect of learning on innovativeness was stronger for project leaders when compared to project staff. Future research could explore multi-group comparisons by evaluating different project management methodologies. Being able to identify which project management methodology has the strongest impact on innovativeness will assist organizations focused on innovation in selecting the best methodology.

Conclusion

Innovation has been identified as key to organizational success and a key factor in creating and maintaining a competitive edge and as such, organizations should look to leverage every opportunity to innovate within their operations. With the increasing use of projects to organize work and to implement key strategies, projects are well positioned for learning to occur which can lead to innovation. This study evaluated the components of an IT/IS project that encourage innovation. Our goal in doing so was to contribute to the literature and to provide empirical evidence to IT/IS leadership and management of IT/IS projects being a conduit to innovation. It is our hope that by providing this evidence senior technology leaders will expand their concept of IT/IS projects and look for ways to create a culture of learning and innovation around these projects.

CHAPTER 5: CONCLUSION

Introduction

The overall purpose of this thesis is to explore the processes, antecedents, and outcomes of learning within the context of IT/IS projects. To accomplish that, a three-part sequential exploratory mixed methods study was designed and executed. The results from each study are presented in Chapters 2–4 of this dissertation. These results provide insights into learning phenomena that challenge and contribute to the existing literature on organizational learning, team learning and IT/IS project management. This concluding chapter provides an overview of the integrated findings, limitations of the study, highlight implications for practice and discusses areas for future research.

Integrated Discussion

This study was fueled by my experience in the IT/IS field. I began my career over twenty-five years ago as a software developer (back then we were called computer programmers) and have had subsequent roles as a QA Lead, Business Analyst, Technology Delivery Manager, Project Manager and a Program Manager. One consistent observation that I have had throughout all of these roles is that all of the IT/IS projects that I have been engaged in have faced similar challenges. The lingering question that this has triggered for me and the question that I set out to answer with this study is why is learning not a focus of project initiatives? More specifically, the primary question that I formulated for this study is: What facilitates project-based learning during IT/IS projects and what are the outcomes of these learnings? Smith and Young (2009) suggest that questions of organizational learning be explored at multiple levels—the organization, the team and the individual. Heeding that guidance, this study was designed to answer the research question by evaluating the learning processes, antecedents, and outcomes at the IT/IS project team level, from the perspective of the individual project team member and by examining the learning outcomes within the organization. The collective findings from this study have helped to answer the central question by identifying the profile for the learning IT/IS project.

Learning Process

One of the goals of this research was to understand what learning routines if any existed within IT/IS projects. Specifically, I wanted to understand the outcomes of those routines and to identify the barriers that impacted their effectiveness. As I theorized, the results of this study show opportunities for learning exist within IT/IS projects and that they are inherent in the project management methodology guiding the project.

In Study 1, I evaluated the role of project post-mortems on the IT/IS team learning process and by capturing the lived experiences of project managers and program managers of end-to-end IT/IS project teams through qualitative semi-structured interviews, I was able to note the knowledge management (e.g., knowledge creation, knowledge transfer and knowledge retention) routines associated with project post-mortems and the circumstances that influenced the usefulness. In the second study, I evaluated the effect of risk management, which is also a routine inherent in the IT/IS project management methodology, on individual IT/IS project team member learning and risk management was shown to have a direct positive influence on learning. In both cases, the project team member's task experience is converted into knowledge through IT/IS project routines that serve as learning processes, which is consistent with the literature (Argote, 1999; Nonaka, 1994).

With project post-mortems, project team members are asked to reflect on their project experience to identify key learnings, whereas, risk management activities are forward thinking and require the project team member to hypothesize about potential project risks and to identify the appropriate risk mitigation plan. The effectiveness of both processes requires the participation of all individual project team members, which supports the organizational learning literature that speaks to the individual being key to the learning activities within the organization (Argote & Miron-Spektor, 2011; Becerra-Fernandez & Sabherwal, 2001; Dodgson, 1993; Nonaka, 1994). Stories from the qualitative study depicting effective learning cycles of knowledge creation, knowledge transfer and knowledge retention, included the individual project or program manager contributing to and leading the efforts.

Antecedents to Learning

Given the importance of individual learning on team/organizational learning, I wanted to understand what factors influence individual learning in IT/IS project teams. The findings highlight the importance of problem solving opportunities that lead to the creation of new knowledge, interpersonal relationships and incentives on the effectiveness of learning routines.

I created and tested quantitative models of learning as a function of the various characteristics of an IT/IS projects. With regard to the active context of learning, which includes project tasks (Argote & Miron-Spektor, 2011), I found that risk management and project complexity have direct positive effects on individual learning, and that learning fully mediated the effect of project complexity on innovativeness. The findings support support and extend the literature on knowledge created from task experience (Nonaka,

1994) by illuminating the importance of complex project tasks leading to individual team members creating knowledge (Argote, 1999) beyond their congenital knowledge (Huber, 1991). For some projects, team members can rely on their congenital knowledge to complete their assigned project task(s). In this instance, individual project team member learning will not occur. Per Huber (1991), congenital knowledge is a combination of the knowledge project team members acquired prior to starting on the project and the information they are provided at the start of the project. In creating this additional knowledge, project members participate in experiential learning, which is a result of intentional, systematic efforts (Huber 1991).

In evaluating the influence of the latent context (Argote & Miron-Spektor, 2011) on individual learning, I found that team trust and team communication were antecedents to individual learning as part of the IT/IS project. These factors are all associated with the interpersonal connections and assist project team members in feeling safe within a team (Edmondson, 1999). The relationships the project and program managers had with other project and program managers facilitated knowledge transfer (Levin & Cross, 2004) using the information collected as part of the project post-mortems, which further supports the notion that learning is a social process (Hartmann & Dorée, 2015).

I also found that learning has to be motivated. Project and Program managers were personally motivated to retain knowledge in an effort to increase their skill set. However, the study participants shared in almost every interview that the knowledge created as part of the project post-mortems was not leveraged by the team or within the organization because there was no project or individual performance incentive associated with doing so. In Latin, motivation means to move or act and motivation theory is focused on the relationship between beliefs, goals and values with action (Eccles & Wigfield, 2002). The concept of using incentives to motivate learning within a project, is not reflected in the literature, nor is it reflected in this study. My future research efforts will include an exploration of motivation as an antecedent to organizational learning.

Learning Outcomes

Finally, this thesis explored outcomes of learning as part of a project. One of the underlying hypotheses of this study is that learning as a part of an IT/IS project drives organizational change and innovativeness which is a cornerstone for its competitiveness. The findings show that learning as part of IT/IS projects does lead to innovativeness and that the antecedents to learning within an IT/IS project (i.e., problem solving and interpersonal connections) and innovativeness are similar. Collectively, the findings suggest that all project team members have a role to play in the learning processes within IT/IS projects which influence the outcomes. This contradicts previous studies that have posited that project leaders are most knowledgeable of the project team members (Bartsch et al., 2013).

In seeking an answer to my central research question of what facilitates learning during an IT/IS project, the profile for the learning IT/IS project was created. This profile is characterized as having learning opportunities built into the framework of an IT/IS project. Further, the profile requires that the learning opportunities have project tasks that lead to solving problems that cause the individual team member to develop new knowledge and/or new skills. Underscoring this profile, is a project environment that encourages and promotes interpersonal connections among project team members. All of the profile characteristics are central to organizational learning; however, not all IT/IS projects possess the characteristics included in the profile. This is significant in that it illustrates and helps to clarify that not all IT/IS projects can serve as a medium for learning.

Limitations

As with any research study, there are potential limitations that would restrict the generalizability of the overall study. First, this research was conducted across multiple levels within the organization. The unit of analysis for the qualitative study was the project team, the unit of analysis for the second study (first quantitative study) was the individual project team member, and the unit of analysis for the third study (second quantitative study) was the organization. Conducting the multiple studies across a single unit of analysis may have generated different results.

As part of our mixed methods research design, the qualitative study was conducted as the first one in the sequence and the findings provided the guidance for the subsequent studies. The sample for the qualitative study was small and targeted one particular IT/IS project role. It is possible that a larger sample size and the inclusion of diverse members of the IT/IS project team could have generated different results and influenced a different direction for Studies 2 and 3.

One of the most significant limitations is the fact that the study measured innovativeness instead of innovation as an outcome to learning. Innovativeness is defined as an organization’s openness to new ideas as an aspect of the organization's culture (Hurley & Hult, 1998) whereas innovation is defined as the creation or adoption of new ideas (Damanpour & Schneider, 20060. The impact of learning as a driver of project outcomes could have been better observed by measuring the amount or type of innovation that occurs in response to learning as part of an IT/IS project.

Organizational learning is achieved when there is a visible change in the organization as a result of experience (Argote & Miron-Spektor, 2011). This study is not longitudinal and does not measure cognitive or behavioral changes in the project team members or the organization over time. The study relies on the project team members to self-report whether they are learning or not. The study could be improved upon by monitoring the performance of project team members and the results of IT/IS projects over time.

Implications for Practice

The goal of this research is to help shift the narrative as it relates to IT/IS projects by expanding the dialogue to include IT/IS projects as vehicles that can be used for organizational learning. Technology and project management leaders who are looking for support in changing the mindset within their organizations as it relates to leveraging knowledge created and learnings from IT/IS projects to drive continuous process improvement can use the findings from this study to help support their argument.

The findings from this study can help to inform management decisions on which projects to target for learning. Problem solving opportunities that lead to new knowledge and strong interpersonal connections were shown to be antecedents to learning. Armed with this information, management can build project teams and project environments that influence learning. When identifying project team members, managers may choose to assign their highly skilled team members to projects that address highly complex problems. Additionally, managers may want to be cautious of assigning team members with known conflicts to the same project team. Creating and measuring project objectives related to learning in addition to the objectives related to project scope, quality and time/cost can help to create a learning culture and strengthen the learning activities as part of IT/IS projects. Employees focus on what gets measured and having a learning objective can help ensure that all IT/IS project team members participate in the knowledge creation, knowledge retention, and knowledge transfer.

This study highlighted two project management processes that serve as learning processes within the IT/IS project—project post-mortems and risk management. Managers should identify ways in which the team and organization can harness and disseminate the information captured as part of those routines. One of the barriers to the effectiveness of project port-mortems was the accessibility of the data. This suggest that organizations should revisit their current strategies for storing that information. Having that data available to everyone within the organization as opposed to specific project teams will go a long way towards increasing the effectiveness of the learning processes.

Implications for Theory

This study contributes to and extends the literature on organizational learning, team learning and project-based learning by providing empirical evidence as to the factors that drive learning within an IT/IS project. Absent from the literature and prior studies on these phenomena is the detailed examination of learning processes and antecedents within this context. The evaluation of routines native to the project management methodologies guiding IT/IS projects in combination with the project environmental helps to fill that gap.

In particular, the results of this study led to the creation of the profile for the learning IT/IS project which can be used as a baseline for future research in this area. This study has also contributed to and extends the literature related to complexity research by calling out that unless learning occurs as a result of addressing project complexity, there is no benefit and it does not lead to innovativeness.

Future Research Considerations

This study contributes to the literature on team- and project-based learning by exploring at a more-detailed level the processes by which learning occurs and the factors that influence learning by capturing and reporting on the lived experiences of professionals who have experience working as part of an IT/IS project team. Future research to address the limitations of this study can help extend and strengthen the findings.

Another area of research to consider is the use of incentives to drive knowledge transfer and knowledge retention activities. As noted in the first study, the project resources were not incentivized to leverage the information captured during the learning routines. Exploring the impact of incentives can help further identify the drivers for learning.

Research exploring the impact of all project activities on learning activities and multi-group studies on the project characteristics (e.g., project methodology used and project size) can also help further the understanding of this topic.

Concluding Thoughts

The goal of my research is to help facilitate process improvement within the field of Information Technology/Information Systems and project management by identifying methods in which organizational learning can successfully occur as part of the project experience. This study provided empirical evidence showing that IT/IS projects are suitable vehicles for learning.

Appendix A: Research Participants Demographics

Participant	Age	Sex	Education	PM Experience	Industry	Title	PMP Certification
Interview 1	40-49	Female	Master's Degree	10-15 Years	Financial Services	Project Manager	Yes
Interview 2	40-49	Male	Doctorate	15 Years or more	Financial Services	Program Manager	No
Interview 3	30-39	Male	Bachelor's Degree	Less Than 5 Years	Financial Services	Project Manager	No
Interview 4	40-49	Male	Doctorate	10-15 Years	Financial Services	Project Manager	Yes
Interview 5	40-49	Male	Master's Degree	10-15 Years	Technology	CTO	No
Interview 6	40-49	Male	Bachelor's Degree	10-15 Years	Financial Services	Project Manager	No
Interview 7	40-49	Female	Master's Degree	5-10 Years	Financial Services	Program Manager	No
Interview 8	40-49	Female	Bachelor's Degree	10-15 Years	Financial Services	Project Manager	Yes
Interview 9	30-39	Female	Bachelor's Degree	5-10 Years	Financial Services	Project Manager	Yes
Interview 10	40-49	Female	Master's Degree	10-15 Years	Financial Services	Program Manager	No
Interview 12	40-49	Female	Master's Degree	15 Years or more	Financial Services	Program Manager	Yes
Interview 13	30-39	Female	Master's Degree	5-10 Years	Financial Services	Project Manager	No
Interview 14	40-49	Female	Master's Degree	15 Years or more	Financial Services	Project Manager	No
Interview 15	30-39	Female	Master's Degree	10-15 Years	Financial Services	Program Manager	No
Interview 16	40-49	Female	Bachelor's Degree	5-10 Years	Financial Services	Program Manager	No
Interview 17	50-59	Female	Doctorate	5-10 Years	Financial Services	Project Manager	No
Interview 18	50-59	Female	Bachelor's Degree	15 Years or more	Financial Services	Project Manager	Yes
Interview 19	30-39	Female	Bachelor's Degree	5-10 Years	Financial Services	Project Manager	No
Interview 21	60-69	Male	Master's Degree	15 Years or more	Healthcare	CTO	No
Interview 22	50-59	Female	Master's Degree	10-15 Years	Healthcare	Project Manager	No
Interview 23	30-39	Female	Bachelor's Degree	10-15 Years	Financial Services	Project Manager	Yes
Interview 24	40-49	Female	Bachelor's Degree	10-15 Years	Document Services	Program Manager	No
Interview 25	40-49	Female	Bachelor's Degree	10-15 Years	Financial Services	Project Manager	No
Interview 26	40-49	Female	Master's Degree	5-10 Years	Document Services	Program Manager	No
Interview 27	40-49	Female	Bachelor's Degree	5-10 Years	Financial Services	Program Manager	Yes

Appendix B: Interview Protocol

Interview Questions

Introduction (interviewer): *"Hello (name____________). Thank you for agreeing to participate in this process and for taking the time to meet with me today. Your participation is greatly appreciated. Before we get started, there are a couple of things I would like to cover."*

Purpose and Format for the Interview (Interviewer): *"I am a current student in the Case Western Reserve University Doctor of Management (DM) program, and I am interested in developing a greater understanding of the post-mortem process. I will ask you a few open-ended questions on this topic, and I will also ask one or more follow-up questions as you respond. The interview will last approximately 60–90 minutes."*

Confidentiality (Interviewer): *"Everything you share in this interview will be kept in strictest confidence, and your comments will be transcribed anonymously – omitting your name, anyone else you refer to in this interview, as well as the name of your current organization and/or past organizations. Your interview responses will be included with all the other interviews I conduct."*

Audio Taping (Interviewer): *"To help me capture your responses accurately and without being overly distracting by taking notes, I would like to record our conversation with your permission. Again, your responses will be kept confidential. If at any time, you are uncomfortable with this interview, please let me know and I will turn the recorder off."*

"Any questions before we begin?"

Interview Protocol

1. Please tell me about yourself.
   Probing Questions:
   a. Work experience
   b. Educational
   c. Family
   d. Age
   e. Race
   f. Describe your current role and responsibilities?

2. Tell me about your experience leveraging learnings from prior projects into new/current projects?
   a. Step-by-Step process?
   b. Reasons or Trigger for leveraging prior learnings?
   c. Formal Process? Informal?
   d. Source of prior learnings? Post Mortem? Lesson Learned?
   e. How did you access the information?
   f. Quality of information available?

g. Was the learning from a successful project? Failed project?
h. Can you give me an example of how it was used? Project Planning? Risk Management?

3. Can you provide an example of when you used a process to evaluate your project outcome?
   Probing Questions:
   a. What was the key driver for initiating this process?
   b. Explain how the process was organized?
   c. Was the data collected shared with others?
   d. If so, how was the information shared? With who?
   e. Can you give me an example of how it was used? Project Planning? Risk Management?
   f. How did you feel about the process?
   g. What were your expectations of the process?
   h. What worked well during the process?
   i. What were the challenges with the process?
   j. How did you feel about the feedback collected?
   k. What is the name of the project?
   l. Was the project a success? Failure?
   m. Project characteristics? Size, budget, resources, time?
   n. Step-by-Step (beginning to end experience of the post-mortem)
   o. What were the reasons for launching the post-mortem?
   p. What were the measures of the post-mortem?
   q. What was the criterion for concluding the post-mortem?
   r. What was the output of the post-mortem? How is the output used?
   s. Impact of post-mortem relative to the organization?
   t. Evidence of the impact of the post-mortem in the current organization? Current projects?
   u. Did the organization embrace it? If yes, how? Can you provide examples?

4. Tell me about another experience leveraging learnings from prior projects into new/current projects?
   Probing Questions (Same as above)

5. Tell me about another time you followed a process to evaluate your project outcome?
   Probing Questions (Same as above)

6. Do you have any additional thoughts on the process used to evaluate project success or failure?
   Probing Questions:
   - Tell me more.
   - Can you provide an example?

Appendix C: Study 2 Survey Scales

Construct/Definition	Items	Source/Reliability
Learning (LRN) - Knowledge acquired by project team members	Scoring: 1—None at all, 2 – A little, 3—A moderate amount, 4 – A lot, 5—A great deal 1. To what extent did your knowledge about the use of key technologies increase? 2. To what extent did your knowledge about the use of development techniques increase? 3. To what extent did your knowledge about supporting users' business increase while working on the project? 4. To what extent did your overall knowledge increase while working on the project?	Nidumolu, Sarma. 1995. "The Effect of Coordination and Uncertainty on Software Project Performance: Residual Performance Risk as an Intervening Variable". Information Systems Research 6 (3). INFORMS: 191–219.
Innovativeness (INNV) - The notion of openness to new ideas as an aspect of the organization's culture	Scoring: 1 – Strongly disagree; 2 – Disagree; 3 – Somewhat disagree; 4 – Neither agree or disagree; 5 – Somewhat agree; 6 – Agree; 7 – Strongly agree 1. My organization readily accepts innovations based on research results. 2. Management in my organization actively seeks innovative ideas. 3. Innovation is readily accepted in this organization. 4. People are penalized for new ideas that don't work. 5. Innovation in this organization is perceived as too risky and is resisted.	Hurley, R. F., & G. Tomas M. Hult. (1998). Innovation, Market Orientation, and Organizational Learning: An Integration and Empirical Examination. Journal of Marketing, 62(3), 42–54.
Project Complexity (PC) - The multiplicity and interdependency of technological elements of an information systems development project.	Scoring: 1 – No; 2 – Yes; 1. The project involved coordinating multiple user units. 2. The system involved real-time data processing. 3. The project involved multiple software environments. 4. The project involved multiple technology platforms. 5. The project involved a lot of integration with other systems. 6. The project involved multiple external contractors and vendors.	Xia, Weidong & Lee, Gwanhoo (2005) Complexity of Information Systems Development Projects: Conceptualization and Measurement Development, Journal of Management Information Systems, 22:1, 45-83
Risk Management (RM) - Added planning, identification and preparation for project risks.	Scoring: 1—None at all, 2 – A little, 3—A moderate amount, 4 – A lot, 5—A great deal 1. To what extent to you agree that the project included the following: Systematic risk identification through	Raz, T., Shenhar, A. J. and Dvir, D. (2002), Risk management, project success, and technological uncertainty. R&D Management, 32: 101–109.

	documentation reviews and information gathering techniques such as interviews and SWOT analysis. 2. To what extent to you agree that the project included the following: Probabilistic risk analysis, including the assessment of the likelihood that a risk will occur and the consequences if it actually occurs. 3. To what extent to you agree that the project included the following: Detailed planning for uncertainty to reduce the probability and/or consequences of an adverse risk event to an acceptable threshold. 4. To what extent to you agree that the project included the following: Methodic trade-off analysis resulting in a detailed risk response plan. 5. To what extent to you agree that the project included the following: Appointing a risk manager	
Autonomy (AUT) - The degree of autonomy (self-direction) the project manager has on the job	Scoring: 1 – Strongly disagree; 2 – Disagree; 3 – Somewhat disagree; 4 – Neither agree or disagree; 5 – Somewhat agree; 6 – Agree; 7 – Strongly agree 1. I have a considerable amount of freedom to do my job. 2. I influence the things that affect me on the job. 3. I have input deciding what tasks or what parts of tasks I will do. 4. I control the scheduling of my own work.	Younts, C. W., & Mueller, C. W. (2001). Justice Processes: Specifying the Mediating Role of Perceptions of Distributive Justice. American Sociological Review, 66(1), 125–145.
Team Trust (TT) - Individual beliefs about peer reliability and dependability.	Scoring: 1 – Strongly disagree; 2 – Disagree; 3 – Somewhat disagree; 4 – Neither agree or disagree; 5 – Somewhat agree; 6 – Agree; 7 – Strongly agree Adapted to: 1. Project members approach their job with professionalism and dedication. 2. Given the project team member's track record, I see no reason to doubt their competence and preparation for the job.	McAllister, D. J. (1995). Affect and Cognition Based Trust as Foundations for Interpersonal Cooperation in Cooperation and Organizations. Academy Of Management Journal, 38(1), 24-59.

	3. I can rely on the project team not to make my job more difficult by careless work. 4. Most people, even those who aren't close friends of the project team members, trust and respect them as coworkers. 5. Other work associates of mine who must interact with this project team consider them to be trustworthy. 6. If people knew more about the members of this team and their background, they would be more concerned and monitor their performance more closely.	

Appendix D: Study 2 Levene's Test

Test of Homogeneity of Variances				
	Levene Statistic	df1	df2	Sig.
AUT_1	0.303	1	645	0.582
AUT_2	1.357	1	645	0.245
AUT_3	0.003	1	645	0.958
AUT_4	2.737	1	645	0.099
LRN_1	0.579	1	645	0.447
LRN_2	4.163	1	645	0.042
LRN_3	2.983	1	645	0.085
LRN_4	2.484	1	645	0.116
OI_1	2.461	1	645	0.117
OI_2	0.069	1	645	0.793
OI_3	0.017	1	645	0.896
RM_1	0.000	1	645	1.000
RM_2	0.204	1	645	0.651
RM_3	0.828	1	645	0.363
RM_4	0.449	1	645	0.503
RM_5	0.074	1	645	0.785
TT_1	1.032	1	645	0.310
TT_2	0.120	1	645	0.729
TT_3	0.121	1	645	0.728
TT_4	1.164	1	645	0.281
TT_5	1.972	1	645	0.161
TT_6	2.657	1	645	0.104
Yrs_Exp	0.438	1	645	0.508
Prj_Budget	1.036	1	645	0.309
Prj_Duration	0.361	1	645	0.548
CMM_LVL	0.322	1	645	0.571

Appendix E: Study 2 Pattern Matrix & Reliability Scores

Pattern Matrix[a]					
	TT	RM	LRN	AUT	OI
Cronbach Alpha	0.876	0.875	0.851	0.802	0.902
AUT_1				0.790	
AUT_2				0.683	
AUT_3				0.625	
AUT_4				0.688	
LRN_1			0.819		
LRN_2			0.759		
LRN_3			0.664		
LRN_4			0.806		
OI_1					0.718
OI_2					0.889
OI_3					0.881
RM_1		0.750			
RM_2		0.848			
RM_3		0.720			
RM_4		0.798			
RM_5		0.700			
TT_1	0.611				
TT_2	0.689				
TT_3	0.741				
TT_4	0.902				
TT_5	0.867				
Extraction Method: Maximum Likelihood.					
a. Rotation converged in 6 iterations.					

Appendix F: Study 3 Survey Scales

Construct/Definition	Items	Source/Reliability
Learning (LRN) - Knowledge acquired by project team members	Scoring: 1—None at all, 2 – A little, 3—A moderate amount, 4 – A lot, 5—A great deal 5. To what extent did your knowledge about the use of key technologies increase? 6. To what extent did your knowledge about the use of development techniques increase? 7. To what extent did your knowledge about supporting users' business increase while working on the project? 8. To what extent did your overall knowledge increase while working on the project?	Nidumolu, Sarma. 1995. "The Effect of Coordination and Uncertainty on Software Project Performance: Residual Performance Risk as an Intervening Variable". Information Systems Research 6 (3). INFORMS: 191–219.
Innovativeness (INNV) - The notion of openness to new ideas as an aspect of the organization's culture	Scoring: 1 – Strongly disagree; 2 – Disagree; 3 – Somewhat disagree; 4 – Neither agree or disagree; 5 – Somewhat agree; 6 – Agree; 7 – Strongly agree 6. My organization readily accepts innovations based on research results. 7. Management in my organization actively seeks innovative ideas. 8. Innovation is readily accepted in this organization. 9. People are penalized for new ideas that don't work. 10. Innovation in this organization is perceived as too risky and is resisted.	Hurley, R. F., & G. Tomas M. Hult. (1998). Innovation, Market Orientation, and Organizational Learning: An Integration and Empirical Examination. Journal of Marketing, 62(3), 42–54.
Project Complexity (PC) - The multiplicity and interdependency of technological elements of an information systems development project.	Scoring: 1 – No; 2 – Yes; 7. The project involved coordinating multiple user units. 8. The system involved real-time data processing. 9. The project involved multiple software environments. 10. The project involved multiple technology platforms. 11. The project involved a lot of integration with other systems. 12. The project involved multiple external contractors and vendors.	Xia, Weidong & Lee, Gwanhoo (2005) Complexity of Information Systems Development Projects: Conceptualization and Measurement Development, Journal of Management Information Systems, 22:1, 45-83
Team Trust (TT) - Individual beliefs about peer reliability and dependability.	Scoring: 1 – Strongly disagree; 2 – Disagree; 3 – Somewhat disagree; 4 – Neither agree or disagree; 5 – Somewhat agree; 6 – Agree; 7 – Strongly agree Adapted to:	McAllister, D. J. (1995). Affect and Cognition Based Trust as Foundations for Interpersonal Cooperation in Cooperation and Organizations. Academy of Management Journal, 38(1), 24-59.

	7. Project members approach their job with professionalism and dedication. 8. Given the project team member's track record, I see no reason to doubt their competence and preparation for the job. 9. I can rely on the project team not to make my job more difficult by careless work. 10. Most people, even those who aren't close friends of the project team members, trust and respect them as coworkers. 11. Other work associates of mine who must interact with this project team consider them to be trustworthy. 12. If people knew more about the members of this team and their background, they would be more concerned and monitor their performance more closely.	
Team Communication (TC) - Whether team members feel that they can state their opinions, thoughts, and feelings without fear.	Scoring: 1 – Strongly disagree; 2 – Disagree; 3 – Somewhat disagree; 4 – Neither agree or disagree; 5 – Somewhat agree; 6 – Agree; 7 – Strongly agree 1. Every project team member participates in team communications 2. Every project team member has a chance to express their opinion 3. Project team members listen to each individual team member's input 4. Project team members feel free to make positive and negative comments 5. Even though we do not have total agreement, we do reach a kind of consensus that we all accept.	Watson, W.E., and Michaelsen, L.K. Group interaction behaviors that affect group performance on an intellective task. Group and Organization Studies, 13, 4 (1988), 495–516.

Appendix G: Study 2 Levene's Test

Test of Homogeneity of Variances				
	Levene Statistic	df1	df2	Sig.
AUT_1	0.303	1	645	0.582
AUT_2	1.357	1	645	0.245
AUT_3	0.003	1	645	0.958
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LRN_1	0.579	1	645	0.447
LRN_2	4.163	1	645	0.042
LRN_3	2.983	1	645	0.085
LRN_4	2.484	1	645	0.116
OI_1	2.461	1	645	0.117
OI_2	0.069	1	645	0.793
OI_3	0.017	1	645	0.896
RM_1	0.000	1	645	1.000
RM_2	0.204	1	645	0.651
RM_3	0.828	1	645	0.363
RM_4	0.449	1	645	0.503
RM_5	0.074	1	645	0.785
TT_1	1.032	1	645	0.310
TT_2	0.120	1	645	0.729
TT_3	0.121	1	645	0.728
TT_4	1.164	1	645	0.281
TT_5	1.972	1	645	0.161
TT_6	2.657	1	645	0.104
Yrs_Exp	0.438	1	645	0.508
Prj_Budget	1.036	1	645	0.309
Prj_Duration	0.361	1	645	0.548
CMM_LVL	0.322	1	645	0.571

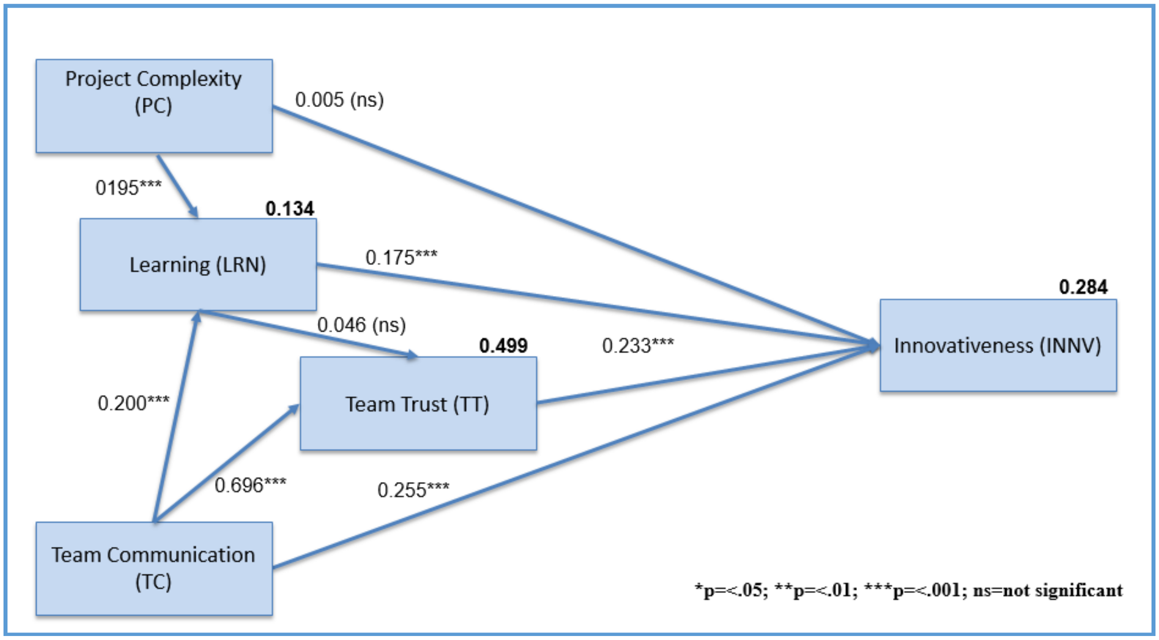
Appendix H: Study 3 Pattern Matrix & Reliability Scores

Pattern Matrix[a]				
	Factor			
	TT	LRN	TC	INNV
Cronbach Alpha	0.876	0.851	0.863	0.902
LRN_1		0.806		
LRN_2		0.776		
LRN_3		0.706		
LRN_4		0.798		
INNV_1				0.790
INNV_2				0.922
INNV_3				0.863
TC_1			0.570	
TC_2			0.966	
TC_3			0.735	
TC_4			0.690	
TT_1	0.579			
TT_2	0.687			
TT_3	0.684			
TT_4	0.883			
TT_5	0.895			

Extraction Method: Maximum Likelihood.

a. Rotation converged in 5 iterations.

Appendix I: Study 3 SEM Model



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