Impact of Technology Learning and Innovation Mindfulness on the Information Technology Dynamic Capabilities of the Firm

by

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A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
May 9, 2015

Keywords: organizational learning, innovation mindfulness,
dynamic capabilities, information technology infrastructure flexibility

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Abstract

The concept and nature of the concept of organizational Absorptive Capacity has generated much research in the Strategic Management, Organizational, and Information Systems literature. Its classification as an organizational asset vs. organizational capability has spurred much debate, and the information systems literature has highlighted the need for further research into how IT impacts, and is impacted by, firm Absorptive Capacity. This dissertation research investigates firm Absorptive Capacity from the capabilities perspective and at the organizational level. Specifically, this research investigates the structure underlying Absorptive Capacity and hypothesizes linear relationships constructs previously researched in the literature as being related to the gathering and application of knowledge, a core concept of Absorptive Capacity. Technology Learning routines, IT Innovation Mindfulness processes and traits, IT Infrastructure Flexibility, and the IT Dynamic Capabilities of the firm are posited as the operationalized processes driving firm Absorptive Capacity, and the hypothesized relationship between them tested.

To test the study model, a Pilot study and Full study was conducted. The study measurement instrument, developed using measures from prior studies, was tested and refined using results from the Pilot study. In the first phase of this research study, 5000 IT professionals, Chief Executive Officers, and Small Business Owners, along with additional IT professionals in the Southeastern United States, were administered the Pilot Study Survey Instrument, generating 109 complete responses. The refined instrument was then administered to 18,833 top IT

Executives of firms, generating 229 complete survey responses. Measurement and Structural models were assessed in each phase, and the hypothesized relationships tested, with results suggesting support for all four study hypotheses. Study results have direct implications for both the research literature investigating the nature of the theorized constructs, as well as their relationship to Absorptive Capacity as a whole, as well as practitioners attempting to improve their firm's ability to innovate using technology. Results and implications are discussed, along with limitations to the study's generalizability and areas for potential future research.

Acknowledgments

I am immensely grateful to all the following individuals for the help and support they have given me over many years of effort expended to achieve this goal:

To my mother, Peggy Ezell, who left her education in order to ensure that her children could complete theirs, and who early instilled in me a love of reasoning, reading, and learning.

To my wonderful and amazing fiancée, Nicole Kaspar, without whose love and support none of this would have been possible. I love you so very much! <3

To my nephew, Spencer Ezell, who not unlike a brother, believed in me and cheered me on every step of the way.

To my friends and faculty at Middle Tennessee State University, who helped a kid from rural West Tennessee find his love of learning and academic research.

I am incredibly indebted to my dissertation chair, Dr. Terry Byrd, by whose patient and wise guidance I was able to navigate the often rocky shoals of the Doctoral program and achieve my dreams. I am also incredibly grateful to my committee members, Dr. Dianne Hall, Dr. Casey Cegielski, and Dr. Kelly Rainer whose both professional and personal wisdom and guidance were essential in completing this dissertation research. Also, I would like to thank Dr. Hubert Feild for serving as my committee's Outside Reader, and for his many years of friendship, counsel, and instruction during my doctoral program.

I give thanks to God, for the many blessings bestowed, prayers answered, and hopes renewed daily.

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ES	Environmental Scanning
MD	Member Diversity
KS	Knowledge Sharing
SO	Sensitivity to Local Operations
RS	Reluctance to Simplify
DL	Deference to Local Expertise
PF	Preoccupation with Failure
CR	Commitment to Resilience
SP	Strategic IT Planning
BE	IT Business Experience
RI	IT Relationship Infrastructure
AF	IT Application Functionality
ITI	IT Integration
TS	Technical Skills
ITIF	IT Infrastructure Flexibility
ET	Environmental Turbulence

Chapter 1: Introduction

Theoretical Justification

Absorptive capacity deals broadly with the ability of the organization to absorb and apply new information in a competitively beneficial and effective way. Those firms with high levels of absorptive capacity will see an increased ability to transform their Information Technology (IT) infrastructures in order to produce both innovative products and processes to create and sustain a competitive advantage in the marketplace (Swanson, 1994; Yoo, Henfridsson, & Lyytinen, 2010). In modern organizations, IT is critical to supporting the competitive capabilities of the firm through the initiation and support of core capabilities (Sambamurthy & Zmud, 2000; Yoo et al., 2010). The better an organization has developed its IT infrastructure, and the IT capabilities around it, the better the firm will be at gathering knowledge and determining when and how to change critical organizational processes, reconfigure IT resources, or develop new ones to remain competitive in the market. Absorptive capacity as conceptualized by the literature deals with the flow of information through the firm and how that information is used by the firm in its working towards achieving strategic goals in the quest for sustained and repeated competitive advantage. In the IS literature, researchers have noted the need for further study into the overall relationship between IT and its impact on firm absorptive capacity (Roberts, Galluch, Dinger, & Grover, 2012).

The absorptive capacity of the firm is described by three main theoretical areas: the scanning and gathering of knowledge (i.e., its identification), the integration (of compatible

knowledge) and/or assimilation of (incompatible but relevant) knowledge, and the application of this knowledge to the operations and resources of the firm (W. M. Cohen & Levinthal, 1990; Daspit, 2012; Daspit & D'Souza, 2013; Malhotra, Gosain, & Sawy, 2005; Park, Suh, & Yang, 2007; Pavlou & El Sawy, 2006, 2010, 2011). Both strategic management and information systems (IS) research have noted constructs and research concepts that fit within the dimensions of absorptive capacity but have not yet been empirically investigated as a whole. The first dimension of absorptive capacity, where an organization actively gathers and scans for information through purposive routines matches the strategic management construct of *organizational learning* (Argyris & Schön, 1999; Crossan, Lane, & White, 1999; Fiol & Lyles, 1985). Literature suggests a relationship between organizational learning and overall firm absorptive capacity (Lane, Koka, & Pathak, 2006), though Roberts et al. (2012) note that this relationship has not yet been fully explored. Next, in order to integrate relevant knowledge into the firm, or transform and assimilate relevant but initially incompatible knowledge, the firm must mindfully consider gathered knowledge and process it. This mindful consideration of the knowledge generated through gathering of information and the claims surrounding IT innovations that are considered for potential adoption and integration into the firm matches the research concept of *innovation mindfulness* (Butler & Gray, 2006; Fiol & O'Connor, 2003; Mu & Butler, 2009; Swanson & Ramiller, 2004; Weick & Sutcliffe, 2006). Finally, as the knowledge is gathered and then processed as to its compatibility and relevance, the firm must take action on relevant information and reconfigure its resources, processes, and add to its firm-wide skillsets in order to adjust to changes in the competitive marketplace. The third literature-noted dimension of absorptive capacity, the application of knowledge to the firm, occurs at certain levels of efficiency, depending on the characteristics and capabilities of the firm. The firm will possess a

certain set of organizational capabilities that allow it to take gathered information and apply it through changes to internal digital resources and processes to effectively to match competitive needs. As the competitive environment in which the firm operates becomes more dynamic, characterized by increasing changes and rapidity competitor activities, the firm will increasingly need the ability to change lower organizational capabilities (i.e., first-order operational capabilities) in order to align with new strategic directions. These rapid-reconfiguration capabilities align with the research concept known as *dynamic capabilities* (Barreto, 2010; Jones, Macpherson, & Jayawarna, 2011; Pavlou & El Sawy, 2010, 2011; Teece, 2007; Teece, Pisano, & Shuen, 1997). Dynamic capabilities of the firm allow for the application of processed and relevance-determined information to the organizational and daily routines of the firm through both the reconfiguration and building of organizational resources in an increasingly rapid manner.

We will investigate the holistic nature of absorptive capacity by examining its underlying structure using the above noted concept through an IS lens. As the firm gathers information on new IT activity in the market through *Technology Scanning*, it will engage in processes of *IT Innovation Mindfulness* to "unpack" information about potential new innovative technologies an IT-related processes in order to develop an understanding of their relevance and need. This new knowledge will impact the *IT Infrastructure Flexibility* of the firm, as mindful choices among IT innovations will help the firm to develop a technology resource base that addresses both current competitive needs and anticipates future potential changes. Finally, as the flexibility of the IT infrastructure increases, the *IT Dynamic Capabilities* of the firm, those skills and abilities the firm possesses in building and altering its IT infrastructure, will increase as well. Overall, these

routines, processes, flexible infrastructure, and capabilities of the firm will represent its broad absorptive capacity.

Research Purpose and Research Questions

Holistically, we seek to investigate the firm's ability to assimilate and apply new and relevant IT information to its organizational processes and strategic activities, and the technology resources that form their base. Roberts et al. (2012) note that the absorptive capacity construct has been investigated as both an organizational capability and asset, with much debate in the strategic management and IS literature as to its exact nature and makeup. We take an organizational capability perspective (Lane et al., 2006) to absorptive capacity, and seek to clarify its underlying nature by examining the organizational routines, mindsets, and capabilities that give the contemporary firm the ability to gather, process, and apply information to internal digital resources and routines. Roberts et al. (2012) further note that the relationship between organizational learning in the firm and absorptive capacity is not clear. Fichman (2004) notes a significant gap in the literature investigating the concept of IT innovation mindfulness, and calls attention to this important area of research. Also, organizational questions related to dynamic capabilities have been noted as some of the most difficult to investigate in the strategic management literature (Daspit, 2012; C. E. Helfat & Peteraf, 2003; Pavlou & El Sawy, 2011; Teece, 2007). The primary research questions this research seeks to answer are as follows:

1. What are the underlying dimensions of the Absorptive Capacity construct?
2. What is the nature of the relationship between Organizational Learning and the Absorptive Capacity construct?

3. What impact does technology-focused organizational learning have upon IT innovation mindfulness?
4. What impact does IT innovation mindfulness have upon the flexibility of the firm's IT infrastructure?
5. Does an increasingly flexible IT infrastructure enhance the dynamic capabilities of the firm to reconfigure IT resources?

Potential Research Contributions

First, this research has the potential to impact research in both the IS and strategic management literature. The absorptive capacity construct is widely debated in the literature, and results from this research could potentially clarify the construct's nature and underlying structure. We hope to clarify the impact that mindfulness in IT innovation adoption has upon the firm IT infrastructure flexibility. Also, we hope that through this study, the theoretical antecedents to IT dynamic capabilities can be clarified by investigating the potential effects of technology learning and a flexible IT infrastructure within organizations.

For professionals in organizations, this research can illuminate the nature of the processes, mindsets, and capabilities that allow companies to innovate successfully and remain competitively nimble in a changing market. Investigating a structured set of learning routines within a firm can help practitioners to reduce cognitive load in attempting to learn about technologies and their fit for adoption purposes, delegating this task as a set of organizational routines. Investigation of IT innovation mindfulness traits can clarify for practitioners the nature of the involvement of all areas of the firm that must take place for proper assessment of new, often radical and expensive, technologies. Finally, an understanding of firm IT dynamic

capabilities can help the management team to understand the structures of planning, coordination, and skillsets that could potentially give them an edge over competitors in reconfiguring technology resources for new strategic directions.

Dissertation Structure

This dissertation is organized into five chapters. Chapter 2 presents a review of the relevant literature. Research investigating the organizational learning concept is reviewed, followed by those studies investigating innovation mindfulness. Following is a review of the literature that develops and defines the concept of the dynamic capabilities of the firm. Next is a delineation of those IT infrastructure capabilities that serve as the IT dynamic capabilities of the firm, and a look at the concept of IT infrastructure flexibility. After this, a discussion of the absorptive capacity concept is conducted and its three theoretical areas aligned with this study's constructs to show the holistic nature of information processing within the firm. Finally, a development of the hypothesized relationships between the study's theoretical constructs is presented and the study model developed. Chapter 3 describes the context, research domain and target participants for the study of the hypothesized model, and presents the development of the measurement instrument. Procedures for data collection are presented, along with the planned statistical analyses that will be used to investigate the data collected and the hypothesized relationships. Chapter 4 presents the results of the Pilot and Full phases of the study. Demographics and respondent characteristics are discussed, and assessment of the measurement model for the Pilot study follows. Next, modifications to the measurement instrument are discussed and justified, and follows with an assessment of both the measurement and structural model of the full study, along with investigation of potential equivalent models. Finally, the

study's hypothesized relationships are tested and results presented. Chapter 5 presents a discussion of the study findings through implications for both researchers and practitioners, limitations of the study, and suggestions for future research. Appendices at the end of the dissertation present measurement instrument items, recruitment tools, and the survey instruments used in the Pilot and Full study phases.

Chapter 2: Literature Review

Organizational and Technology Learning

A routine is a learned, patterned, repeating behavior, originating from a specific goal or goals, and realized through prior or new knowledge which guides the behavioral action (Winter, 2003). An *entity* has engaged in a learning behavior if, by the processing of information, the number of possible actions and behaviors it can potentially engage in increases (Huber, 1991). Both individuals and organizations are entities that are capable of learning (Attewell, 1992; Chiva & Alegre, 2005; Huber, 1991). The actions and behaviors of the members of an organization, and thus of the organization itself, are based upon *operational* routines that have been previously established in the company (Levitt & March, 1988). The lessons learned and the knowledge previously generated in an organization are represented by and stored in these routines, and these routines represent part of the "memory" of the organization (Chiva & Alegre, 2005; Hargadon & Fanelli, 2002; Huber, 1991; Levitt & March, 1988). Operational routines are the end-product of the company's processing of and attempts at understanding its accumulated knowledge in the context of both its history, and the history of other organizations (B. R. Clark, 1972; Levitt & March, 1988; Martin, Sitkin, & Boehm, 1985). The knowledge generated by the organization's past and present experiences is also codified in both written documentation used by its members, and in the common understandings (i.e. norms) held by organizational members regarding the normal processes of the company (Cook & Yanow, 1993; Hargadon & Fanelli,

2002; Levitt & March, 1988). This broader concept of knowledge generation at the firm level is known as *organizational learning*, defined as the activities in which knowledge is gathered by the firm, shared throughout its divisions, and applied by the firm to increase the success of competitive activities in the marketplace (Argyris & Schön, 1999; Bhatt & Grover, 2005; W. M. Cohen & Levinthal, 1990; Cook & Yanow, 1993; Crossan et al., 1999; Fiol & Lyles, 1985; Huber, 1991; Levitt & March, 1988).

Alongside the company's operational routines, organizational *learning* routines generate some of the organization's knowledge (Chiva & Alegre, 2005), incorporating knowledge both internal and external. These learning routines can both modify existing operational and learning routines, and lead to the creation of new types of both. Organizational learning routines, then, can be defined as purposeful and active processes by which information is sought, gathered, processed, and used (Chiva & Alegre, 2005; Zahra & George, 2002). They can be thought of as mechanisms through which the organization engages in active knowledge improvement about itself, its activities, and its competitive environment. Indeed, those companies that wish to remain competitive will need to continuously gather new information in order to drive innovation activities and become aware of potential future applicable information (Castiaux, 2007; Drucker, 1991; Grant, 1996; Schewe, 1996; Tabak & Barr, 1999). Zahra and George (2002) state that the learning routines a company engages in will enable a dynamic capability in the firm, in its effectiveness in using prior information to reshape its organizational processes for a competitive edge. Learning routines represent both the presence and result of a company's active exploration of new competitive opportunities, and the reshaping of the organizational processes and resources in order to take advantage of them (D. C. Galunic & Eisenhardt, 2001; Pavlou & El Sawy, 2011; Teece, 2007; Winter, 2003).

Three primary operational routines as established by the organization appear to have a majority of the focus of studies examining the organizational learning construct. First, *environmental scanning* of the competitive marketplace enables the firm to gather knowledge through learning routines via either scanning activities (learning-about) or through direct organizational experience (learning-by-doing) (Jeyaraj, Balser, Chowa, & Griggs, 2009; Levitt & March, 1988; Patel & Patel, 2008; P. Wang & Ramiller, 2009). The learning occurring with either method takes place through intentional efforts (Huber, 1991). Organizations that actively scan both their competitive environments can gather better information about potential IT innovations, competitive activities, and adjust firm operations to stay competitive. (Fiol & O'Connor, 2003; Mustonen-Ollila & Lyytinen, 2004; Zollo & Winter, 2002). The possession of imperfect knowledge on the part of managers drives them to scan their firm's competitive surroundings to gather signals of industry norms (Mithas, Tafti, & Mitchell, 2013). Examples of environmental scanning by firms in an IT context can involve active gathering of IT information from trade and professional publications, newspapers and magazines (Jeyaraj et al., 2009; Lounsbury, 2001), constant reviewing of new IT, posing questions on functionality and staying in contact with product developers (Cegielski, Reithel, & Rebman, 2005), from among others. Second, *organizational hiring practices* that focus on creating a diverse employee knowledge base empowers the firm to better process new information and synergistically link it to the knowledge already held by its members and information systems (W. M. Cohen & Levinthal, 1990; Huber, 1991; Mehrtens, Cragg, & Mills, 2001). The knowledge present in the organization and gained from the various organizational learning activities can be enhanced by a diverse member culture, and help the firm to mindfully enact organizational change (Hargadon & Fanelli, 2002). Bhatt and Grover (2005) note that firms should engage in routines that seek to

hire employees skilled in IT and provide them a structure for developing competitively beneficial IT innovations. Finally, *inter-divisional information sharing* / *sub-unit knowledge sharing* and the establishment of communication channels between divisional groups and the IS department improves the firm's ability to gather, translate, communicate, and process data, assisting it to make accurate judgments about new practices and innovations (W. M. Cohen & Levinthal, 1990; Huber, 1991). Organizations can see "sustained effectiveness" by developing and knowledge-sharing routines that link disparate areas of expertise as well as linking information technologies that store the knowledge assets of the organization (Purvis, Sambamurthy, & Zmud, 2001, p. 117).

We posit that by focusing on a specific subset of knowledge, specifically information technology (IT), organizations can improve the knowledge gained in that area and improve its ability to choose from among potential new IT to adopt as well as be better able to implement those new IT resources through firm process and existing resource configurations. Cegielski, Reithel, and Rebman (2005) highlight previous research showing that less than a third of Fortune 1000 firms' CIOs conducted reviews of emerging information technologies (EITs) citing a lack of sufficient time to do so as the primary reason (Cegielski & Rebman, 2003). The CIO's noted that technology-scanning focused organizational learning processes such as continuously reviewing and considering EIT information (Environmental Scanning), creating and sharing local IT information resources (Sub-Unit Knowledge Sharing) as well as attending to the advice of internal experts (Diversity of Member Expertise) were among several suggestions for firm-level processes helpful in alleviating decision maker cognitive overload (Cegielski et al., 2005). Our focus will be on those organizational learning routines that represent an attempt by the firm to continuously and purposefully engage in technological scanning on a continuous basis.

IT Innovation Mindfulness Processes

The concept of *mindfulness* defines a highly active cognitive state where an entity is increasingly aware of reality, old ideas and assumptions are constantly reconsidered, and new assumptions and propositions about reality are constantly created (Langer & Imber, 1980; Valorinta, 2009). Mindfulness at the organizational level is similarly considered to include the ability of the company to maintain a high level of sensitivity to the competitive marketplace, to stay flexible concerning new information, and to develop and maintain the ability to respond to unexpected events in a rapid and flexible manner (Langer & Moldoveanu, 2000; Levinthal & Rerup, 2006; Mu & Butler, 2009; Valorinta, 2009; Weick & Sutcliffe, 2001; Weick, Sutcliffe, & Obstfeld, 1999). The mindful organization will engage in ongoing analysis, refinement of expectations, will incorporate new knowledge gained from experiences, will focus sharply on context, and will better handle unexpected events (Weick & Sutcliffe, 2001). Mindfully acting organizations will be receptive to new information and will consider multiple perspectives, creating new categories to properly and contextually frame new information as needed (Fiol & O'Connor, 2003; Langer, 1997).

The literature has proposed and investigated five organizational mindsets (operationalized through routines) or traits (externally viewable) common to organizations who act in a mindful manner in the competitive marketplace (Butler & Gray, 2006; Fiol & O'Connor, 2003; Mu & Butler, 2009; Swanson & Ramiller, 2004; Weick & Sutcliffe, 2001, 2006) First, the organization will engage in active *consideration of local firm specifics*, where it considers the local potential effectiveness and fit of any innovation or operational change in terms of matching moves in the market (Mu & Butler, 2009). Consideration of the local specifics of the company help prevent the organization from the implementation of organizational processes or systems

due to bandwagon pressures present from observed competitor activities (Fiol & O'Connor, 2003; Mu & Butler, 2009; Swanson & Ramiller, 2004). Next, an organization will *refuse to simplify* any statements of "fact" provided by external or internal change advocates and any facts surrounding the change are assumed, initially, to be biased. (Adomavicius, Bockstedt, Gupta, & Kauffman, 2008). The firm will be purposefully focused on determining exactly how any IT innovation will fit within their organization (Fiol & O'Connor, 2003), and work through any facts given regarding the change by the community discourse surrounding it (Fiol & O'Connor, 2003; Mu & Butler, 2009; Swanson & Ramiller, 2004). Third, an organization demonstrating a high *sensitivity to failure* will exhibit a culture that promotes the open and non-threatening discussion of mistakes and errors, and the structures necessary to enable this, will be established, increasing the mindfulness of the firm (Butler & Gray, 2006; Weick & Roberts, 1993). As every organizational event is impactful upon the firm's overall health, errors, "misses," and areas for potential improvement must be monitored, reported, and action taken (Weick et al., 1999). Finally, firms will demonstrate mindfulness to the competitive environment through the demonstration of *resiliency to failure* through the establishment of plans and processes that will help the company recover from issues or incidents (Mu & Butler, 2009). The firm will intensely study the potential effects of any change in the organization, whether an IT innovation or new organizational process (Swanson & Ramiller, 2004) and will modify either the technology or the organizational processes to enhance its competitive advantage in the market (Mu & Butler, 2009).

IT Dynamic Capabilities

One value that IT is seen to bring to business is in its ability to impact organizational performance in terms of operational efficiency and competitive stance (Melville, Gurbaxani, & Kraemer, 2007). Previous research has examined the influence of IT on firm performance in general, and how this relationship is moderated by the competitive environment (Chiasson & Davidson, 2005; Hitt & Brynjolfsson, 1996; Melville et al., 2007). Xue et al. (2012) investigated the moderating effect of the turbulence of the competitive environment on the relationship between firm performance and specific IS investments, with a focus on exploitation and exploration firm outcomes. In complex and turbulent environments, IT asset portfolios were found to be associated with a greater increase in firm innovation processes and activities (i.e., exploration processes), while competitive environments less complex and turbulent in nature were seen to benefit efficiency processes within organizations (i.e., exploitation processes) (Xue et al., 2012).

Though IT is seen in the literature as bringing value to the organization, researchers have considered this ability contingent on *firm capabilities* and those resources within the firm that complement the specific nature of certain IT and enhance its effect (Melville, Kraemer, & Gurbaxani, 2004; Roberts et al., 2012; Wade & Hulland, 2004). This view is echoed by Orlikowski and Iacono (2001), who state that IT and the general categories of IT itself are always intertwined within a contextual setting, a time, place, or organizational community. The ability of a firm to strategically respond to the market will depend on the types of changes occurring in the competitive landscape, the IT and general firm resources available to the company at the time the need for change is recognized, and the specific capabilities for effective restructuring of resources to meet the new competitive need possessed by the firm. IT will

impact business processes, and alignment between the two groups occur, in order to help the company meet its strategic goals (Xue et al., 2012).

Broadly, capabilities in the firm have been defined as being ". . . intentionally created by management to transform input to output with the goal of achieving competitive advantage through the long-term adaptation, integration, and reconfiguration of resources using idiosyncratic routines" (Daspit, 2012, p. 36). Firm capabilities are created in order to ultimately help the firm to complete a competitive goal (Ray, Barney, & Muhanna, 2004) and draw upon the routines and previously learned knowledge present in the firm (Daspit, 2012). Daspit (2012) further notes that several models of the types of and relationships between the capabilities in the firm have been developed. Generally, capabilities in the firm are seen to exhibit a hierarchical relationship with each other (Winter, 2003). *Operational/Organizational* capabilities describe an organization's ability to execute on its routine and pre-planned daily operations and processes (Pavlou & El Sawy, 2011; Winter, 2003). These capabilities represent the daily ability of the firm to use its resources to meet its primary competitive goals, to conduct the normal activities of the business (Winter, 2003). They are seen as functional firm activities (Collis, 1994) or zero-order capabilities (Daspit, 2012; Teece et al., 1997; Winter, 2003). The *Dynamic* capabilities of the organization are seen as meta-processes, in that they enable the firm to change and restructure existing operational processes, to better meet the firm needs within an increasingly turbulent competitive environment (Pavlou & El Sawy, 2011; Teece, 2007; Winter, 2003). Dynamic capabilities are considered to be first-order capabilities of the firm, in that they assist the organization's effectiveness in the reconfiguration of resources, to extract value from their zero-order capabilities, and remain in alignment with the changing dynamics of the competitive landscape (Teece et al., 1997; Winter, 2000; Zahra & George, 2002). These types of

organizational capabilities are based in the Resource Based View (RBV) of the Firm, which sees companies having a competitive advantage over their peers through their possession of certain organizational resources that other firms may not possess in equal quantity and/or extent (Barney, 1991; Wernerfelt, 1984). Though the RBV views organizational resources as static (Abraham, Aier, & Winter, 2012), the perspective of dynamic capabilities sees the firm gaining the knowledge and skills needed to effectively reconfigure those resources to match changes in the competitive marketplace (Eisenhardt & Martin, 2000; Teece et al., 1997; C. L. Wang & Ahmed, 2007). A good analogy for dynamic capabilities is in the ability to artistically pivot while in-performance that jazz performers and professional thespians possess (Leone, 2010; Weick, 1998). Dynamically reconfiguring firm resources can be an increasingly improvisational act (Leone, 2010), especially as the turbulence of the competitive marketplace increases (C. L. Wang & Ahmed, 2007).

Businesses constantly face a increasing rate of rapid change and turbulence in their competitive environments (Byrd & Turner, 2000). As the rate of turbulence in the competitive marketplace increases, moving from low levels of market dynamism, munificence, and complexity to high levels (Xue et al., 2012), firms lean on their dynamic capabilities and the IS that enables them. To solve new problems in the competitive marketplace, firms will bring to bear prior knowledge on the problem, and use that prior knowledge to guide their exploration for new knowledge (Attewell, 1992; W. M. Cohen & Levinthal, 1990; Pavlou & El Sawy, 2006; Roberts et al., 2012), eventually exploiting that knowledge through changes to operational processes (Levinthal & March, 1993; Levinthal & Rerup, 2006; March, 1991). Su et al. (2013) note previous research that links the critical role that an organization's prior knowledge plays in allowing the firm to consider, integrate, and apply external knowledge to its routines and

resources, enabling an increasingly mature absorptive capacity capability in the firm (Hughes & Wareham, 2010; Vega-Jurado, Gutiérrez-Gracia, & Fernández-de-Lucio, 2008).

Interestingly, as market turbulence rises to higher levels, the impact of the firm's prior knowledge lessens, as the possible outcomes of the moves in the market become less and less predictable (Eisenhardt & Martin, 2000; C. L. Wang & Ahmed, 2007). With less time to attempt prediction of how the competitive environment will change and attempt to map out future action due to increased turbulence, firm actions will become pressured more towards the *improvisational* (Leone, 2010; Moorman & Miner, 1998). Pavlou and El Sawy (2010) differentiate dynamic capabilities from improvisational ones in terms of market turbulence being seen as waves for the former, and storms the latter. In these scenarios, previously accumulated and processed knowledge become even more important, as the success or failure of the improvisational action by the firm depends on the expertise and knowledge available (Hmieleski & Corbett, 2008). Leone (2010) notes the literature view that as markets become more turbulent and resource reconfiguration activities rise in improvisational nature with them, the capability of the firm to carry out these rapid changes depends on the firm culture, transmission and accuracy of new knowledge, and the amount of old knowledge previously gathered (Vera & Crossan, 2004, 2005). Improvisational capabilities are noted as being first-order capabilities of the firm, complementary to dynamic capabilities (Pavlou & El Sawy, 2010), with a difference being that they are capabilities called upon by the firm when the change in the competitive landscape is vastly less predictable, calling for shorter timeframes in carrying out both assessment and strategic pivoting or reconfiguration of firm resources (Abraham et al., 2012). As noted, improvisational capabilities rely on resource reconfiguration in shorter timespans and with the prior learning of the organization playing less of a role in the guidance of the actions behind

those changes. We have focused this study on the learning and assimilation/transformation of knowledge by the firm, and limited it on the investigation of firm dynamic capabilities. The IT infrastructure of the modern firm forms the base for all its capabilities, and improves the effectiveness of both first-order capability types (Mata, Fuerst, & Barney, 1995; Santhanam & Hartono, 2003; N. Wang, Liang, Zhong, Xue, & Xiao, 2012).

IT Infrastructure Flexibility and Firm Dynamic Capabilities

The technology and technology-related practices that make up a firm's IT infrastructure serve as the basis for all its competitive activities and the information systems (IS) leveraged in the course of those activities (Byrd, Lewis, & Bradley, 2006; Byrd & Turner, 2000; Davenport & Linder, 1994; Weill, 1993). IT infrastructure flexibility has been previously defined as the integration and modularity of IT resources in the firm (Byrd & Turner, 2000), though Bhatt and Grover (2005) have defined aspects similar in nature to these (e.g., compatibility, modularity, scalability, etc.) as IT infrastructure *quality*, a categorization echoed by Duncan (1995). Research has consistently found that developing a robust and competitively flexible IS infrastructure is a top priority among firm executives (Brancheau, Janz, & Wetherbe, 1996; Byrd et al., 2006; Eckhouse, 1999). Research has highlighted various dimensions underlying the IT infrastructure of the firm, such as connectivity of IT, application operation, compatibility of IT components, transparency of data, effective management of IT, knowledge of the business domain, IT knowledge of top management, and technical skills (Byrd & Turner, 2000). As the flexibility of the IT infrastructure increases, the firm's ability to reconfigure the resources it consists of, even in periods of rapid change, should increase as well. Tian, Wang, Chen, and Johansson (2010) note that organizations possess certain IT deployment capabilities, which they define as

organizational capabilities that enable the firm to reconfigure the components of the IT infrastructure to meet firm strategic needs.

These capabilities to reconfigure the IT infrastructure to meet the competitive needs of the market align with the definition of *dynamic capabilities* of the firm. As the flexibility of the IT infrastructure of the firm increases, the reconfiguration options for IT resources should increase as well, enhancing the capability of the firm to reconfigure them. Byrd and Turner (2001) investigated the relationship between the *technical skills* (Lee, Trauth, & Farwell, 1995) of employees and the modularity and integration found in the firm's IT Infrastructure, and found a positive, statistically significant effect. This would initially suggest an *antecedent* relationship between IT infrastructure flexibility and the IT dynamic capabilities of the firm. It is important to note, though, that their model was based off of prior research (Broadbent & Weill, 1997; Broadbent, Weill, & St. Clair, 1999) that found these IT personnel technical skills key in enabling the firm to reconfigure IT infrastructure resources to effectively create new IT infrastructure capabilities for competitive activities. This would suggest that the technical skills of IT staff are an IT dynamic capability, helping the firm to reconfigure resources, sometimes rapidly. Further, to delineate the nature of the flexibility/dynamic capabilities relationship, Byrd and Turner (2000) note research by De Leeuw and Volberda (1996) who state that higher levels of flexibility allows for higher levels of reconfiguration control over their resources, enabling them to respond to the competitive environment more effectively. Taken together, this would suggest that the flexibility of the IT infrastructure, which allows organizations to respond to changes in the market (Byrd & Turner, 2000), would do so in an antecedent manner to IT dynamic capabilities. Further, this suggests that though technical skills may be present, if the IT

infrastructure is not flexible through its inherent reconfiguration options, the *capability* of the firm to use those skills to reconfigure its IT infrastructure resources will be limited.

Byrd and turner also investigated knowledge of the business domain or *business experience* of IT employees, defined as the IT staff knowledge of business goals, needs and the effective application of IT towards fulfilling these (Bhatt & Grover, 2005; Lee et al., 1995). Though they found a statistically significant effect on dimensions of IT infrastructure flexibility (Byrd & Turner, 2001), we contends a *reverse* of this relationship as described for the technical skills of IT staff above. As the flexibility of the firm's IT infrastructure increases, the ability, or *capability* of IT staff to apply their business domain knowledge in the effective and competitively-driven reconfiguration of IT resources should increase. A more flexible technical infrastructure in the firm gives IT staff more resource reconfiguration options in apply business domain knowledge in adapting to market changes. Bhatt and Grover (2005) found that business experience was an IT capability that was significantly impactful upon the competitive advantage of the firm, an advantage based in the flexibility of the firm's IT infrastructure. Though their empirically tested model did not include a direct link between business experience and IT infrastructure flexibility, Bhatt and Grover (2005) list it as a dynamic capability, enhancing the reconfiguration of resources for opportunity exploitation and competitive advantage. Bhatt and Grover (2005) also noted *IT Relationship Infrastructure*, which they defined as the sharing of risk and management of IT between top executives and the IT staff as a dynamic capability as well. The IT relationship infrastructure takes time to develop, further assists in the effective configuration and use of IT resources through the intra-organizational flow of knowledge, and is another source of competitive advantage for the firm (Barney & Hansen, 1994; Bhatt & Grover, 2005; Nahapiet & Ghoshal, 1998). Application operation or *IT Application Functionality* is

defined as the flexibility to modify and reorganize the modules of software applications with little or no negative systemic effect (Byrd et al., 2006; Byrd & Turner, 2000; Gibson, 1994). Byrd and Turner's (2000) instrument development study found that IT executives within the surveyed firms perceived IT application functionality as a first-order dimension of the IT infrastructure technical second-order factor Modularity. Their study suggests a relationship between the concept of IT infrastructure flexibility and IT application functionality, though assessed in that research context as part of a confirmatory factor analysis (CFA) and instrument development (Byrd & Turner, 2000). We posit that, given the definition for IT application functionality given above, that IT infrastructure flexibility would serve in an *antecedent* role to the ability to modify and reorganize software modules throughout the organization. Byrd, Lewis, and Bradley (2006) conducted further empirical work with the IS infrastructure concept and examined the antecedents *Strategic IS Planning* (SISP) and *IT Integration*. They defined SISP as the level of long term, wide-ranging, and strategically focused consideration of the firm's IT resources and assets (Byrd et al., 2006). This broad and inclusive planning for the use of IT resources assists in the more efficient coupling of hardware and software assets, better allocation and configuration of IT resources, better information sharing and intra-organizational communication, better identification of strategically superior opportunities, and a stronger cooperation between IT and the areas of the organization (Lederer & Sethi, 1988; McLean & Soden, 1977; Pyburn, 1983). In its role of bringing in and usage of information to the effective and competitively beneficial creation, configuration, and usage of IT resources, the research seems to suggest the role of SISP as a dynamic capability of the firm. SISP can be considered here similar to the concept of the Management of IT as noted by Byrd and Turner (2000), through its role in the wise usage of firm IT resources by management and IT staff. Byrd et al.

(2006) empirically tested and found a link between these IT constructs, strengthening the placement of SISP as a dynamic capability. Finally, IT integration is defined as the level interconnectivity of the various software and hardware platforms and systems implemented and used throughout the firm (Byrd et al., 2006). The perceived value of highly integrated IT within the firm is strongly held among businesses and business leaders (Byrd, 2001; B. R. Lewis, Snyder, & Rainer Jr, 1995), reducing costs, human labor and intervention, and increasing the flow of information throughout the organization (Rockart, Earl, & Ross, 1996). Byrd et al. (2006) note IT integration as impactful upon the IT infrastructure of the firm and empirically investigate the effect of SISP upon IT integration, among other dimensions and constructs. Weill (1993; 1998; 2002) notes the strong link between a well-developed IT infrastructure and the competitive advantages and ability of the firm, and specifically notes its ability to facilitate operational capabilities in a firm's various business areas (Weill, 1993). This ability to reconfigure the applications and technologies of an IT infrastructure noted by Weill (1993) and Byrd et al. (2006) would plausibly suggest a relationship between IT infrastructure flexibility and a the ability to develop a well-integrated IT infrastructure (i.e. interconnected and dynamically interoperable). Though a relationship can plausibly be said to exist between *all* of the antecedents noted, we place the flexibility of the IT infrastructure as an antecedent to both SISP and IT integration. This strong interoperability and integration of IT systems equates to the IT connectivity, IT component compatibility, and transparency of data (for better transfer of data between systems) antecedents noted by Byrd and Turner (2000). If the organization has a flexible IT infrastructure that consists of compatible, interoperable, and easily reconfigurable components, this gives the firm an ability to dynamically rearrange these resources to meet new competitive needs, increasing the dynamic capabilities of the firm.

The research literature suggests that each of these previously investigated dimensions can be viewed as IT-focused *dynamic capabilities* of the firm. As each area increases in strength, the ability of the firm to reconfigure its IT resources in order to meet the often rapidly changing demands of the competitive marketplace should increase as well. The IT integration and IT application functionality capabilities of the firm make up the technical "backbone" of the IT infrastructure's reconfiguration ability. These define the nature and characteristics of the IT resources that are available to the firm, and the nature of their relationships to each other, their compatibility, their similarity and differences, and the configurations that are currently available and potentially available in the future. The nature of these technical assets will impact and direct the creation and addition of future assets to the IT infrastructure, limiting the addition of certain technological categories and enabling the addition of others. The technical skills of the IT staff guide the technical administration and maintenance of the technologies and the efficiency of their configuration. The IT staff's business experience empowers personnel to assess the compatibility with and integration into with the operations of the firm of the company's IT infrastructure resources, as well as efficiency of reconfigurations to meet the firm's competitive needs. The IT relationship infrastructure expands this antecedent view out even further, defining the nature of the links between the firms top management team and the technical and personnel IT assets of the firm. This relationship defines the governance structure, the "rules of engagement" between IT and the other divisional areas of the company, and helps foster the flow of information and awareness between the two groups, helping with IT resource acquisition, development, integration, and reconfiguration. This relationship structure, along with the SISP that can then better occur when the IT of the firm is seen as business owned instead of only the focus of one small area of the company, helps to guide the maturation of the firms IT

infrastructure and its alignment with the competitive needs of the firm in many of its areas. These capability antecedents focus really on the *technical* assets available to the firm and their nature, as well as the *knowledge* assets possessed by the firm, emergent from the daily decision making and activity of its management and IT staff.

The characteristics of a firm's IT infrastructure and the abilities needed to reconfigure its resources enable the firm to move quickly in the competitive marketplace in order to match new innovations and innovative activities and decrease a competitor's potential innovative lead (Byrd & Turner, 2000; Duncan, 1995). The attainment of flexibility in interconnected IT hardware, software, knowledge, and skills within the organization has been noted as a top priority by IT executives targeting competitive improvements for the firm and as a competitive weapon in turbulent markets (Byrd & Turner, 2001). This ability to reconfigure the firm's IT resources and change its IT infrastructure to match changes in the competitive environment in an increasingly rapid fashion has been defined as IT infrastructure flexibility (Allen & Boynton, 1991; Brancheau et al., 1996; Byrd & Turner, 2000; Davenport & Linder, 1994; Duncan, 1995; Tian et al., 2010). Byrd and Turner (2000) offer a combined definition of IT infrastructure flexibility based on the idea of easily and effectively diffusing hardware, software, skills, and IT-related values through the technology and people that make up the existing corporate technology structure. Bhatt and Grover (2005) reviewed several empirical studies that investigated the effect of IT planning and IT-related firm capabilities on the firm and its competitive outcomes. Business and IT knowledge of the management team have been found to effect the ability of the firm to assimilate IT (C. P. Armstrong & Sambamurthy, 1999), showing the impact of management's actions through SISP on the diffusion and use of IT throughout the firm, as under Byrd and Turner's (2000) combined definition. Peppard and Ward (2004) note research by Breu,

Hemingway, Strathern, and Bridger (2002) where the impact of the nature of the IT infrastructure, as well as the skills of the IT user, have on the competitive agility of the organization. They further highlight several additional empirical and conceptual studies that note that skills in the management of IT is a strong differentiator for firm competitive success above and beyond direct investments in IT (Peppard & Ward, 2004), investments that can be seen as highly imitable under the resource-based view (RBV) of the firm (Barney, 1997, 2001; Barney, Ketchen, & Wright, 2011). Aral and Weill's (2007) study findings reinforce this notion, as their results suggest that both IT investments and organizational IT capabilities (i.e., IT use and management skills through capability development for organizational goal development), drive differences in firm competitive performance. Bhatt and Grover's (2005) empirical study defined the "quality" of the IT infrastructure as the extent to which it was modular, components were compatible, the infrastructure was scalable, and multitasking in several application environments is possible, among other characteristics. Empirical evidence suggested that these aspects of flexibility had a statistically significant effect on the competitive advantage of the firm, a relationship echoed by other studies (C. P. Armstrong & Sambamurthy, 1999; Broadbent & Weill, 1997; Broadbent, Weill, & Neo, 1999; McKay & Brockway, 1989; Tian et al., 2010; Weill et al., 2002) and suggesting the organizational need for a flexible IT infrastructure.

Bhatt and Grover's (2005) findings further suggest that as mindful and appropriate technology adoption choices are made, the flexibility of the IT infrastructure will increase. Aral and Weil (2007) note research (Broadbent & Weill, 1997; Duncan, 1995) that suggests IT infrastructure investments will impact the ability of the firm to meet future business needs, allow for innovative activity, and improve performance over the long term. As mindful choices account for current and future needs of the organization, IT flexibility should increase, allowing for

future optimal reconfigurations of IT resources. As the infrastructure increases in flexibility, the ability of the firm to rapidly reconfigure these resources (through modularity and the ability to integrate them in the operational processes) should increase as well, suggesting an antecedent relationship between IT infrastructure flexibility and the IT dynamic capabilities of the firm. We align this study with the theoretical evidence and seek to empirically investigate this antecedent relationship, among others.

Empirical research has also previously found a positive relationship between the technology learning activities of the firm and several of the IT infrastructure capabilities noted above. Bhatt and Grover's (2005) study framed organizational learning as a dynamic capability and noted that firms with robust and effective knowledge capabilities (which we frame as purposive and routinized organizational activities for scanning and gathering technological knowledge) will be better able to build and carry out firm capabilities. They note research (Barney, 1991, 1997; Peteraf, 1993; Zhang & McCullough, 2003) which highlights the different extent to which firms build their internally embedded IT capabilities and the learning routines that are key to their creation. The IT capabilities of the firm, and here the IT infrastructure capabilities, are built over time through the gathering and integration of knowledge (Bassellier, Reich, & Benbasat, 2001; Mata et al., 1995). They can be built using knowledge already learned through the firm's construction of similar systems in the past (Neo, 1988), or through the exploration of the activities going on in the competitive environment (Bhatt & Grover, 2005). Bhatt and Grover (2005) specifically point out that increased organizational learning will enable the firm to change the nature of its IT infrastructure, increase IT staff business experience, and potentially restructure the relationship of the IT staff with management and the rest of the organization, an effect most beneficial in rapidly changing environments.

We follow in this line of thinking in this study, where increased knowledge through technological learning routines enhances the ability of firms to make mindful decisions about IT innovations to adopt, enabling increased IT infrastructure flexibility to meet competitive changes in the market through dynamic capabilities. Increasing flexibility in the IT infrastructure should allow rapid reconfiguration of IT infrastructure resources through increased IT dynamic capabilities. The learning the firm engages in, the transformation and integration of the knowledge it accumulates, and the application of that knowledge through internal changes forms a path that illustrates the flow of knowledge through the firm and its effect on the company's competitive stance and effectiveness. A holistic look at the end-to-end flow of knowledge follows next, demonstrating the debate on its nature and structure, and where technological learning, IT innovation mindfulness, IT infrastructure flexibility, and the IT infrastructure dynamic capabilities of the firm lay within this topology.

Absorptive Capacity: The IT Innovation Ecosystem

While some research has examined both the general and specific effects of IT on the firm (Chiasson & Davidson, 2005; Hitt & Brynjolfsson, 1996; Melville et al., 2007; Xue et al., 2012), other studies have also examined the potential effect of implemented firm IT on the processes and routines that make up the dimensions of absorptive capacity (i.e., Roberts et al., 2012). Absorptive capacity has been viewed by literature, among other perspectives, as an organizational capability (W. M. Cohen & Levinthal, 1990; Pavlou & El Sawy, 2006; Roberts et al., 2012). We broadly adopt this view, as we posit that there are specific firm processes, enhanced by IT and examined by the literature, that in fact represent the underlying structure of the absorptive capacity of the firm. The IT that makes up information systems exert an influence

on the firm through its relationships with other firm processes and resources (Wade & Hulland, 2004). Research has shown the impact that developing absorptive capacity has upon the firm (Lane et al., 2006; Lichtenthaler, 2009; Todorova & Durisin, 2007), as well as how IT can enable this development and enhance the firm's ability to gather, internalize, and apply newly gained knowledge (Malhotra et al., 2005).

At an abstract level, absorptive capacity can be thought of as the impact that prior firm learning has on the ability of the firm to evaluate newly gained knowledge and effectively apply it in an attempt to improve its competitive advantage (W. M. Cohen & Levinthal, 1990; Lane et al., 2006). The firm adjusts its operational routines through the integration of newly assessed and processed information, yielding new knowledge and new ability to assess, gather, and process new information in the future. (W. M. Cohen & Levinthal, 1990; Lenox & King, 2004; Lyytinen & Rose, 2006; Teece & Pisano, 1994). This ability, and its impact on the effectiveness with which companies can adopt and implement new innovations (through exploiting the knowledge gathered) is the core idea behind the concept of Absorptive Capacity (W. M. Cohen & Levinthal, 1990; Lenox & King, 2004; Lyytinen & Rose, 2006; Teece & Pisano, 1994; Zahra & George, 2002).

The maturity of an organization's absorptive capacity impacts its ability to both explore/discover new information and new processes developed in the competitive environment and exploit it through integration into its organizational routines and member understandings (Lenox & King, 2004; Teece & Pisano, 1994). The development, implementation, and adjustment of business processes in organizations involve both exploitation and exploration (Levinthal & March, 1993; Levinthal & Rerup, 2006; March, 1991). With exploitation, firms take the knowledge stored in organizational routines and documentation, and that held by its

members, and applies it to daily operations in order to compete marketplace and meet overall business goals. Exploitation of knowledge is used to improve operational efficiencies and reduce costs (Benner & Tushman, 2003). Firms can also engage in exploitation by investing capital in IT capabilities to further improve operational efficiencies, reducing labor, inventory, and waste expenditures (Xue et al., 2012). On the other hand, exploration processes by a firm see it searching for new knowledge when the existing knowledge base is deemed inadequate to fulfill some organizational, environmental, or competitive need. Here, firms search for new knowledge, develop new products or services for the competitive market, and generally advance their innovative traits (Benner & Tushman, 2003). Firms can invest in IT to benefit their exploration capabilities and drive innovation (through knowledge acquisition/organizational learning routines such as technological scanning), facilitating the flow of new knowledge into, out of, and throughout the organization (Xue et al., 2012)

Though the concept of absorptive capacity has been discussed at the individual level with regards to workplace contexts where IT innovations have been introduced to new users (Attewell, 1992; Fichman & Kemerer, 1999; Pavlou & El Sawy, 2006), our focus remains at the organizational level of analysis, in alignment with a majority of IS research on the topic (Roberts et al., 2012). The emergence of the absorptive capacity of the firm is facilitated by the organization having in place appropriate information structures and processes through with knowledge can flow and ease the application of new knowledge to firm processes (Roberts et al., 2012), influencing firm performance and competitive advantage (Zahra & George, 2002). Firm competitive advantage has been linked to the organization's effective ability to deploy capabilities in a manner superior to competitors (Christensen & Overdorf, 2000; Day, 1994; Wade & Hulland, 2004). Those firms with superior IT capabilities have been found to perform

better in the marketplace than those without (Bharadwaj, 2000). Wade and Hulland (2004) further note a study by Marchand et al. (2000) which found that firms with mature abilities in managing their IS, the collection and assimilation routines of gathering information, and the application of that information internally tended to demonstrate superior marketplace performance. Other research has suggested an even stronger link, noting that investments in IT (both infrastructure and applications) benefit the firm in all capabilities areas (operational and dynamic/improvisational) and improve firm performance greatly (Mithas, Ramasubbu, & Sambamurthy, 2011; Mithas, Tafti, Bardhan, & Goh, 2012; Mithas et al., 2013). Still other research notes the primary role that dynamic capabilities in reconfiguring IT resources play in firm performance and sustained competitive advantage (Mata et al., 1995; Santhanam & Hartono, 2003). The literature strongly suggests a link between IT, its use in scanning, assimilating, transforming, and applying information (i.e., its absorptive capacity capability), and the success of the firm. The development of the absorptive capacity capability of the firm is important to its continued competitive success, allowing it to better foresee the value of innovations and gain competitive advantage by adopting and implementing them earlier than peer firms (W. M. Cohen & Levinthal, 1994; Roberts et al., 2012). Knowledge creation capabilities of the firm, represented by the absorptive capacity activities, are key to the sustainment of repeated competitive advantage (Su et al., 2013) as well as the ability of the firm to innovate effectively (Duggan, 2012).

The absorptive capacity of a firm emerges from four broad areas of activity through which knowledge flows and impacts the operations and strategic positioning of the firm. These areas of activities consist of knowledge identification, assimilation, transformation, and application to the firm routines and strategies (W. M. Cohen & Levinthal, 1990; Roberts et al.,

2012). Daspit and D'Souza (2013) call these stages acquisition, assimilation, transformation, and exploitation, and label each stage a *capability* of the firm, its ability to carry each stage of knowledge interaction effectively. We seek to describe and investigate the processes/activities implemented within a firm that enable each one of these absorptive capacity areas. *Knowledge identification* activities are those that involve the firms search for knowledge, both internally and externally (Enkel, Gassmann, & Chesbrough, 2009; Sofka & Grimpe, 2010; Su et al., 2013), through active listening and scanning of the competitive environment (Fosfuri & Tribó, 2008; Liao, Welsch, & Stoica, 2003). *Assimilation* of knowledge occurs after it has been gathered, and these activities help the firm to comprehend the knowledge it has gathered, assess its relevance, determine if the knowledge must be transformed to fit prior an existing knowledge structures, or if it can be directly applied within the organization (Daspit & D'Souza, 2013; Jansen, Van Den Bosch, & Volberda, 2005; Lefkowitz & Lesser, 1988; Zahra & George, 2002). *Transformation* involves activities that alter the structure or context of the gathered and relevant knowledge in order for it to match those internal knowledge structures present within the organization (Fosfuri & Tribó, 2008; Lane et al., 2006; Roberts et al., 2012). Finally, the *application* activities involved in a firm's absorptive capacity see the transformed knowledge being put to use within the firm, altering firm resources and adjusting the strategic position or actions of the firm in the competitive marketplace (W. M. Cohen & Levinthal, 1990; Daspit & D'Souza, 2013; Jansen et al., 2005; Roberts et al., 2012).

Roberts et al. (2012) note that the historical perspectives on the nature of absorptive capacity has included viewing it as a firm asset (i.e., prior learned knowledge), an organizational capability (i.e., in knowledge assimilation), as well as a dynamic capability (i.e., in knowledge application), and they note the potential relationship of these three views. The absorptive

capacity of the firm itself is dependent upon those routines for scanning that bring in new knowledge, process it, and apply it through the adjustment of organizational resources (W. M. Cohen & Levinthal, 1990). We adopt a similar view and propose that the processes of Technology Learning, of IT Innovation Mindfulness (whereby knowledge is considered, incorporated, and transformed for the process of innovation adoption consideration), as well as the IT Dynamic Capabilities of the firm all fit within the overall theoretical structure of absorptive capacity as examined in the literature. Wang and Ahmed (2007) highlight research that suggests as the absorptive capacity of the firm rises, its ability to reconfigure its resources through dynamic capabilities will also rise. Figure 2.1 demonstrates our proposed alignment of organizational routines, traits, and capabilities within the theoretical construct of absorptive capacity. Research has found empirical evidence of a linear relationship between the four absorptive capacity dimensions (Daspit & D'Souza, 2013). While other studies have examined absorptive capacity as an individual construct with multiple dimensions (e.g., Su et al., 2013), our focus is on the firm processes, examined in previous management and information systems literature and also viewed in this study as having a linear relationship, that we put forth underlay these dimensions. Hypothesized relationships the literature suggests exist between these firm processes and capabilities, and examine how they work together to represent the overall absorptive capacity of the firm, are proposed next.

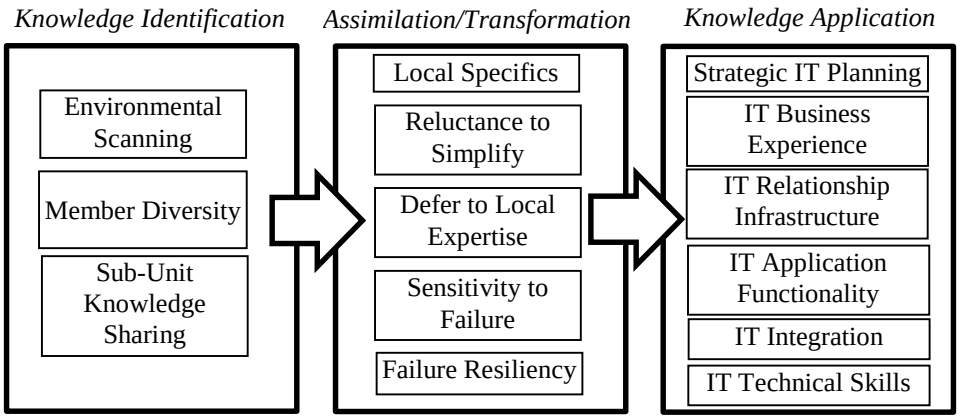


Figure 2.1 Absorptive Capacity Dimensions and Theorized Construct Structure

Theoretical Model

Orilikowski and Iacono (2001) note that not only does IT have an impact upon the organization and its nature but that the nature and activities of the organization changes IT. Knowledge gained from external sources will spur a flurry of Innovation Mindfulness activities. Should we engage in this new process? Will this innovative IT technology bring efficiencies or a competitive edge in the market place? Once mindful consideration of the information/innovation has taken place, the dynamic capabilities of the organization are leveraged in order to fulfill the firms strategic desires brought about by the new information/innovation and enact changes within the organization. This change can impact both the IT resources that support and base the organizational capabilities and the systems that make up the dynamic capabilities. As the competitive environment changes, we put forth that changes, guided by the competitive discourse and context the firm is immersed in, will occur in IT resources (and the existing firm capabilities they enable) to match the new organizational climate and strategy (Orlikowski & Iacono, 2001; Pavlou & El Sawy, 2011). Feedback loops adjust the sensing and learning processes near the top as newly acquired knowledge is considered, processed, and applied, and

organizational processes (both operational and dynamic) are adjusted through lessons learned (Kraatz, 1998; Levinthal & Rerup, 2006; Levitt & March, 1988; March, 1991). Though we acknowledge that firms will generate new knowledge after the implementation of gathered knowledge through routines enabled by their dynamic capabilities, and that this new knowledge will feed back into the knowledge base of the organization to be used in future absorptive capacity activities, we seek to examine only the linear nature of the construct and the uni-directional impact of new knowledge upon the firm.

Broadly, the literature has considered the firm's dynamic capabilities related to its absorptive capacity through the sense that both constructs involve the gathering, processing, and application of information to the operations and routines of an organization (Chatterjee, Pacini, & Sambamurthy, 2002; Roberts et al., 2012). Both constructs have received ample attention in both the organizational and IS literature. Pavlou and El Sawy (2011) drew upon previous work that investigated distinct traits which hinted at process dynamism in firms (Teece, 2007; Teece & Pisano, 1994). Four capabilities were adapted for use in their dynamic capabilities model: Sensing; learning; integrating; coordinating (Pavlou & El Sawy, 2011). Sensing is defined as scanning of the competitive environment for new trends and technologies in order to locate opportunities, and to generate, respond to, and to disseminate market intelligence (C. Galunic & Rodan, 1998; Kogut & Zander, 1992; Pavlou & El Sawy, 2011; Teece, 2007). Learning is the ability to take existing process capabilities and change them using the information gained from the sensing capabilities, through acquiring, assimilating, transforming, and exploiting internal and external knowledge (Pavlou & El Sawy, 2011; Zahra & George, 2002). Integrating capability sees the firm capable of combining information into the new organizational routines and processes that were created during the learning processes, through contribution,

representation, and interrelation of an individual's information to the firm as a whole (Pavlou & El Sawy, 2010). Finally, Coordinating capability enables the firm to deploy resources, as needed, to the newly created processes within the company, by assigning key personnel and optimal finding resource/task fits (Eisenhardt & Galunic, 2000; Pavlou & El Sawy, 2011).

Roberts et al. (2012) call for further empirical work of a "holistic" nature (p. 639) in the investigation of the IT-Absorptive Capacity relationship. Building upon research by Wade and Hulland (2004), Roberts et al. (2012) define three types of IT-grounded organizational capabilities that we believe align closely with Pavlou and El Sawy's (2011) dynamic capabilities construct. Outside-in, spanning, and inside-out IT capabilities are proposed as antecedents to three proposed dimensions of absorptive capacity (Roberts et al., 2012): Outside-in IT capabilities are seen as externally focused technologies, coordinating information flow and action with industry partners and vendors; Inside-out IT capabilities are dominantly internal to the firm, with easy and unrestricted knowledge flow between employees and firm divisions, increasing the ability of the firm to exploit knowledge (Benner & Tushman, 2003); and Spanning IT capabilities bridge the gap between the former two IT system groups, allowing knowledge to flow bi-directionally between internal and external needs.

Their work suggests that the activities that make up the absorptive capacity capabilities of the firm are strongly based in both the type and the structure of the IT implemented within the company. Roberts' et al. (2012) proposed model places these three IT-type categories acting as antecedents to three dimensions of the absorptive capacity construct: Identification, transformation and integration, and application of knowledge (Lane et al., 2006). Zahra and George (2002) similarly structure absorptive capacity as a four-dimension construct involving acquiring, assimilating, transforming, and exploitation of knowledge. These four processes have

been noted as *firm capabilities*, and absorptive capacity has been proposed as the dynamic capability of the firm (Zahra & George, 2002). Pavlou & El Sawy (2011) further explore the nature of dynamic capabilities from a similar perspective. Noting Zahra and George (2002), they similarly align the dimensions of absorptive capacity (learning, assimilation, transformation, and application (W. M. Cohen & Levinthal, 1990; Roberts et al., 2012)) with their proposed parsimoniously grouped dimensions for dynamic capabilities (i.e., sensing, learning, integration, and coordination) (Pavlou & El Sawy, 2011). In positing a more unified model of absorptive capacity, its processes, and how it is based in interrelated categories of IT, we believe the Lane et al (2006), Zahra and George (2002) and Pavlou and El Sawy (2011) dimensions align both in theory and definition. Table 1 demonstrates the alignment and complementarity between the terms.

Table 2.1 Absorptive Capacity Construct Dimensions and Alignment

Authors:	Roberts et al. (2012), Lane et al. (2006)	Zahra and George (2002)	Pavlou and El Sawy (2011)
Term:	Absorptive Capacity	Absorptive Capacity	Dynamic Capabilities
Dimensions:	Knowledge Identification	Knowledge Acquisition	Sensing
	Knowledge Transformation / Integration	Knowledge Assimilation	Learning
		Knowledge Transformation	Integrating
	Knowledge Application	Knowledge Exploitation	Coordinating

These studies demonstrate the close relationship between the IT present in a firm, the learning and knowledge processing routines implemented, and the capabilities of the firm to reconfigure resources to match changes in the competitive environment. We propose that the absorptive capacity construct itself can be thought of *broadly* as an organizational dynamic

capability, but should not be mistaken for dynamic capability itself. Though the literature shows alignment among the various conceptualizations of the dimensions of absorptive capacity, we argue that dynamic capabilities are restricted to those activities that *directly* enable the reconfiguration and creation of firm resources. our attention in this study is on those capabilities for the reconfiguration, implementation, and leveraging of IT resources within the firm, a focus found in few other studies (Tian et al., 2010). Daspit and D'Souza (2013) note research by Volberda et al. (2009) that found those firms who enhance their capabilities in all four of the above discussed absorptive capacity activities find themselves better able to more effectively alter other firm capabilities. The better able the firm is at scanning for and gathering relevant knowledge, storing, transforming, and applying it, the more effective will be their ability to reconfigure existing firm resources used in operational routines. This creates *new* firm capabilities, bestowing upon the organization competitive advantage over their peers in the marketplace. Su et al. (2013) found that the level of absorptive capacity capability in the firm had a positive impact on the firm's instances and ability to act innovatively in the area of new product development, a process that requires both a reconfiguration of firm resources and the new capabilities that the reconfiguration enables. Wang and Ahmed (2007) note prior research that found that processes such as the integration of knowledge, dynamic learning, technology accumulation, and the ability to create, assimilate, integrate, and reconfigure knowledge, among others, all play roles in enabling the dynamic capabilities of the firm. We put forth that this provides an even stronger suggestive link between organizational learning routines such as technological scanning, mindfulness of IT innovations through the assimilation and transformation of knowledge, and the application of that knowledge in reconfiguring IT

resources (i.e., adoption and implementation of IT innovations and innovative processes) by building and enhancing the firm's dynamic capabilities.

The capabilities for exploring, discovering, and in-flowing knowledge to the organization reside in the *acquisition* capabilities of the firm's absorptive capacity. Organizational learning through technology scanning routines, purposefully implemented and executed by the firm, will monitor the turbulence of the market environment closely, through self-exploratory routines, community discourse, partnership weak and strong ties, etc. Outside-In categories of IT artifacts (e.g., inter-organizational systems and supply chain management systems (Nevo, Nevo, & Ein-Dor, 2009; Wade & Hulland, 2004)) enable the functionality for the scanning and gathering of information into the organization through sensing and learning routines.

Next, after the knowledge has been acquired from external sources, it must be considered for applicability to the organizations routines, daily operations, and strategic goals. This knowledge comes in as an *innovation*, something new to be used to meet some new strategic need of the firm, or solve a problem. The innovation can be a process or the mindful consideration of a new IT instantiation. In this *assimilation* and *transformation* newly gathered information will be combined with previously obtained knowledge, transformed if needed, and prepared for relevant use in the organization. Information systems which fall within the "spanning" area of Roberts' et al. (2012) IT-type categorization (e.g., decision support, knowledge management, and ERP systems (Nevo et al., 2009; Wade & Hulland, 2004)) provide the underlying technology allowing for these combinatory knowledge processes. By considering as much of the information at hand as possible, decision makers can make a fully mindful choice as to the knowledge's applicability to the firm, its goals, and allow it to guide changes needed within the organization in order to meet any new challenges in the competitive landscape.

Pavlou and El Sawy (2010, 2011) define dynamic capabilities as a first-order construct, to be carried out depending on the amount of environment turbulence and the needed change in the firm's competitive stance it suggests. Depending on the urgency of the needed change, spurred by the turbulence in the environment, rapid, semi-structured, and fast-implemented improvisational capabilities would be considered *first* if market turbulence were *high*. If market instability is at decreasing levels of activity, then a sort of organizational triage occurs, with capabilities and needed changes to the organizational resources considered and successively occurring more slowly and at more controlled and predictable levels.

Technology Learning and Innovation Mindfulness

Su et al. (2013) point out that when the rate of technology change (i.e., technology turbulence) is high in a competitive market, the technical knowledge possessed by a firm becomes obsolete rapidly (Brockman & Morgan, 2003; Cillo, De Luca, & Troilo, 2010; Talke, Salomo, & Rost, 2010). This reinforces the need for firms to continually engage in environmental scanning in order to stay abreast of the newest IT innovations that could be potential adoption (and implementation) targets. We consider the focus of organizational learning on knowledge related to information technology as *Technology Learning.* Once this information is brought into the organization through scanning routines, intentional sharing of knowledge across sub-units of the firm and the IT that enables this are seen as a key components to the effective development of the organization's overall absorptive capacity capability (Roberts et al., 2012; Teigland & Wasko, 2003). Internally, divisions seeking knowledge can use the spanning-type IT systems (Roberts et al., 2012) to examine technology-related information being gathered by the firm to help in their decision making processes. The information gathered through technology scanning processes empowers the firm to discover and consider more facts

regarding an IT innovation, lessening the tendency to simplify innovation capabilities into assumptions of fit and impact. Roberts et al. (2012) note that when absorptive capacity is viewed as an organizational asset, the literature has focused on its framing as diversity of knowledge and amount of related knowledge possessed by the firm, and that these characteristics of the firm's pool of knowledge are key to the firms' ability to consider IT innovations and impact its absorptive capacity (W. M. Cohen & Levinthal, 1990; Fichman, 2001). Purposeful practices of the hiring of organizational members with diverse experience, knowledge, and backgrounds (W. M. Cohen & Levinthal, 1990; Huber, 1991; Mehrtens et al., 2001), specifically those with diverse knowledge in IT, can increase the knowledge breadth and depth in the firm. The diversity and amount (breadth and depth) of knowledge possessed by the firm assist those organizational members considering a new IT innovation move past mere awareness of the artifact to understanding of the technology and its relevance to organizational routines and competitiveness (Fichman & Kemerer, 1999; Roberts et al., 2012).

The knowledge possessed by the firm impacts the acquisition and application of new related knowledge (Liang, Saraf, Hu, & Xue, 2007) as well as the implementation of a new innovation (C. L. Wang & Ahmed, 2007; Woiceshyn & Daellenbach, 2005). The maturity of the firm's overall absorptive capacity enhances its ability to learn about, consider, adopt, and assimilate new IT innovations (Roberts et al., 2012; Saraf, Liang, Xue, & Hu, 2013), suggesting that these technology scanning routines and mindfulness processes are related and have a place within the construct. More information enables the firm to engage in a more detailed analysis of operational and competitive fit of the innovative process or technology to the firm. As the ability of the firm to engage in the gathering and learning of information increases, we would expect the decision makers within the firm to possess a richer set of information upon which to make

strategic decisions, including the adjustment or revamp of operational processes and the adoption of specific IT technologies. Thus, we state this study's first hypothesized relationship:

Hypothesis 1 (H1): The level of Technological Learning present in the firm will have a positive relationship with the extent of IT Innovation Mindfulness within the firm

Technology Learning and IT Dynamic Capabilities

An organization that seeks to bolster its firm-level learning capabilities through hiring practices that seek a diverse member culture will see an increased ability to identify, process, and apply knowledge that is relevant to operational changes central to the firm's strategic goals (W. M. Cohen & Levinthal, 1990; Huber, 1991; Mehrtens et al., 2001). Firms seeking to enact changes in its IT infrastructure that support new operational and strategic goals will see a benefit from the acquisition of members with diverse IT experience and backgrounds, bolstering the breadth and depth of knowledge possessed by the firm. Research has noted that firm members who have heterogeneous backgrounds in both technical and managerial IT skills will help the organization to sustain a competitive advantage in the market (Mata et al., 1995) through effective, knowledgeable, and competitively beneficial changes in the firm's IT infrastructure (Boar, 1997; Brancheau et al., 1996; Davenport & Linder, 1994; Kettinger, Grover, Guha, & Segars, 1994). The better the organization is at engaging in learning through technological scanning, the larger the amount of detailed knowledge it will possess, assisting the firm in its effective application of new knowledge (W. M. Cohen & Levinthal, 1990; Lenox & King, 2004) through the reconfiguration of the firm's IT resources (Pavlou & El Sawy, 2010, 2011). The literature has shown that the acquisition of knowledge through sensing and scanning routines and its application through reconfigurations in firm resources are related under the absorptive capacity construct (Pavlou & El Sawy, 2011; Roberts et al., 2012; Schwager, Byrd, & Turner,

2000; C. L. Wang, Ahmed, & Rafiq, 2008). Simply stated, the more knowledgeable firm employees are in regards to specific innovations and their capabilities due to purposive technology scanning routines, the more effectively they should be at reconfiguring firm technical resources to meet competitive marketplace shifts (Bhatt & Grover, 2005; Cash, McFarlan, & McKenney, 1992). Organizational learning through technological scanning routines will positively impact the capability of the firm to reconfigure resources and processes that use those resources competitively in the marketplace. The first hypothesis is stated as:

Hypothesis 2 (H2): The level of Technological Scanning present in the firm will have a positive relationship with the firm's Dynamic Capabilities.

IT Innovation Mindfulness and IT Infrastructure Flexibility

A core firm capability described in the absorptive capacity literature is the application of gathered knowledge that it has deemed relevant, and either assimilated or transformed (Lane et al., 2006; Roberts et al., 2012; Zahra & George, 2002). Effective transformation and application of this knowledge depends on the ability of the company to be mindful when considering an IT innovation adoption. IT innovation mindfulness involves the process of carefully considering organizational details (consider local specifics), refusing to accept information *prima-facie* (reluctance to simplify), closely monitoring failures and sub-optimal organizational outcomes (sensitive to failures), and to build resiliency into its infrastructures and processes to prevent failures from severely impacting its competitive stance in the market (failure resiliency) (Butler & Gray, 2006; Fiol & O'Connor, 2003; Mu & Butler, 2009; Swanson & Ramiller, 2004; Weick & Sutcliffe, 2001, 2006). The level of mindfulness with which the firm considers, assimilates, and transforms IT innovation information will have a strong impact on its effectiveness in applying IT-related knowledge in a competitively beneficial manner. A firm with a mindful

focus on the veracity and applicability of the information it has gathered should be better able to understand the impact that information can have on the firm as it guides changes to operational and strategic processes. A firm's ability to leverage its mindful consideration of gathered knowledge in the adoption and implementation of IT innovations depend on the firm's understanding and perception of the quality of the information that it possesses and that information's relevance to strategic goals. Firms that mindfully choose from among IT adoptions will build an increasingly flexible IT infrastructure that can anticipate both current and future business and strategic needs (Duncan, 1995). We state this study's next hypothesis as

Hypothesis 3 (H3): The extent of IT Innovation Mindfulness within the firm will have a positive relationship with the IT Infrastructure Flexibility of the firm.

IT Infrastructure Flexibility and IT Dynamic Capabilities

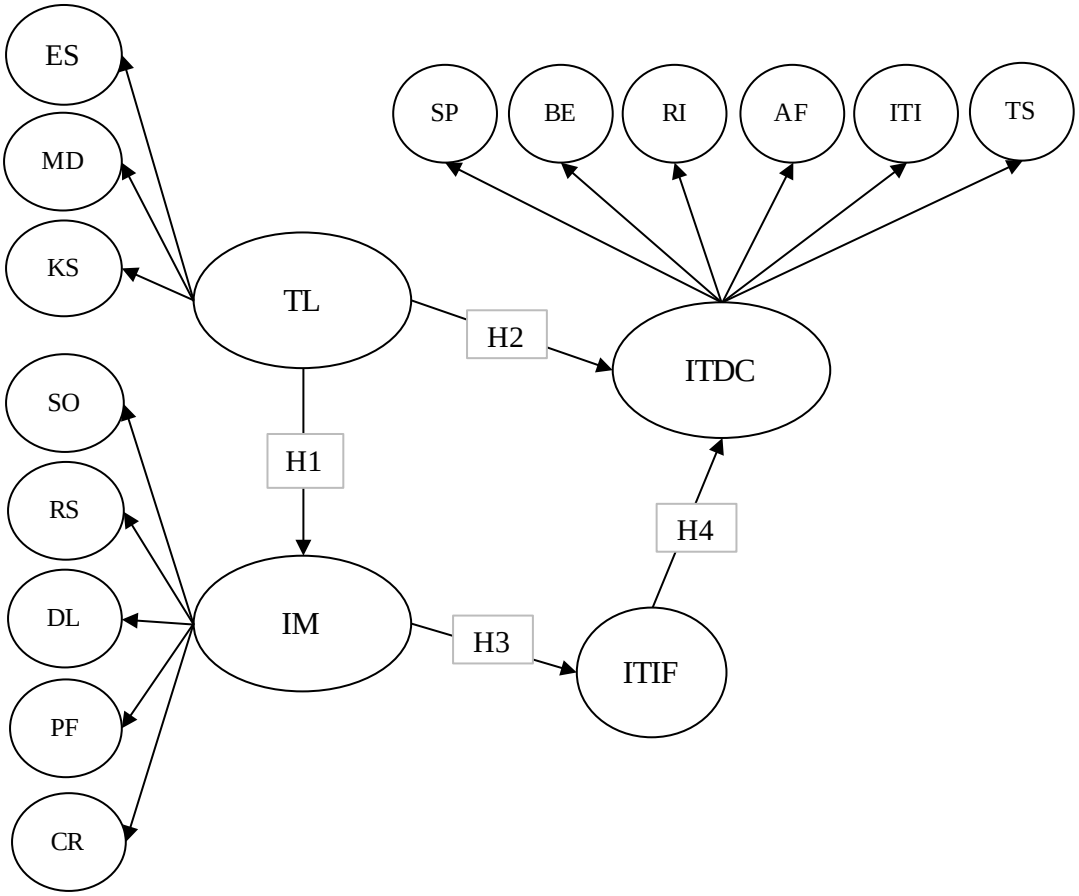
Byrd and Turner (2000, 2001) as well as Bhatt and Grover (2005) explore six dimensions that make up the IT infrastructure of the firm. These have been represented as dynamic capabilities of the firm and we frame them in the same category for study. *Strategic IT planning* has been shown to impact the diffusion, configuration, and use of IT in the firm, (C. P. Armstrong & Sambamurthy, 1999; Kearns & Lederer, 2003; Ravichandran & Lertwongsatien, 2005). The *IT technical skills* of the IT staff, impact the competitive agility of the organization through its use and reconfiguration of the IT infrastructure resources (Breu et al., 2002; Byrd & Turner, 2001; Peppard & Ward, 2004). The knowledge of the IT staff of the operations and strategic goals of the business, framed as the *IT business experience*, has been shown to be related to the successful application of IT capabilities to the competitive actions of the business (Bhatt & Grover, 2005; C. E. Clark, Cavanaugh, Brown, & Sambamurthy, 1997; Reich & Benbasat, 1990; Sabherwal & King, 1995). Next, the *IT relationship infrastructure* sees IT

responsibilities in the firm being shared between the IT staff and the management team, trust building between the two groups, increasing bi-directional communication and knowledge flow, and a greater understanding of the roles, responsibility and work between the two groups (Bhatt & Grover, 2005). With this increased communication and understanding of roles, activities, and responsibilities, the organizational agility in adjusting and reconfiguring the IT resources that make up the IT infrastructure across the firm should plausibly increase to meet rapidly changing competitive needs. This unique relationship of trust, leadership, and interaction between top management and the IT staff is a dynamic capability in its effect on increasing the firm's ability to communicate and coordinate internally and rapidly reconfigure IT resources, giving the firm a potential competitive edge over its peers (Barney & Hansen, 1994; Bhatt & Grover, 2005; Nahapiet & Ghoshal, 1998). Finally, Byrd et al. (2006) define *IT application functionality* as the ease of modifying software applications in the IT infrastructure without wide-spread impacts, and *IT Integration* as the communicative compatibility and ease-of-interaction that technologies in the IT infrastructure have with each other. The modularity, interconnectedness, and characteristics lending towards swapping and altering of components in the IT infrastructure, while sometimes imitable under the RBV view (Barney, 2001; Bhatt & Grover, 2005; Dehning & Stratopoulos, 2003; Peppard & Ward, 2004), limits what reconfigurations are possible when combined with the IT dynamic capabilities of the firm. Those firms with an IT infrastructure consisting of technological components that are modular and easily-alterable should empower the less-imitable capabilities already mentioned to work faster as the competitive environment becomes increasingly turbulent. Put more broadly, a modular and alterable IT technology infrastructure, with IT staff highly trained in technical skills and knowledgeable about the operations and strategic goals of the firm, along with a well-developed communication

relationship with the management staff who regularly include IT in the strategic planning of the organization all represent unique and increasingly non-imitable capabilities of the firm. As the organization increasingly implements a flexible IT infrastructure, it should experience an increase in both the possession of these capabilities and its ability to execute upon them. This advantage enables them to better meet the needs of the turbulent competitive marketplace and maintain or re-gain a competitive advantage (N. Wang et al., 2012). With this, the last hypothesized relationship of this study's research model is stated as follows:

Hypothesis 4 (H4): The level of IT Infrastructure Flexibility in the firm will have a positive relationship with the IT Dynamic Capabilities of the firm.

Figure 2.2 presents the study model with hypothesized relationships between theoretical constructs.



First-Order Factors: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE**: IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills

Second-Order Factors: **TL**: Technology Learning; **IM**: IT Innovation Mindfulness; **ITDC**: IT Dynamic Capabilities

Figure 2.2 Study Hypothesized Relationships

Summary

This chapter has reviewed the literature behind the theoretical constructs of organizational learning (with a focus in this study on *technology* learning), IT innovation mindfulness, IT infrastructure Flexibility, and the IT dynamic capabilities of the firm. The overarching theoretical concept of firm absorptive capacity has been investigated and the

alignment between the main constructs in this study and the absorptive capacity dimensions presented. Finally, relationships between the study concepts grounded in the evidence suggested by the literature have been hypothesized and the theoretical model for the study presented.

Chapter 3: Research Methodology

Context

In the preceding two chapters, various IT and Organizational concepts have been discussed. Research literature from the fields of information systems and strategic management have been reviewed with a focus on understanding past work performed in the areas of organizational learning, innovation mindfulness, firm dynamic capabilities, and IT infrastructure flexibility. We build upon the previous historical and empirical work done in these research areas by focusing its investigation on technology, how organizations learn about and share technology information internally, and how the internal information flow and absorption impacts the firm's ability to reconfigure its technology-related resources for competitive flexibility in the marketplace. First, the impact of technology learning upon innovation mindfulness is examined. Next, the impact that technology learning has upon the IT dynamic capabilities of the firm is investigated. After this, the effect of the presence of IT innovation mindfulness in the firm upon the flexibility of the organization's IT infrastructure is examined. Lastly, the impact of the maturity of firms' skills in reconfiguring its internal technology-related resources through its IT Dynamic Capabilities is investigated. The relationships between these factors are investigated at the organizational level.

Institutional Approval

The Institutional Review Board at Auburn University granted approval to conduct this study on October 9, 2014 under Protocol Number 14-310 EP 1409. A copy of the approval notification is presented in Appendix H.

Research Domain and Participants

Research into the hypothesized relationships between the above mentioned factors of technology learning, IT innovation mindfulness, IT dynamic capabilities, and IT infrastructure flexibility took place in two study phases. An initial pilot study was conducted to broadly sample participants in order to test the measurement validity of our electronic survey instrument. These participants included IT executives, IT management, system administrators, business owners, and chief executive officers (CEOs) of firms, and were seen as appropriate respondent targets due to their position in the firm (Bhatt & Grover, 2005) The full phase of the study was conducted next with a refined electronic survey instrument being administered to a more focused participant window of IT executives and IT management officers only.

Pilot Study

Research Domain

The pilot study of this research involved the administration of the survey instrument to a broad participant sample of IT executives, IT management, system administrators, business owners and CEOs of firms. To build the initial sampling frame for the study, email addresses and basic demographic data were extracted from the Wharton Research Data Services COMPUSTAT Capital IQ database through its People Intelligence service. The Capital IQ database contains regularly updated information on 4.5 million global professionals covering a time span of 1998-2011 (Wharton, 2014). Survey recipients were chosen based on their listed job title and its

relation to technology, ownership of a firm, or its chief executive officer. Table 3.1 lists the job title descriptions used in the search parameters for the query that extracted the pilot study's sampling frame. Further, the query also included those individuals still actively employed within the company listed for that professional at the time of the search. This query yielded 40,879 unique email addresses accurate as of September 30, 2014. The full query can be found in Appendix A.

Table 3.1 Wildcard Criteria Terms for Filtering COMPUSTAT Query Results

Wildcard term:	*information*', '*technology*', '*cto*', '*cio*', '*data*', '*innovation*', '*digital*', '*visionary*', '*knowledge*', '*information technology*', '*computer*', '*computing*', '*CEO*', '*chief executive officer*', '*owner*'

Participants

As the intent of the pilot study is to test the survey instrument broadly across the three groups and determine its efficacy in measuring our targeted constructs at the organizational level, the 40,879 email addresses in our sampling frame were randomly sorted using a normal distribution-based random number generator in Microsoft Excel, in ascending order, and the first 5,000 individuals from the sorted list were chosen as our target participants to recruit for the study. This random sorting was performed to ensure that individuals who fall in IT, owner, or CEO categories would all have an equal chance of having the survey administered to them. Individuals in all three of these categories are seen as being involved daily in both the gathering of information about and choice among the adoption of IT innovations, and coordinating changes in organizational resources and directed efforts towards implementing these innovations in the

firm during the course of strategic activities. These organizational activities and roles position these individuals as appropriate participants in this study. Table 3.2 offers a break-down of the position titles extracted from the random sort that make up the pilot study participant list. After removing one invalid email address, 4,999 professionals made up the final panel to whom the Pilot study survey instrument was administered.

Table 3.2 Pilot Study Participant Sample by Job Title*

Title	Count
Chief Executive Officer	1033
Chief Executive Officer and President	542
Chairman and Chief Executive Officer	145
Chief Executive Officer, President and Director	143
Founder and Chief Executive Officer	142
Chief Executive Officer and Director	139
Chief Technology Officer	131
Co-founder and Chief Executive Officer	93
President and Chief Executive Officer	78
Founder, Chief Executive Officer and President	62
Chief Executive Officer and Managing Director	55
Chief Information Officer	54
Owner	50
Director of Information Technology	43
Chairman of The Board and Chief Executive Officer	42
Chairman, Chief Executive Officer and President	34
Owner and President	30
Co-Founder, Chief Executive Officer and President	28
Co-Founder and Chief Technology Officer	25
Other:	2131
Total:	5000

**Note:* Totals accurate in COMPUTSAT database as of September 30, 2014

Full Study

Research Domain:

The full study phase of this research involved administration of the survey instrument to a very large population of IT executives and management professionals located primarily in the United States, with individuals in firms located internationally making up a small percentage of the study population. One individual per company was chosen for the purposes of the survey administration, due to the intent of the full study to examine the above-described factors at the

organizational level. Individuals who serve as IT executives or at the management level in IT in organizations are seen as ideal candidates for inclusion in the participant list. These individuals deal directly with technology and organizational-related issues on a daily basis and attempt to resolve those issues through well-informed choices about the capabilities and applicability of IT innovations. These individuals not only gather information about IT innovations but also advise the executive team of the organization in regards to which technological activities the organization should engage in in order to meet operational and strategic goals. For this reason, IT executives and IT managers were selected for survey administration to investigate the study's targeted factors at the organizational level.

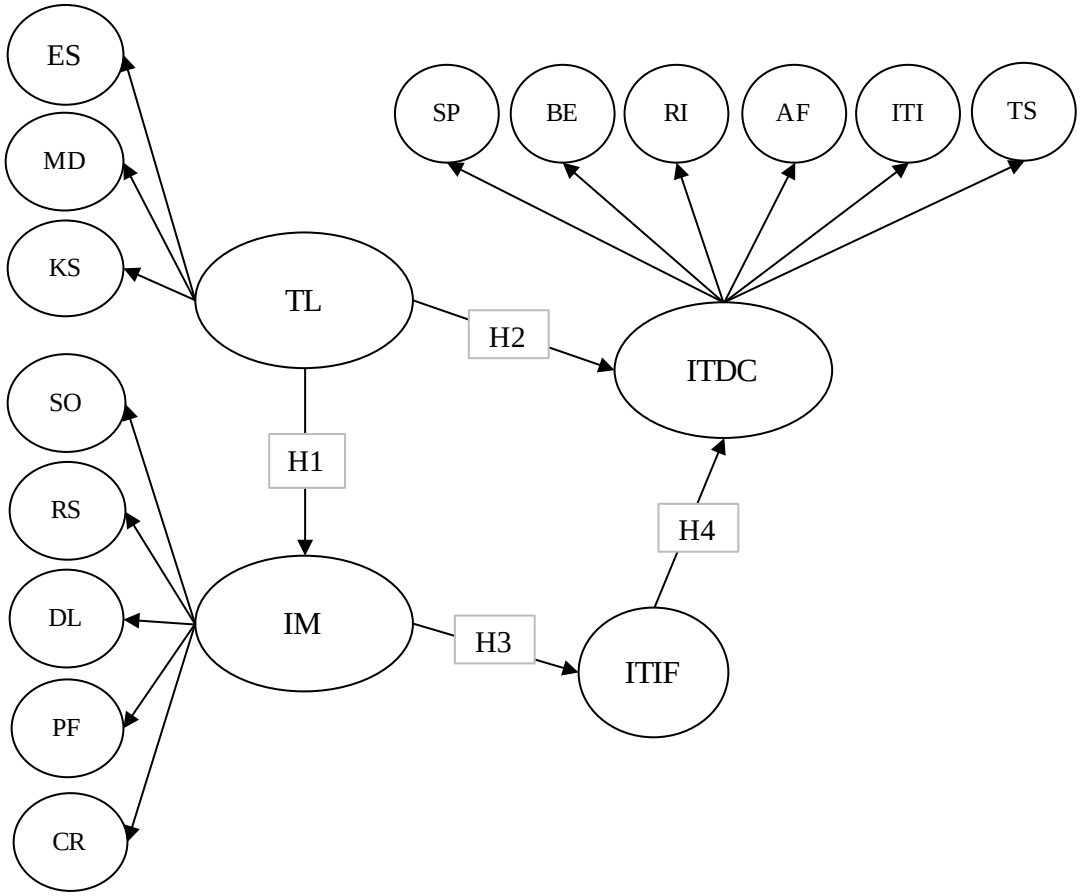
Participants

In order to build the population of IT executives and managers needed for this broad study, IT professionals from two separate databases were used. First, those executives and managers not represented in the sampling frame from the pilot study were selected from the COMPUSTAT Capital IQ People Intelligence database. In the pilot study phase of this research 1,038 IT-related positions were surveyed, leaving 7,501 IT-related professionals available for this study. This list was further reduced to remove any individuals who are located in Canada, in order to meet compliance with Canadian Anti-Spam Legislation ("Fighting Internet and Wireless Spam Act (FISA)," 2014). After this removal, 7,123 individuals in IT-executive and IT management related positions remained. Secondly, a separate listing of participants was obtained from the *Directory of Top IT Executives* which contains email addresses and other related information on 13,500 CIOs and IT Executives (Applied Computer Research, 2014). From this list, individuals who were listed as their company's top IT executive were selected, filtering for only those individuals located in the United States. This resulted in a separate list of 11,837 top

IT executives. Finally, a separate query was run in Microsoft Access to combine these two lists and remove any duplicates found. When combined, the two lists contained 18,960 individuals in IT executive-related positions, and the two lists were found to overlap on only 103 professionals (a .0054% overlap). These individuals' duplicate entries were removed from the COMPUSTAT generated list, along with invalid email addresses, resulting in a final participant email list of 18,856 IT executives and IT management-related positions. Table 3.3 lists a breakdown of the countries represented in the full participant list. As response rates in contemporary survey-based empirical research studies are diminishing, we targeted the full list for survey administration in an attempt to maximize response rates.

Table 3.3 Full Study Potential Participant List with Counts

Country	Count
United States	16405
United Kingdom	458
Sweden	267
Germany	242
Norway	128
Israel	112
Switzerland	104
Finland	102
India	87
Denmark	79
Australia	78
France	72
Other	722
Total:	18856



First-Order Factors: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE**: IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills

Second-Order Factors: **TL**: Technology Learning; **IM**: IT Innovation Mindfulness; **ITDC**: IT Dynamic Capabilities

Figure 3.1 Research Model

Research Model and Measurement Instrument

Study Research Model

We investigate the impact that increasing levels of organizational learning about technology (Technology Learning) and mindfulness regarding choices among IT innovations (IT Innovation Mindfulness) has upon both the IT dynamic capabilities of the firm and its perceived

level of IT infrastructure flexibility. In the previous chapter, hypothesized relationships between these constructs of interest were proposed. Figure 3.1 presents the research model underlying this study.

Development of Measurement Instrument

The research model is made up of three second-order factors each with first-order factors: (1) Technology learning, with 3 first-order factors consisting of: (a) Environmental Scanning; (b) Member Diversity; and (c) Knowledge Sharing; (2) IT Innovation Mindfulness, with 5 first-order factors of: (a) Sensitivity to Local Operations; (b) Reluctance to Simplify; (c) Deference to Local Expertise; (d) Preoccupation with Failure, and (e) Commitment to Resilience; and (3) IT Dynamic Capabilities, with 6 first-order factors consisting of: (a) Strategic IT Planning; (b) IT Business Experience; (c) IT Relationship Infrastructure; (d) IT Application Functionality; (e) IT Integration; and (f) Technical Skills. The model's outcome factor is represented by the first-order IT Infrastructure Flexibility. All first-order factors are measured with items adapted from previous research studies in the IS, strategic management, and organizational literature. Table 3.4 presents a summary of the items used in this study, the literature they are drawn from, and the previously found reliability for those measures. All first-order factors were measured using multi-item scales, and all items were based on a 7-point Likert-type, with scaling ranging from 1 to 7, with 1 referring to the lowest score in the measure ("Strongly Disagree") to 7 representing the highest score ("Strongly Agree").

Items for Technology Learning First-Order Factors

For the factor of Technological Learning, items for *Environmental Scanning* will be adopted from Lichtenthaler (2009). For *Member Diversity* and *Sub-Unit Knowledge Sharing*, items will be adopted from the instrument used by Templeton, Lewis, and Snyder (2002).

Items for IT Innovation Mindfulness First-Order Factors

For the factor of IT Innovation Mindfulness, items for all five dimensions of *Sensitivity to Local Specifics*, *Reluctance to Simplify*, *Deference to Local Expertise*, *Preoccupation with Failure*, and *Failure Resiliency* will be adopted from the measurement instrument used by Mu and Butler (2009).

Items for IT Dynamic Capabilities First-Order Factors

Our focus is on the firm's ability to take incoming IT-related knowledge, process it, and nimbly apply it to the reconfiguration of IT resources for competitive advantage. The items for the first-order factors of IT Dynamic Capabilities seek to measure those IT Infrastructure reconfiguration skills which we hypothesize is impactful upon the IT Flexibility of the firm. Items for *Strategic IS Planning* and *IT Integration* will be adapted from Byrd, Lewis, and Bradley (2006). *IT Business Experience* and *IT Relationship Infrastructure* items will be adapted from Bhatt and Grover (2005). *IT Application Functionality* items will be adapted from Byrd and Turner (2000). Items for *Technical Skills* will be adapted from Byrd and Turner (2001).

Items to Measure IT Infrastructure Flexibility

Our outcome factor of interest will be *IT Infrastructure Flexibility* with six items adapted from a measure used by Bhatt and Grover (2005).

Table 3.4 Summary of Measures Adapted from Prior Studies

Second-Order Factor	First-Order Factor	Source	N of Items	Reliability*
Technology Learning	Environmental Scanning	(Lichtenthaler, 2009)	4	.96
	Member Diversity	(Templeton, Lewis & Snyder, 2002)	3	.69
	Knowledge Sharing	(Templeton, Lewis & Snyder, 2002)	4	.85
IT Innovation Mindfulness	Sensitivity to Local Specifics	(Mu & Butler, 2009)	4	.82
	Reluctance to Simplify	(Mu & Butler, 2009)	4	.73
	Deference to Local Expertise	(Mu & Butler, 2009)	3	.89
	Preoccupation with Failure	(Mu & Butler, 2009)	4	.74
	Commitment to Resilience	(Mu & Butler, 2009)	4	.89
IT Dynamic Capabilities	Strategic IT Planning	(Byrd, Lewis, & Bradley, 2006)	4	.85
	IT Integration	(Byrd, Lewis, & Bradley, 2006)	4	.81
	IT Business Experience	(Bhatt & Grover, 2005)	4	.80*
	IT Relationship Infrastructure	(Bhatt & Grover, 2005)	4	.74*
	IT Application Functionality	(Bhatt & Grover, 2005)	4	.50
	Technical Skills	(Byrd & Turner, 2001)	4	.75
n/a	IT Infrastructure Flexibility	(Bhatt & Grover, 2005)	6	.78*

*Note: Indicated are values of Construct Reliability (Bhattacherjee, 2001; Fornell & Larcker, 1981; Hair et al., 2010), otherwise are Cronbach's alpha (Nunnally & Berstein, 1994) values.

Procedures

Survey Instrument Preliminary Testing

Prior to the beginning of the pilot study phase of this research, the adapted survey instrument was reviewed by three IS doctoral students with prior industry expertise and one Management doctoral student with prior organizational experience at a major University in the southeast. Reviewers were asked to examine the wording of the items for Content validity (Hair, Black, Babin, & Anderson, 2010, p. 125). Measurement items were presented and grouped with their intended target constructs along with a concise definition of that construct as observed from prior research literature. Reviewers were asked to read each item and judge its clarity and compatibility with the construct definition associated with it. After this first round of suggested changes, the survey instrument along with its suggested changes were reviewed by a faculty member in IS at a major University in the southeast. Further changes were suggested and the instrument was increasingly refined. A listing of the final items refined for the Pilot study can be found in Appendix B.

Pilot Study

The adapted and refined survey instrument was administered to 4,999 individuals holding current positions in either an IT Executive or Management-related, Chief Executive Officer, or Owner position in an organization. Administration of the survey and data collection for the pilot study phase of this research took place from November-December, 2014 over a 3-week period. An initial recruitment email was developed to invite each professional to participate in this study by completing the survey. A link to the survey instrument was included in the email. The first page of the survey contained a link that allowed the participant to view the IRB-approved information letter for the survey. Potential participants were informed in both the recruitment email and on the first page of the survey instrument that their participation was completely

voluntary, they were able to withdraw from the study at any time, and that their responses would be completely anonymous. The initial recruitment email script is presented in Appendix C. Initial recruitment emails were distributed through the Qualtrics online survey system. After one week, a reminder email was sent to participants who had not either completed the survey or opted-out, using a recruitment follow-up email, presented in Appendix D. This same follow-up email was sent one-week later for a final recruitment of participants. Appendix F presents the initial Pilot study survey instrument.

In order to increase response participation in the study, during the second and third weeks of data collection, four additional smaller recruitment efforts were made. First, twenty-seven business owners, CEO's, and IT Executives in the southeastern United States were emailed directly with a copy of the initial recruitment email script and invited to participate in the study. This potential participant list was chosen from a review of businesses in the southeastern region and potential compatibility of their daily operations and strategic goals to the constructs under investigation in this study. Second, fifteen professionals in IT management familiar to the study's principle investigator were emailed and presented with the initial recruitment email script and invited to participate in the study. Third, fifteen IT professionals and management-level individuals enrolled in IS distance learning courses at a major southeastern University were presented with the initial recruitment email script and invited to participate in the study. Finally, individuals at the System Administrator forum on the popular social media website Reddit.com. (http://www.reddit.com/r/sysadmin) were invited via three postings to self-select and participate in the study. This forum describes itself as "A reddit dedicated to the profession of Computer System Administration" and lists a subscription rate of 95,594 IT professionals (Reddit.com, 2015). Recruitment postings included information from the recruitment and follow-up email

scripts, along with a link to the survey and contact information for the primary investigator of the study.

Additional Refinement of Measurement Instrument

After the administration of the survey instrument, an analysis of the response data was conducted and the Measurement model was examined through a Confirmatory Factor Analysis (CFA) (Hair et al., 2010; Kline, 2011; Sheskin, 2011; Tabachnick & Fidell, 2006). Descriptive statistics for each item were examined to assess normality of the response data through Skew and Kurtosis values (Kline, 2011; B.R. Lewis & Byrd, 2003; McDonald & Ho, 2002; Tabachnick & Fidell, 2006). Indicator reliability was assessed for each measurement item through examination of the Squared Multiple Correlation (SMC) (MacKenzie, Podsakoff, & Podsakoff, 2011) values. Convergent validity of the items were assessed through examination of the unstandardized and standardized factor loadings (Hair et al., 2010; MacKenzie et al., 2011). Fit of individual measurement items was assessed through examination of their Standardized Covariance Residual values (Hair et al., 2010). Though Modification indices are noted as useful in suggesting misfit of measurement items in a model (Byrne, 2009, p. 177), Sheskin (2011, p. 1706) warns that changes made to the measurement instrument due to Modification index values during a CFA should additionally be "justified" by the literature and theory behind impacted constructs. With this in mind, Modification indices were generated and examined but were not impactful upon the removal or modification of measurement items. Finally, since Model Fit statistics are measures of average fit of the model to the observed variance-covariance matrix, a single stage assessment of fit for the measurement model as a whole is not assistive in helping to identify poorly performing measurement items (Kline, 2011; Sheskin, 2011). With this in mind, overall Model Fit was assessed in a multi-stage manner similar to that conducted by Lewis and Byrd (2003).

After assessment of the pilot study's measurement model through the above reliability and fit statistics, 14 items were dropped from the survey. Additionally, 5 items that were of a poor or mediocre fit but did not exceed commonly accepted thresholds in the literature to drop them from the measurement instrument were retained but their item wordings adapted to more closely match them to the definition of the construct they were associated with. Additionally, the decision was made to retain these items in order to preserve a minimum of 3 measurement items per first-order construct for the purposes of covariance-based Structure Equation Modeling (CB-SEM) (Hair et al., 2010). The changes made to the measurement instrument are noted in the table in Appendix B.

Full Study

The further refined survey instrument was administered to 18,856 individuals holding current positions in either an IT Executive or Management-related position in an organization. Administration of the survey and data collection for the pilot study phase of this research took place from January-February, 2015 over a 3-week period. The initial recruitment email in Appendix C was used to invite each professional to participate in this study by completing the survey. A link to the survey instrument was included in the email. Potential participants were informed in both the recruitment email and on the first page of the survey instrument that their participation was completely voluntary, they were able to withdraw from the study at any time, and that their responses would be anonymous. Initial recruitment emails were distributed through the Qualtrics online survey system.

Because of the technical limitations of the Qualtrics survey system, participant recruitment mailings were split into 5 separate groupings. Participants were randomly sorted and divided into 5 groups, and all five groups were sent both the same initial recruitment email as well as the first follow-up recruitment email in week 2. In week 2, in coordination with the IRB,

2 changes were made to the follow-up recruitment email, and 1 change made to the front page of the survey instrument. The recruitment email was modified to note that: (1) the participant could contact the principle investigator directly to request a summary of the study's findings if they wished; (2) the participant was informed that the IRB-approved information letter for the study could be found on the front page of the survey for their review. The front page of the survey was changed to display the entire IRB-approved information letter for the study. Appendix E lists the second version of the recruitment email approved by the IRB for use in week 3 of the data collection. Appendix G presents the Full Study survey instrument, with the Information Letter for the study displayed as the front page of the survey instrument for week 3 of the data collection. Table 3.5 displays the recruitment mailing schedule used for the study using 5 split panels due to limitations in the survey software. The Qualtrics software removed 23 email addresses from the study potential participant list due to invalidly formed email addresses, resulting in a final number of 18,833 email addresses across the five panels.

Table 3.5 Full Study Recruitment Mailing Schedule

Panel	Size	Week 1	Week 2	Week 3
1	4497	Initial	Reminder 1	Reminder 2
2	2350			Initial
3	4497	Initial	Reminder 1	Reminder 2
4	2996	Initial	Reminder 1	Reminder 2
5	4493	Initial	Reminder 1	
Total	18833			

Statistical Analysis

Integrity of the data and its applicability for CBSEM analysis was assessed. Descriptive statistics for each item were examined to assess normality of the response data through Skew and

Kurtosis values (Kline, 2011; B.R. Lewis & Byrd, 2003; McDonald & Ho, 2002; Tabachnick & Fidell, 2006). A Missing-at-Random test was performed on the data to determine if listwise deletion or if estimation/imputation of missing data values from the existing data was needed to uphold the analytical value of the responses (Gefen, Straub, & Rigdon, 2011; Kline, 2011). The Variance Inflation Factor was calculated in order to check for threshold value violations, which would suggest excessive multicollinarity in the data (Hair et al., 2010; Kutner, Nachtsheim, Neter, & Li, 2004), indicating potential bias in the analysis results. Investigation for outliers in the response data was carried out, to assess possible biasing effects on study results. Non-response bias was conducted in the full study phase to assess potential differences between early and late survey respondents (J. S. Armstrong & Overton, 1977; Gefen et al., 2011)

Construct Reliability

Construct reliability was assessed through the calculation of Cronbach's alpha values (Hair et al., 2010; MacKenzie et al., 2011; Nunnally & Bernstein, 1994), and those values compared to thresholds accepted in the research literature, in order to investigate the ability of items to measure their intended latent variables. Indicator reliability (MacKenzie et al., 2011) was also investigated by assessing the value of the square of each observed variable's factor loading (i.e., Squared Multiple Correlation coefficient) and comparing it to commonly accepted research threshold in the empirical literature.

Construct Validity

Convergent Validity.

We assessed the convergent validity of the constructs by: assessment that measurement item factor loadings on latent variables are statistically significant (Bhattacherjee, 2001; Fornell & Larcker, 1981); assessment of the statistical significance of unstandardized factor loadings of observed items on latent variables, and that standardized factor loadings of observed items on

latent factors are in line with accepted research threshold values (Hair et al., 2010; MacKenzie et al., 2011); assessment of the Average Variance Extracted (AVE) value for all constructs and its comparison with commonly accepted thresholds found in the literature (Hair et al., 2010; MacKenzie et al., 2011).

Discriminant Validity.

We assessed the discriminant validity of measurement items by: assessment of the severity of the inter-correlations of the constructs (Hair et al., 2010); comparison of the AVE value to the square of the construct inter-correlations (Bhattacherjee, 2001; Fornell & Larcker, 1981; Hair et al., 2010); conducting the Chi-Square Difference Test (Bhattacherjee, 2001; Gerbing & Anderson, 1988; Hair et al., 2010; B.R. Lewis & Byrd, 2003) by constraining all latent variable correlations to 1.0 and testing for a statistically significant deterioration in the Chi-Square Goodness-of-Fit statistic.

Common Method Bias

A test for bias introduced via the survey instrument (i.e., Common Method Bias) was conducted by carrying out Harmon's Single-Factor test (Gefen et al., 2011; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Model Fit through Confirmatory Factor Analysis

Model fit statistics was calculated in a manner similar to Lewis and Byrd's (2003) CFA analysis. Model fit was first assessed for each construct individually, and fit statistics generated for each. Secondly, each construct was allowed to co-vary with one other construct. Finally, the fit statistics of the entire measurement model was calculated and reported. For each analysis, the Chi-Square Goodness of Fit (Hair et al., 2010; Kline, 2011; MacKenzie et al., 2011; Sheskin, 2011), Standardized Root Mean Square Residual (SRMSR) (Byrne, 2009; Fabrigar & Wegener,

2009; Hu & Bentler, 1995; Ullman, 2007), Root Mean Square Error of Approximation (RMSEA) (Kline, 2011; Sheskin, 2011), and Comparative Fit Index (CFI) (Byrne, 2009; Gefen et al., 2011; Hu & Bentler, 1995; Kline, 2011; Marsh, Hau, & Wen, 2004; Sheskin, 2011) statistics was calculated and compared to commonly accepted threshold values as accepted by the IS research literature, assessing the fit of this study's implied model to the model observed in the data (Sheskin, 2011).

Hypothesis Testing

Empirical examination of the study's hypothesized construct relationships was conducted through covariance-based structural equation model (CBSEM) analysis (Gefen et al., 2011) of survey data. Control variables included *Level of Environmental Turbulence*, adapted from Wang et al. (2012), as well as *Employee Count*, *Company Revenue (Previous Year)*, *IT Executive Reporting*, and *Industry*, control variables constructed specifically for this study.

Summary

In this chapter, the overall research methodology has been presented. The research domain and scope, and the intended participants for the study have been presented. Participants, procedures, and analyses used in both the study's Pilot phase and Full phase of data collection have been described. Lastly, a detailed listing of the statistical analyses used for the full data collection has been presented that were used to test the hypothesized relationships between the study constructs of Technology Learning, IT Innovation Mindfulness, IT Dynamic Capabilities, and IT Infrastructure Flexibility.

Chapter 4: Results

In the preceding chapter, the procedures, methodologies, and target participants for the Pilot and Full phases of this research study were described. In this chapter, the analysis and results of the data collected from the study phases will be presented. The chapter begins with a presentation of the results of the survey administration and data collection for both study phases, along with respondent and item descriptive analysis. This is followed by an analysis of the data collected during the pilot phase of the study and results from the examination of the measurement model including fit statistics, as well as reliability and validity of the measures used. Next, a summary of the results used to guide the modification of the initial survey instrument are presented. A presentation and analysis of the Full study data follows next, including assessment of the structural model in order to test the hypothesized relationships described in Chapter 2. Results are summarized at the conclusion of this chapter.

Data Collection

Data collection for the study took place in two phases. In the Pilot study phase, a survey instrument was emailed to 4,999 professionals holding either a CEO, ownership, or IT executive / IT Management position within an organization. Professionals were located at firms primarily in the United States, but also consisting of organizations located internationally. Individuals were chosen from the COMPUSTAT Capital IQ database if their listed title within the organization was consistent with those targeted for the study and if they were currently employed at their

firm. The pilot study mailing list was randomly chosen from a larger potential participant list consisting of 40,879 individuals, representing 12.23% of the target population of interest. Individuals working in IT in the southeastern United States, individuals holding CEO and ownership positions in organizations in the southeastern United States, and IT professionals on a popular social media website were also presented with the Pilot study recruitment email script and invited to participate. In the Full study, 18,833 individuals holding IT executive or IT management positions were recruited to participate in the study by completing the survey. This broad mailing represents 100% of the target population of interest for the study. Individuals in the full study consisted of two groups: (1) those individuals working in IT executive or management related positions and currently employed in those positions who were not recruited in the Pilot study; and (2) individuals from the *Directory of Top IT Executives* who were located in the United States only.

Respondent Demographics

Pilot Study

Of the 4,999 professionals recruited in the primary mailing panel, 62 completed responses were received, yielding a response rate of 1.24%. A majority of the contacted IT executives in the southeastern United States, 13 out of 15, completed the survey, yielding an 86.67% response rate for this smaller panel. In the third panel, five IT executives of the 15 IS distance learning students participated in the study by completing the survey, yielding a 33.33% response rate. Finally, out of 159 IT professionals who self-selected and started the survey, 19 complete responses were received, corresponding to an 11.95% completion rate for this fourth panel. In total, 109 completed surveys were collected for the Pilot phase of the study. The completion results are summarized in Table 4.1.

Table 4.1 Pilot Study Participants and Responses

Source	Mailed	Responded	Response Rate
WRDS Capital IQ	4999	62	1.24%
Personal IT Execs	15	13	86.67%
Distance ISMN	15	5	33.33%
Other IT Execs	27	10	37.04%
Reddit Sysadmin	159*	19	11.95%
Total:		109	

**Note*: Quantity of Surveys started by self-selecting participants

Study participants were asked to report on several characteristics pertaining to the firms in which they are currently employed. First, participants were asked to report on the number of employees they estimate to be currently retained by their company. The results found that: 18.35% of respondents reported their company sizes as between 200 and 500 employees; 11.93% of respondents reported a firm size of over 10,000 employees; and an additional 11.93% of respondents reported an employee count at their firm between 50-100 employees, suggesting a broad range of firm size coverage in the response data. Reported employee counts are summarized in Table 4.2.

Table 4.2 Pilot Study Employee Number Demographics

Number of Employees	Frequency	Percentage	Cumulative
0-10	10	9.17%	9.17%
10-20	9	8.26%	17.43%
20-50	9	8.26%	25.69%
50-100	13	11.93%	37.61%
100-200	9	8.26%	45.87%
200-500	20	18.35%	64.22%
500-1,000	8	7.34%	71.56%
1,000-5,000	12	11.01%	82.57%
5,000-10,000	6	5.50%	88.07%
> 10,000	13	11.93%	100.00%
Total	109		

Next, survey respondents were asked to report on the estimated Gross Revenue of their company in the last fiscal year. The results found that: 21.9% of survey respondents reported that their firm brought in over $500 Million in gross revenue the most recent fiscal year; 13.33% reported company revenue in the range of $50 Million to $100 Million, while 12.38% of respondents reported gross revenue in the range of $1 Million to $5 Million; and 28.57% of all respondents estimated that their company's gross revenues were $5 Million or less. Four respondents did not report and estimated gross revenue for their firm in the last fiscal year. The reported gross revenue ranges suggest that a broad range of organizational financial resources are represented in the data, covering the spectrum of resources available to firms for the purchase and implementation of IT innovations and reconfiguration of firm IT resources. Gross revenue data is summarized in Table 4.3.

Table 4.3 Pilot Study Firm Gross Revenue Demographics

Gross Revenue	Frequency	Percent	Cumulative
$1 - $100,000	4	3.81%	3.81%
$100,000 - $500,000	4	3.81%	7.62%
$500,000 - $1 Million	9	8.57%	16.19%
$1 Million - $5 Million	13	12.38%	28.57%
$5 Million - $10 Million	6	5.71%	34.29%
$10 Million - $20 Million	10	9.52%	43.81%
$20 Million - $50 Million	12	11.43%	55.24%
$50 Million - $100 Million	14	13.33%	68.57%
$100 Million - $500 Million	10	9.52%	78.10%
> $500 Million	23	21.90%	100.00%
Total	105		
Missing	4		

Third, survey respondents were asked to report on the leadership structure within the firm: specifically, to what position the top IT officer in the firm reported to. The results found that: 43.12% of participants reported that the firm's top IT officer reported directly to the CEO;

15.6% reported that the firm's President was the direct supervisor of the top IT officer; and 11.01% reported that the Chief Financial Officer (CFO) was directly reported to by the top IT officer. Table 4.4 summarizes the top IT officer reporting structure for the response data. Interestingly, 15.6% of participants reported "Other" and provided other position titles not listed directly in the survey instrument. Four responses were education related: (1) "Chancellor of our campus"; (2) "Provost"; (3) "Senior Associate Dean for MBA Programs"; and (4) "Superintendent. 12 responses listed business related positions for the top IT officer to report to: (1) "Business Unit GM's"; (2) "Chief Marketing Officer"; (3) "Director"; (4) "District Director"; (5) "Elected Official"; (6) "Executive General Manager (who reports to CEO)"; (7) "Managing Partner – Its a partnership"; (8) "Operations Director who reports to the CEO"; (9) "Research and Development Manager"; (10) "System Director"; (11) "Technology Partner"; and (12) "VP of Quality". Finally, one respondent recorded the following for whom their top IT officer position reports to: "We are a resin technology company not an IT company! When we need IT we do it ourselves and use standard programs." The position to who the top IT officer of the company reports to represents and underlying part of the relationship structure between IT and the executive team of the firm (Bhatt & Grover, 2005). The response data from the Pilot study of the firm suggests sufficient coverage of the variety of the relationship structures present in modern organizations.

Table 4.4 Pilot Study Top IT Officer Reporting Structure Demographics

Position	Frequency	Percent	Cumulative
Chief Executive Officer (CEO)	47	43.12%	43.12%
President	17	15.60%	58.72%
Vice President	4	3.67%	62.39%
Chief Operations Officer	8	7.34%	69.72%
Chief Financial Officer	12	11.01%	80.73%
Owner	4	3.67%	84.40%
Other	17	15.60%	100.00%
Total	109		

Lastly, survey respondents were asked to self-report on the primary competitive industry in which their firm operates. Results found that: 12.84% of respondents reported their firm's primary industry as "Technology," with another 12.84% reporting their firm's competitive industry as "Manufacturing"; 10.09% of respondents reported "Health Services" as their firm's primary industry; and 8.26% reporting "Education." The summary of reported firm primary industries is presented in Table 4.5. Additionally, 11.93% of respondents selected "Other" for their primary industry on the survey instrument and self-reported the following 13 industry types: (1) "Aerospace/Defense"; (2) "architecture"; (3) "Biotechnology"; (4) "Computer gaming"; (5) "Defense"; (6) "Entertainment"; (7) "IT Staffing"; (8) "Oil & Gas Engineering, Service, & Manufacturing"; (9) "oil&Gas"; (10) "Public Library System"; (11) "Solid Waste Management"; (12) "Steel"; and (13) "Studebt Loan Guarantor (non-profit)" (sp). The primary industry response data suggests a broad coverage of all types in the Pilot study data.

Table 4.5 Pilot Study Primary Firm Competitive Industry Demographics

Primary Industry	Frequency	Percent
Agriculture	1	0.92%
Banking	6	5.50%
Business Services	4	3.67%
Communications	6	5.50%
Construction	3	2.75%
Education	9	8.26%
Finance	6	5.50%
Government	3	2.75%
Health Services	11	10.09%
Insurance	3	2.75%
Investment	2	1.83%
Legal/Law	2	1.83%
Manufacturing	14	12.84%
Mining/Drilling	1	0.92%
Real Estate	1	0.92%
Retail	0	0.00%
Technology	14	12.84%
Transportation	5	4.59%
Utilities	4	3.67%
Wholesale	1	0.92%
Other	13	11.93%
Total	109	

Full Study

For the Full study phase of this research, 18,833 IT professionals were invited to participate in the study over a four-week period through email recruitment using the refined Full study survey instrument. Of the potential participant group, 229 complete responses were received, yielding a 1.22% response rate. Though the response rate is lower than the desired 15%-20% threshold commonly seen in research, participants in the study were drawn broadly and demographic information obtained from the data suggest a wide sampling across the population. Bhatt and Grover (2005) note that low response rates are common in IS due to difficulty in obtaining responses from top management individuals. Hair (2010, p. 10) notes that as sample sizes rise above 100, statistical test power reaches acceptable levels. The response quantity for this Full study meets the minimum threshold of 200 responses needed for

covariance-based structural equation (CB-SEM) using Maximum Likelihood (ML) estimation (Gefen et al., 2011). As in the Pilot study, Full study participants were asked to self-report on their perception of several characteristics regarding the firm they are currently employed with.

Due to the length of time during which data was collected from survey respondents, and due to the voluntary nature of the respondents self-selecting to complete the administered surveys, the full-study data was analyzed for the presence of non-response bias (J. S. Armstrong & Overton, 1977; Gefen et al., 2011). Non-response bias in an investigation of the assumption that in survey-based research, if a large portion of potential respondents failed to complete a survey instrument (Gefen et al., 2011), that those who returned the survey later in the data-collection window have introduced selection-bias into the responses, and are similar in their bias to those who chose not to return completed surveys (J. S. Armstrong & Overton, 1977; Atif, Richards, & Bilgin, 2012; Clottey & Benton, 2013). Non-response bias in the full study respondent data was investigated using the Wave Analysis Technique, dividing the data into two nearly equal halves (J. S. Armstrong & Overton, 1977) and conducting an two-tailed independent samples t-test (Clottey & Benton, 2013; Sheskin, 2011) on each the variables used in the measurement model, under the assumption of homoscedasticity of variance . All tests were found to be non-significant at the $p < .05$ level, suggesting no statistically significant difference between the mean of the item values in the measurement model between early and late survey respondents.

First, participants reported on the number of employees retained by the organization. Two participants did not report a firm size, with 227 responding. Results found that: 23.79% of participants reported firm size between 500-1000 employees, with 19.82% reporting between 200-500 employees; 63.00% of all participants reported firm sizes of 1,000 or less; and 7.93%

reporting more than 10,000 employees retained by the firm. These responses suggest broad coverage varying-size firms in the data. Table 4.6 summarizes participant reported firm sizes.

Table 4.6 Full Study Employee Number Demographics

Number of Employees	Frequency	Percentage	Cumulative
0-10	5	2.20%	2.20%
10-20	6	2.64%	4.85%
20-50	9	3.96%	8.81%
50-100	10	4.41%	13.22%
100-200	14	6.17%	19.38%
200-500	45	19.82%	39.21%
500-1,000	54	23.79%	63.00%
1,000-5,000	44	19.38%	82.38%
5,000-10,000	22	9.69%	92.07%
> 10,000	18	7.93%	100.00%
Total	227		
Missing	2		

n = 229

Next, participants were asked to estimate the gross revenue of their firms. 23 participants did not report a value for this question, with 206 participants responding. Results found that: 23.79% of study participants estimate the gross revenue of their firm at a value between $100 million and $500 Million for the last fiscal year; 24.27% estimated gross revenue for their organization at over $500 million; and 51.94% of survey participants estimated firm gross revenue at $100 Million or under. The response data for the Full study suggests a wide sampling of firms with financial resources for innovation adoption implementation through IT resource reconfiguration. Table 4.7 summarizes the revenue estimates reported by study participants.

Table 4.7 Full Study Firm Gross Revenue Demographics

Gross Revenue	Frequency	Percent	Cumulative
$1 - $100,000	3	1.46%	1.46%
$100,000 - $500,000	5	2.43%	3.88%
$500,000 - $1 Million	1	0.49%	4.37%
$1 Million - $5 Million	16	7.77%	12.14%
$5 Million - $10 Million	11	5.34%	17.48%
$10 Million - $20 Million	12	5.83%	23.30%
$20 Million - $50 Million	24	11.65%	34.95%
$50 Million - $100 Million	35	16.99%	51.94%
$100 Million - $500 Million	49	23.79%	75.73%
> $500 Million	50	24.27%	100.00%
Total	206		
Missing	23		

n = 229

Table 4.8 summarizes participants' report of who in their firms the top IT officer reports to. 31.72% report that the top IT officer in the organization reports to the firm's CEO, with 19.82% of respondents listing the Chief Financial Officer (CFO) as the position the top IT officer directly reports to. Of the responses, 14.10% of participants listed the firm President as the top IT officer's direct supervisor, and 16.30% of respondents listed custom position titles not included on the survey instrument, answering "Other." These titles are listed in Appendix I.

Table 4.8 Full Study Top IT Officer Reporting Structure Demographics

Position	Frequency	Percent
Chief Executive Officer (CEO)	72	31.72%
President	32	14.10%
Vice President	19	8.37%
Chief Operations Officer	17	7.49%
Chief Financial Officer	45	19.82%
Owner	5	2.20%
Other	37	16.30%
Total	227	
Missing	2	

n = 229

Participants in the full study were also asked to report on the primary industry in which their firm competes. Table 4.9 summarizes this information and suggests a somewhat-broad coverage of major industries. Results found that: 33.48% of all participants reported “Education” as their firms’ primary competitive industry, with 14.54% selecting “Government” on the survey instrument; 9.25% of study participants reported “Manufacturing” as the main industry in which their organization operates, with 3.96% selecting “Technology”; and 10.13% of respondents selected “Other” and self-reported the industry in which they perceive their firm competing. These are listed Appendix J.

Table 4.9 Full Study Primary Firm Competitive Industry Demographics

Industry	Frequency	Percent
Agriculture	2	0.88%
Banking	2	0.88%
Business Services	12	5.29%
Communications	0	0.00%
Construction	7	3.08%
Education	76	33.48%
Finance	4	1.76%
Government	33	14.54%
Health Services	11	4.85%
Insurance	4	1.76%
Investment	2	0.88%
Legal/Law	1	0.44%
Manufacturing	21	9.25%
Mining/Drilling	0	0.00%
Real Estate	2	0.88%
Retail	6	2.64%
Technology	9	3.96%
Transportation	3	1.32%
Utilities	3	1.32%
Wholesale	6	2.64%
Other	23	10.13%
Total	227	
Missing	2	

n = 229

Finally, Full study participants were asked to self-report the name of their position. Three respondents did not provide and answer for this question, with 196 listing the title for their position within the organization. Responses were mixed, with spellings of positions and their titles varying sometimes only very slightly. Some responses listed their technical position and their executive position within the firm. For example, 15.28% of respondents listed “CIO” as the title for their position within the firm, while other respondents reported positions such as “CIO and SVP” or “CIO/VP.” Of the responses gathered, 4.80% reported their position as “CTO” and

0.87% reported “Chief Technology Officer” as their position’s title. Reported position titles are fully listed in Appendix K.

Data Analysis

Pilot Study

Normality and Missing Data

Table 4.10 presents the item-level statistics for the observed variables in the Pilot study. Number of complete responses, mean, standard deviation, skew, kurtosis, and missing data quantity and percentages are reported. All item-level statistics in Table 4.10 were produced and missing-value analysis conducted using the IBM SPSS Statistics (v. 22) software. Assessment of statistics for skew and kurtosis of observed variables have been noted in the literature as an effective means of determining the approximation to normality of the data for these items, with upper thresholds of 3.0 for skew and 10.0 for kurtosis (Kline, 2011; McDonald & Ho, 2002; Tabachnick & Fidell, 2006). All measurement items’ skew and kurtosis values fell under these thresholds, suggesting both an approximate normality to the distribution of our data and the appropriateness of the use of Maximum Likelihood for the estimation of our measurement model (Tabachnick & Fidell, 2006)

Due to the presence of missing data, a missing-value analysis was conducted on the Pilot study data to determine if the pattern of missing data was random, and if the pattern was biasing upon any results of the data analysis. Little’s MCAR test (Hair et al., 2010, p. 63) was carried out, and results (χ^2 (894) = 865.85, p = .74) suggest that the pattern of missing data behaved in a completely random fashion beyond that of random chance (Tabachnick & Fidell, 2006, p. 63). Tabachnick and Fidell (2006) note that for missing data percentages below 5%, any procedure

for handling missing values works effectively well, introducing negligible bias into the results of further statistical analysis (2006, p. 63), while Hair et al. (2010, p. 56) note this threshold as 10%. As reported in Table 4.6, all missing value percentages for our items are well under the stricter 5% level. A regression/trend method (Hair et al., 2010, p. 54; Sheskin, 2011, p. 490) was used to substitute missing values in the data, and more desirable than deletion of cases with missing value, primarily due to our low response quantity (Sheskin, 2011, p. 489). Further analysis of the pilot study data was carried out on the data with missing values substituted with the linear-trend technique.

Table 4.10 Pilot Study Item Level Descriptives

Item	N	Mean	S.D.	Skew	Kurtosis	Missing	Item	N	Mean	S.D.	Skew	Kurtosis	Missing
ES1	108	4.78	1.67	-0.18	-1.18	1 (.9%)	SP2	108	4.31	1.97	-0.06	-1.16	1 (.9%)
ES2	107	4.64	1.60	0.04	-1.28	2 (1.8%)	SP3	108	4.28	1.82	-0.06	-0.94	1 (.9%)
ES3	108	4.59	1.52	-0.08	-0.97	1 (.9%)	SP4	109	4.67	1.82	-0.32	-0.84	0
ES4	108	4.85	1.54	-0.22	-1.01	1 (.9%)	BE1	108	4.35	1.59	-0.14	-0.49	1 (.9%)
MD1	109	4.45	1.79	-0.07	-0.99	0	BE2	106	4.30	1.60	-0.13	-0.58	3 (2.8%)
MD2	109	4.63	1.78	-0.32	-0.99	0	BE3	108	4.48	1.56	-0.27	-0.36	1 (.9%)
MD3	107	2.29	1.89	1.43	0.80	2 (1.8%)	BE4	106	4.15	1.77	-0.09	-0.87	3 (2.8%)
KS1	108	4.27	1.59	-0.03	-0.53	1 (.9%)	RI1	109	4.33	1.84	-0.24	-0.78	0
KS2	109	4.35	1.51	-0.35	-0.35	0	RI2	109	4.30	1.82	-0.31	-0.74	0
KS3	109	5.00	1.64	-0.67	-0.28	0	RI3	108	4.21	1.85	-0.25	-0.76	1 (.9%)
KS4	109	4.18	1.57	0.14	-0.59	0	RI4	108	4.32	1.87	-0.31	-0.82	1 (.9%)
SO1	108	4.27	1.57	-0.10	-0.63	1 (.9%)	AF1	108	4.38	1.74	-0.25	-0.71	1 (.9%)
SO2	108	4.56	1.44	-0.28	-0.22	1 (.9%)	AF2	108	4.19	1.61	-0.09	-0.51	1 (.9%)
SO3	108	4.43	1.72	-0.23	-0.79	1 (.9%)	AF3	105	4.06	1.71	0.00	-0.50	4 (3.7%)
SO4	108	4.31	1.46	-0.12	-0.28	1 (.9%)	AF4	108	3.64	1.88	0.25	-0.90	1 (.9%)
RS1	108	4.44	1.78	-0.37	-0.75	1 (.9%)	ITI1	108	4.85	1.62	-0.38	-0.55	1 (.9%)
RS2	108	4.32	1.73	-0.37	-0.75	1 (.9%)	ITI2	108	4.78	1.60	-0.40	-0.37	1 (.9%)
RS3	108	4.37	1.70	-0.18	-0.83	1 (.9%)	ITI3	108	5.12	1.64	-0.66	-0.19	1 (.9%)
RS4	108	4.18	1.55	-0.07	-0.46	1 (.9%)	ITI4	107	5.05	1.69	-0.56	-0.44	2 (1.8%)
DL1	108	4.94	1.62	-0.52	-0.33	1 (.9%)	TS1	109	3.92	1.93	0.06	-1.06	0
DL2	108	5.06	1.52	-0.59	-0.20	1 (.9%)	TS2	109	4.23	1.86	-0.18	-0.99	0
DL3	108	5.23	1.46	-0.61	-0.04	1 (.9%)	TS3	108	4.02	1.82	0.05	-0.86	1 (.9%)
DL4	107	5.32	1.51	-0.69	-0.15	2 (1.8%)	TS4	108	5.10	1.56	-0.96	0.41	1 (.9%)
PF1	108	4.60	1.64	-0.24	-0.70	1 (.9%)	ITIF1	107	4.36	1.64	-0.16	-0.52	2 (1.8%)
PF2	108	4.63	1.57	-0.34	-0.42	1 (.9%)	ITIF2	107	4.18	1.58	0.08	-0.56	2 (1.8%)
PF3	108	4.69	1.65	-0.24	-0.81	1 (.9%)	ITIF3	107	4.43	1.54	-0.19	-0.22	2 (1.8%)
PF4	108	4.14	1.76	-0.01	-0.84	1 (.9%)	ITIF4	107	4.79	1.55	-0.34	-0.33	2 (1.8%)
CR1	108	5.07	1.51	-0.54	-0.07	1 (.9%)	ITIF5	108	4.84	1.56	-0.40	-0.15	1 (.9%)
CR2	108	4.92	1.73	-0.62	-0.43	1 (.9%)	ET1	108	3.50	1.88	0.52	-0.82	1 (.9%)
CR3	107	4.62	1.89	-0.49	-0.72	2 (1.8%)	ET2	109	3.84	1.79	0.34	-0.85	0
CR4	108	5.36	1.46	-0.93	0.56	1 (.9%)	ET3	108	3.44	1.53	0.62	0.11	1 (.9%)
SP1	109	4.50	1.85	-0.24	-0.97	0	ET4	108	3.63	1.68	0.56	-0.34	1 (.9%)

Note: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE**: IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills; **ITIF**: IT Infrastructure Flexibility; **ET**: Environmental Turbulence

Construct Reliability

Table 4.11 presents the estimation of measurement scale properties for the constructs theorized in the pilot study, as well as inter-correlations between these first-order constructs and their squared correlations. First, Cronbach's alpha reliability statistics were calculated for all first-order constructs used in the measurement instrument (Hair et al., 2010; MacKenzie et al.,

2011). Kline (2011) notes that Cronbach's alpha measures "internal consistency reliability, the degree to which responses are consistent across the items within a measure" (p. 69). The literature has noted acceptable threshold values for this reliability statistic in the range of .50 (Hair et al., 2010) to a stricter level of .70 or above (Kline, 2011). Of the first-order constructs used in the measurement model for the Pilot study, only Member Diversity fell below the stricter of the threshold levels (α_c = .56), suggesting only adequate convergence of this construct on its true score.

Next, construct reliability statistics (Bhattacherjee, 2001; Fornell & Larcker, 1981; Hair et al., 2010) were calculated for all first-order constructs in the measurement model to further assess inter-construct convergence of items, as Cronbach's alpha can potentially underestimate reliability (Hair et al., 2010). Acceptable minimal threshold range from .7 (Hair et al., 2010) to .8 (Bhattacherjee, 2001). In the pilot study results, only Member Diversity failed to meet the lower of the two preferred reliability statistic thresholds (CR = .66).

Finally, standardized and unstandardized factor loadings, Critical Ratios, and Squared Multiple Correlation coefficients (SMC) were calculated, as presented in Table 4.12. MacKenzie et al. (2011) note that the SMC, or variance extracted statistic, estimates the amount of variance explained in an item as by the latent construct loading upon it, with a commonly accepted threshold value is .5 or greater for this statistic. Several measurement items from the Pilot study showed weak variance explanation by their theoretical factor loadings by falling under the .5 threshold: (1) MD3; (2) DL3; (3) PF2; (4) SO2; (5) AF4; (6) SP4; (7) TS4; (8) ET3; and (9) ET4.

Table 4.11 Pilot Study Scale Properties for First Order Constructs

Construct	Mean	S.D.	α[1]	C.R.[2]	AVE[3]	ITIF	ES	MD	KS	SO	RS	DL	PF	CR	SP	BE	RI	AF	ITI	TS	ET
ITIF	4.51	0.29	.94	0.94	0.75	**0.87**	0.27	0.21	0.30	0.26	0.27	0.24	0.15	0.38	0.11	0.26	0.29	0.53	0.20	0.38	0.02
ES	4.73	0.13	.92	0.92	0.74	0.52***	**0.86**	0.46	0.31	0.29	0.39	0.34	0.21	0.18	0.15	0.16	0.27	0.25	0.13	0.15	0.12
MD	3.80	1.31	.56	0.66	0.45	0.46	0.68	**0.67**	0.41	0.42	0.42	0.49	0.22	0.43	0.19	0.25	0.40	0.36	0.34	0.42	0.13
KS	4.46	0.38	.86	0.85	0.60	0.55***	0.55***	0.64	**0.77**	0.74	0.47	0.39	0.13	0.45	0.05	0.35	0.45	0.28	0.10	0.20	0.04
SO	4.39	0.13	.85	0.85	0.59	0.51***	0.54***	0.65	0.86***	**0.77**	0.62	0.48	0.23	0.55	0.06	0.43	0.49	0.30	0.06	0.17	0.02
RS	4.33	0.11	.91	0.91	0.73	0.52***	0.62***	0.65	0.68***	0.79***	**0.85**	0.50	0.24	0.51	0.08	0.25	0.43	0.30	0.10	0.14	0.04
DL	5.15	0.17	.84	0.84	0.58	0.49***	0.58***	0.70	0.62***	0.69***	0.71***	**0.76**	0.36	0.57	0.17	0.16	0.36	0.36	0.20	0.21	0.02
PF	4.52	0.25	.80	0.81	0.52	0.39***	0.46***	0.47	0.36**	0.48***	0.49***	0.60***	**0.72**	0.44	0.28	0.11	0.26	0.14	0.19	0.08	0.06
CR	4.99	0.31	.89	0.89	0.68	0.62***	0.43***	0.66	0.67***	0.74***	0.72***	0.76***	0.67***	**0.82**	0.13	0.29	0.46	0.34	0.22	0.22	0.06
SP	4.44	0.18	.91	0.92	0.74	0.33**	0.39***	0.44	0.23*	0.24*	0.29**	0.41***	0.53***	0.36***	**0.86**	0.29	0.32	0.15	0.19	0.16	0.06
BE	4.33	0.14	.94	0.94	0.79	0.51***	0.4***	0.50	0.59***	0.65***	0.50***	0.40***	0.33**	0.53***	0.54***	**0.89**	0.74	0.31	0.15	0.30	0.00
RI	4.31	0.06	.96	0.96	0.85	0.54***	0.52***	0.63	0.67***	0.70***	0.66***	0.60***	0.51***	0.68***	0.56***	0.86***	**0.92**	0.52	0.12	0.34	0.00
AF	4.05	0.32	.89	0.90	0.70	0.73***	0.50***	0.60	0.53***	0.55***	0.55***	0.60***	0.38***	0.59***	0.39***	0.56***	0.72***	**0.83**	0.11	0.43	0.03
ITI	4.95	0.16	.89	0.89	0.67	0.44***	0.36**	0.58	0.32**	0.25*	0.32**	0.45***	0.44***	0.47***	0.44***	0.39***	0.34**	0.33**	**0.82**	0.27	0.02
TS	4.30	0.56	.87	0.88	0.65	0.62***	0.38***	0.65	0.45***	0.41***	0.37***	0.46***	0.28*	0.47***	0.40***	0.55***	0.59***	0.66***	0.52***	**0.81**	0.00
ET	3.60	0.18	.80	0.79	0.51	0.12	0.35**	0.36	0.19	0.13	0.19	0.15	0.25	0.24*	0.24*	0.02	0.06	0.17	0.16	-0.02	**0.71**

Note: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE**: IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills; **ITIF**: IT Infrastructure Flexibility; **ET**: Environmental Turbulence.

[1] Cronbach's Alpha; [2] Construct Reliability; [3] Average Variance Extracted.

Square-root of AVE values in bold along diagonal. Correlations below diagonal, squared correlations above.

n = 109, ***$p \leq .001$, **$p \leq .01$, *$p \leq .05$

Table 4.12 Pilot Study Item Loadings

Item	B[1]	β[2]	Critical Ratio	SMC[3]	Item	B[1]	β[2]	Critical Ratio	SMC[3]
ES1	1.00	0.80	n/a[4]	0.64	AF2	0.94	0.93	15.53***	0.86
ES2	1.07	0.87	10.42***	0.75	AF3	0.86	0.80	11.34***	0.64
ES3	1.15	0.89	10.72***	0.79	AF4	0.80	0.68	8.43***	0.46
ES4	1.21	0.89	10.77***	0.79	BE1	1.00	0.93	n/a[4]	0.87
KS1	0.97	0.71	7.29***	0.50	BE2	1.03	0.97	21.06***	0.93
KS2	1.18	0.90	9.34***	0.82	BE3	0.91	0.86	14.49***	0.74
KS3	1.02	0.73	7.46***	0.53	BE4	0.93	0.79	11.7***	0.62
KS4	1.00	0.74	n/a[4]	0.55	ITI1	1.00	0.74	n/a[4]	0.54
MD1	3.87	0.82	2.00	0.67	ITI2	1.02	0.76	7.76***	0.57
MD2	3.72	0.79	1.99	0.63	ITI3	1.23	0.89	9.17***	0.79
MD3	1.00	0.20	n/a[4]	0.04	ITI4	1.25	0.88	9.09***	0.78
CR1	1.04	0.84	10.63***	0.70	RI1	1.00	0.90	n/a[4]	0.81
CR2	1.17	0.83	10.39***	0.68	RI2	1.03	0.94	16.72***	0.88
CR3	1.20	0.78	9.55***	0.61	RI3	1.03	0.92	15.99***	0.85
CR4	1.00	0.84	n/a[4]	0.70	RI4	1.03	0.92	15.55***	0.84
DL1	1.26	0.80	7.42***	0.63	SP1	1.00	0.93	n/a[4]	0.86
DL2	1.30	0.88	8.04***	0.78	SP2	1.06	0.92	17.11***	0.85
DL3	0.94	0.66	6.26***	0.44	SP3	1.01	0.96	19.15***	0.91
DL4	1.00	0.68	n/a[4]	0.47	SP4	0.62	0.58	6.98***	0.34
PF1	0.89	0.76	7.86***	0.57	TS1	1.00	0.93	n/a[4]	0.86
PF2	0.62	0.55	5.48***	0.30	TS2	0.94	0.90	14.56***	0.81
PF3	0.90	0.76	7.88***	0.58	TS3	0.82	0.80	11.43***	0.64
PF4	1.00	0.79	n/a[4]	0.62	TS4	0.47	0.54	6.14***	0.29
RS1	1.28	0.88	10.39***	0.77	ITIF1	1.14	0.89	11.47***	0.79
RS2	1.23	0.87	10.21***	0.75	ITIF2	1.13	0.92	12.10***	0.84
RS3	1.21	0.87	10.27***	0.76	ITIF3	1.05	0.87	11.07***	0.75
RS4	1.00	0.79	n/a[4]	0.62	ITIF4	1.01	0.83	10.39***	0.69
SO1	1.05	0.80	9.60***	0.64	ITIF5	1.00	0.82	n/a[4]	0.67
SO2	0.83	0.69	7.77***	0.47	ET1	2.37	0.91	4.56***	0.83
SO3	1.09	0.75	8.83***	0.57	ET2	2.23	0.90	4.56***	0.81
SO4	1.00	0.82	n/a[4]	0.67	ET3	0.96	0.46	3.46***	0.21
AF1	1.00	0.91	n/a[4]	0.83	ET4	1.00	0.43	n/a[4]	0.19

n = 109, ***p ≤ .001

[1]Unstandardized Factor Loadings; [2]Standardized Factor loadings; [3]Squared Multiple Correlation Coefficient; [4]Fixed parameter in AMOS model

Note: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE**: IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills; **ITIF**: IT Infrastructure Flexibility; **ET**: Environmental Turbulence

Construct Validity

A check of construct validity is an assessment of the efficacy of the research instrument's items to measure one or more theorized constructs (Hair et al., 2010, p. 686; Kline, 2011, p. 71). Hair et al. (2010) further note that evidence of construct validity in a measurement instrument suggest an ability of that measure to detect the true construct score of its population (p. 686). Construct validity was assessed through tests for convergent and discriminant validity of the measurement items.

Convergent validity is an assessment of the ability of a set of items to measure the same construct (Kline, 2011, p. 71) through the sharing of a large majority of the estimated variance (Hair et al., 2010). First, statistical significance of all unstandardized factor loadings in the measurement instrument is an initial indicator of convergent validity for items (Bhattacherjee, 2001; Fornell & Larcker, 1981; Hair et al., 2010; MacKenzie et al., 2011; Sheskin, 2011). As presented in Table 4.8, all item factor loadings were significant ($p \leq .001$) except for two: MD2; and MD3. Next, estimates of the standardized factor loadings can suggest evidence of convergent validity if their values are found to be above certain thresholds proposed by the research literature, ranging from greater than .5 to a stricter .7 (Hair et al., 2010; MacKenzie et al., 2011). Except for three items, all standardized factor loadings in the Pilot study were greater than .5, with a majority above the stricter .7 threshold. Low-loading items consisted of: (1) MD3 ($\beta = .20$); (2) ET3 ($\beta = .46$); and (3) ET4 ($\beta = .43$). Finally, assessment of convergent validity was conducted through examination of the Average Variance Extracted (AVE) values, which represent an average of the variance explained by items associated with each construct (Fornell & Larcker, 1981; Hair et al., 2010). Except for Member Diversity (AVE = .45), all calculated AVE values were above the .5 minimum threshold (Hair et al., 2010; MacKenzie et al., 2011)

mentioned in the literature for evidencing convergent validity. Taken together, these three assessments suggest evidence for adequate convergent validity in the measurement instrument. The results suggest that several construct items (e.g., MD3, ET3, ET4) damper the strength of convergent validity in the instrument.

Evidence of discriminant validity in a measurement instrument suggests that its items measure unique and relatively distinct constructs (Gerbing & Anderson, 1988; Hair et al., 2010; Kline, 2011; B.R. Lewis & Byrd, 2003). Discriminant validity for our measurement items was tested in several ways. First, comparison of the calculated AVE values of a construct to the squared values of the inter-construct correlation coefficients between that construct and all others in the CFA model can provide evidence of discriminant validity in a measurement instrument (Bhattacherjee, 2001; Fornell & Larcker, 1981; Gefen et al., 2011; Hair et al., 2010). Calculated AVEs for three of our constructs were found to be lower than the squared inter-correlation coefficient for another construct: (1) Member Diversity (AVE = .45) with Deference to Local Expertise (r^2 = .49); (2) Knowledge Sharing (AVE = .60) with Sensitivity to Local Operations (r^2 = .74); and (3) Sensitivity to Local Operations (AVE = .59) with Reluctance to Simplify (r^2 = .62). AVE values for all other constructs were larger than their associated inter-construct squared correlation values. Second, a chi-square difference test (Bhattacherjee, 2001; Gerbing & Anderson, 1988; Hair et al., 2010; B.R. Lewis & Byrd, 2003) was conducted between the theorized measurement model and a model where correlations between latent first-order factors were constrained to a value of 1. The results of the test were significant ($\Delta\chi^2$ = 2512.88, Δdf = 117, $p \leq .001$), suggesting evidence of discriminant validity. Overall, tests suggest adequate discriminant validity with a few problem constructs/items.

Finally, discriminant validity can be assessed through a test for Common Method Bias (CMB) within the measurement instrument (Gefen et al., 2011). Harmon's Single Factor Test (Gefen et al., 2011; Podsakoff et al., 2003) is tested by conducting an Exploratory Factor Analysis / Principle Components Analysis (Sheskin, 2011) and examining the results of the unrotated factor solution to verify that more than on dominant factor exists in the solution, usually through assessment of eigenvalues greater than 1.0. Results of this test on the Pilot study data suggested a 13 factor solution to our measurement instrument based on the threshold of eigenvalues greater than 1.0. The 13 factor solution accounted for 79.06% of the variance in the data, with first-order factors each accounting for 37.42%, 6.59%, 5.85%, 5.21%, 4.40%, 3.85%, 3.28%, 2.60%, 2.51%, 2.14%, 1.93%, 1.72%, and 1.59% respectively. Results suggested that no one factor accounted for more than 50%. Though this threshold is mentioned in previous research as helpful in determining the presence of a general factor (Podsakoff & Organ, 1986), Podsakoff et al. (2003) note more recently that there is no commonly accepted threshold for this test, and the test itself is limited to a diagnostic function that cannot statistically remedy common method variance in a dataset.

Model Fit Assessment

Measurement model fit was assessed in a step-through manner similar to that carried out by Lewis and Byrd (2003) who follow Gerbing and Anderson (1988) procedures for conducting a full SEM analysis. Model fit indices (Hair et al., 2010; Kline, 2011; Sheskin, 2011) were calculated in each step of the measurement model analysis to determine the average equity of the variance-covariance matrix of the hypothesized measurement model to the observed variance-covariance matrix in the data. Since the fit indices are a measure of average closeness between the two, a step-through method is recommended to pinpoint issues with the measurement model

and determine which constructs, if any, are problematic in modeling the behavior of the underlying data (Kline, 2011; Sheskin, 2011). First, fit statistics were calculated for each first-order construct alone, followed by calculations of fit indices for first-order variables loading on their theorized second-order constructs. Finally, fit indices were calculated for the full measurement model including all first and second-order constructs measured using the survey instrument. Measurement model fit indices are reported in Table 4.9.

First, Chi-Squared Goodness of Fit statistics (Hair et al., 2010; Kline, 2011; MacKenzie et al., 2011; Sheskin, 2011) were calculated during each step. The Chi-Squared fit statistic is used to determine if there is evidence that a statistically significant difference between the observed and hypothesized variance-covariance models (Sheskin, 2011, p. 1704), though it is often seen as sensitive to sample size and may not entirely indicate a poor-fitting model if a significant *p*-value is found (Kline, 2011; Sheskin, 2011). One index was calculated from the incremental model fit family (Hair et al., 2010) The Goodness-of-Fit (GFI) value was produced, which investigates how well the hypothesized measurement model accounts for the variance in the covariance model constructed from the sample data gathered by the researcher (Ullman, 2007). GFI values will range from 0 to 1 (Sheskin, 2011), with values above .90 commonly seen as indicating good fit of the theorized measurement model (Gefen et al., 2011). Next, two fit statistics from the "absolute" family of indices were calculated. Standardized Root Mean Residual (SRMR) (Hair et al., 2010) values were calculated in the CFA analysis. Sheskin (2011) notes the SRMR provides an average of the fitted residual differences between the observed and implied values in the correlation matrix constructed from the gathered data, and presents various acceptable thresholds that SRMR values should fall below: .05 (Byrne, 2009); .06 (Hu & Bentler, 1999; Ullman, 2007); and .08 (Fabrigar & Wegener, 2009). Also, the Root Mean Square

error of Approximation (RMSEA) value was produced in each step of the CFA analysis, known as a badness-of-fit value, with values near 0 suggesting a perfect fit of the hypothesized model to the underlying data (Kline, 2011; Sheskin, 2011). Estimated values of .05 or below are desired for evidence of a well-fitting model (Sheskin, 2011). RMSEA is noted as a well-respected and informative indicator of model fit (Byrne, 2009; Fabrigar & Wegener, 2009; Kline, 2011; Sheskin, 2011). Finally, the Bentler Comparative Fit Index (CFI) is reported for each CFA step, which is an effective indicator of if the hypothesized model is better than a baseline "null" model (Sheskin, 2011) at matching the variance structure in the observed data. Values preferred for the CFI range from above .90 (Gefen et al., 2011; Hu & Bentler, 1999; Marsh et al., 2004) to a stricter threshold of above .95 (Byrne, 2009). Ullman (2007) notes that the RMSEA and the CFI are among the most reported in SEM research and their inclusion in the reporting helps to meet Hair et al.'s (2010) guidelines for what to report in this type of research. Results from the assessment of model fit are presented in Table 4.13

Due to the presence of only three measurement items for the first-order construct of Member Diversity, fit statistics could not be calculated due to full model saturation (Kline, 2011). For all first order constructs except IT Integration (GFI = .84), GFI statistics were above the desired threshold of .9. Apart from Environmental Turbulence (SRMR = .17) and IT Integration (SRMR = .09), all first-order constructs fell below the less restrictive SRMR threshold of .08. Only Preoccupation with Failure (RMSEA (90% C.I.) = .00 (.00, .081)) was estimated to fall below the desired RMSEA threshold of .05. Finally, all first-order constructs had estimated CFI statistics above the desire threshold of .9 except for IT Integration (CFI = .86). Next, model fit was assessed for loadings of second-order constructs on the theoretical groupings of first-order factors. Only Technology Learning (GFI = .91) exceeded the threshold for GFI.

Only IT Dynamic Capabilities (SRMR = .09) failed to meet or fall below the desired threshold of .08. No second-order latent constructs were found to have estimated RMSEA values below the desired .05 threshold, though the 90% confidence interval did contain that value (RMSEA (90% C.I.) = .07 (.023, .100)). All second-order constructs were estimated with CFI values above the desired .9 threshold values. Finally, fit statistics for the full measurement model were also calculated. Results from the Chi-Squared goodness-of-fit found a statistically significant difference between the hypothesized and observed variance-covariance models (χ^2 (1832) = 3187.77, $p \leq .001$) for the Pilot study data. Results from the assessment of model fit suggest a model of mediocre fit to the underlying observed variance (GFI = .58, SRMR = .08, RMSEA (90% C.I.) = .08 (.078, .088), CFI = .80).

Table 4.13 Pilot Study Measurement Model Fit Statistics

Step	2nd Order	1st Order	χ^2(df)	*p* -value	GFI	SRMR	RMSEA	90% C.I.	CFI
(1)	TL	ES	8.62 (2)	.01	0.96	0.02	0.18	(.068, .302)	0.98
		MD[1]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		KS	13.13 (2)	.00	0.95	0.04	0.23	(.121, .351)	0.94
	IM	SO	16.01 (2)	.00	0.93	0.06	0.26	(.149, .377)	0.93
		RS	4.39 (2)	.11	0.98	0.02	0.11	(.000, .242)	0.99
		DL	14.33 (2)	.00	0.94	0.06	0.24	(.133, .362)	0.94
		PF	0.21 (2)	.90	1.00	0.01	0.00	(.000, .081)	1.00
		CR	8.65 (2)	.01	0.96	0.03	0.18	(.068, .303)	0.97
	ITDC	SP	3.05 (2)	.22	0.99	0.01	0.07	(.000, .216)	1.00
		BE	10.34 (2)	.01	0.96	0.03	0.20	(.090, .322)	0.98
		RI	9.32 (2)	.01	0.96	0.01	0.18	(.077, .311)	0.99
		AF	5.56 (2)	.06	0.98	0.03	0.13	(.000, .261)	0.99
		ITI	44.23 (2)	.00	0.84	0.09	0.44	(.335, .560)	0.86
		TS	9.60 (2)	.01	0.96	0.05	0.19	(.081, .314)	0.97
	ITIF	--	18.60 (5)	.00	0.94	0.03	0.16	(.086, .239)	0.97
	ET	--	60.78 (2)	.00	0.82	0.17	0.52	(.414, .638)	0.73
(2)	TL	--	60.29 (41)	.03	0.91	0.04	0.07	(.023, .100)	0.97
	IM	--	299.06 (160)	.00	0.80	0.08	0.09	(.074, .105)	0.90
	ITDC	--	464.84 (237)	.00	0.74	0.09	0.09	(.082, .107)	0.91
(3)	*All*	--	3187.77 (1832)	.00	0.58	0.08	0.08	(.078, .088)	0.80

[1] Unable to calculate individual fit statistics for three-item construct

Note: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE**: IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills; **ITIF**: IT Infrastructure Flexibility; **ET**: Environmental Turbulence; **TL**: Technology Learning; **IM**: IT Innovation Mindfulness; **ITDC**: IT Dynamic

Modification of the Survey Instrument

Pedhazur (1997) notes that initially, most hypothesized theoretical models will have unsatisfactory fit which will lead to modifications. Understanding this, Sheskin (2011) and Kline (2011) warn that modifications should be guided by the theory and literature that study constructs are based in, in addition to empirically-based suggestions for modifications. Though the theoretical constructs investigated in this study were sourced from and individually investigated in prior empirical research, we investigate hypothesized relationships between these constructs in a single model. A pilot study was conducted to assess the efficacy of the measurement instrument towards measuring these constructs, and the empirical results from that study, in addition to close attention to the literature underlying the instrument's constructs,

guided revisions to the study instrument. Table 4.14 summarizes both the dropped items and reworded items that were used for the Full study phase of this research.

The research literature notes several considerations and empirical thresholds that can guide the decision drop items from a measurement instrument in order to improve model fit: Items for which a low standardized factor loading value, generally below .5 (Hair et al., 2010; MacKenzie et al., 2011); Items that are estimated to have statistically non-significant unstandardized factor loadings (MacKenzie et al., 2011); Items estimated to have low values for the Squared Multiple Correlation coefficient (SMC), generally .5 or below (MacKenzie et al., 2011); and through inspection of the Standardized Correlation Residuals and Modification Indices (M.I.) (Kline, 2011). Following assessment of the measurement model's fit through a CFA analysis, these statistics were examined and changes made to the measurement instrument prior to the full study. Nine items were dropped from the survey due to either a low value of the standardized factor loading that exceeded the desired threshold or a low value of the SMC that exceeded the .5 threshold, or both. Item ITI2 was dropped after assessment on three aspects; due to an SMC value near the threshold (SMC = .57); a large M.I. value between its error term and that of ITI1 (M.I. = 30.93), along with a value (M.I. = 11.92) suggested for a path between these observed items, suggesting a high correlation between these two items not well modeled; and finally, the wording for this item, "Our organization has a high level of Communications Technology integration" is similar to the wording for ITI1, "Our organization has a high level of Information Technology integration," it seems out of place in terms of the construct definition, focusing on only one aspect of the IT Infrastructure of the company with other items looking more broadly. KS4's SMC value (SMC = .57) was close to the drop consideration threshold, and also exhibited a high number of standardized residual covariances that, while under a commonly

accepted upper threshold of 4.0 (Hair et al., 2010, p. 649), were above 2.0 suggesting a poor prediction of covariance terms in the model between this item and others. Hair (2010) notes further that standardized residual covariances between +/- 2.5 and +/- 4.0 warrant a closer look and consideration for item removal (p. 703).

Inspection of the wording for KS4, "When employees need expertise that is different than their own, they know exactly who will have it," shows a more singular focus on knowledge sharing in the organization, whereas the other three KS items are focusing on broad knowledge sharing perceptions in the firm. For these reasons, KS4 was dropped from the measurement instrument. ES4 was dropped due to its high number of standardized residual covariances as well as its wording's focus on the firm's industry for technology scanning, instead of a broader look at all technologies (which might be outside the firm's initial consideration but may prove to be beneficial innovation). Five items (ITIF4, ITIF5, ET2, BE4, and CR3) were dropped through the following considerations: their wording were not as focused on the definition of their intended construct as that of the other items for that first-order factor; their estimated SMC and standardized factor loadings were the lowest of the items for that first-order factor; and parsimony in terms of quantity of items on the measurement instrument was sought in order to ensure high survey completion rates. Finally, five items (MD3, KS3, KS1, DL4, and AF3) were retained though they had low values for either the SMC or standardized factor loading, or both, though their wordings were modified to more closely match their first-order construct definitions. Additionally, these items were retained in order to meet the requirement of at least three observed items per latent variable for model identification in covariance-based structural equation modeling (Hair et al., 2010; Ho, 2006; Sheskin, 2011), though Kline (2011) notes that models that have two or more latent variables can have two or more indicators each, and still be

identified (2011, p. 138). One demographic question was added to the measurement instrument, asking participants to self-report their job title/position within their firm. The modified instrument was then administered to the Full study participant list, and is listed in Appendix B.

Table 4.14 Summary of Modifications to Pilot Study Instrument

Item:	β [1]	SMC [2]	Modification (Reason)
SO2	.69	.47	Dropped (Low Thresholds)
RS4	.79	.62	Dropped (Low Thresholds)
DL3	.66	.44	Dropped (Low Thresholds)
PF2	.55	.30	Dropped (Low Thresholds)
SP4	.58	.34	Dropped (Low Thresholds)
AF4	.68	.46	Dropped (Low Thresholds)
TS4	.54	.29	Dropped (Low Thresholds)
ET4	.43	.19	Dropped (Low Thresholds)
ET3	.46	.21	Dropped (Low Thresholds)
ITI2	.76	.57	Dropped (Low Thresholds & High Modification Index)
KS4	.74	.55	Dropped (Low Thresholds & High Quantity of Standardized Residual Covariances)
ES4	.80	.64	Dropped (High Quantitity StandardizedResidual Covariances)
ITIF5	.82	.67	Dropped for Instrument Parsimony
ITIF4	.83	.69	Dropped for Instrument Parsimony
ET2	.90	.81	Dropped for Instrument Parsimony
BE4	.79	.62	Dropped for Instrument Parsimony
CR3	.78	.61	Dropped for Instrument Parsimony
MD3	.20	.04	Reworded to keep three items per first-order construct
KS3	.73	.53	Reworded to keep three items per first-order construct
KS1	.71	.50	Reworded to keep three items per first-order construct
DL4	.68	.47	Reworded to keep three items per first-order construct
AF3	.80	.64	Reworded to keep three items per first-order construct

[1] Standardized Factor Loading value

[2] Squared Multiple Correlation coefficient

Note: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE:** IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills; **ITIF**: IT Infrastructure Flexibility; **ET**: Environmental Turbulence; **TL**: Technology Learning; **IM**: IT Innovation Mindfulness; **ITDC**: IT Dynamic Capabilities; **ITIF**: IT Infrastructure Flexibility

Full Study

Normality and Missing Data

Table 4.15 presents the item-level statistics for the observed variables in the Full study phase of this research. Quantity of complete responses, mean, standard deviation, skew, kurtosis, and quantity of missing data along with percentages are reported for each measurement item. All item-level statistics in Table 4.15 were estimated using IBM SPSS (v. 22). Assessment of skew and kurtosis statistics found all values to be under the literature thresholds of 3.0 and 10.0, respectively (Kline, 2011; McDonald & Ho, 2002; Tabachnick & Fidell, 2006), suggesting approximate normality to our data and the appropriateness of ML estimation for both our measurement and structural models. Due to the presence of missing values in our response data, a missing value analysis was conducted using Little's MCAR test (Hair et al., 2010). Results of the analysis (χ^2 (522) = 470.69, p = .95) suggested that the missing data was missing completely at random, depending neither on the values present or on the pattern of values that were missing (Tabachnick & Fidell, 2006). As reported in Table 4.15, all missing value percentages were well under the 5% level noted by Tabachnick and Fidell (2006) as the threshold of potential inducement of bias in data due to missing data and methods replace them. With the study's low missing-value percentage, a regression/linear trend method was chosen and used to replace missing values in the data (Hair et al., 2010, p. 54; Sheskin, 2011, p. 490). Further analysis of the full study data was carried out on the data with missing values substituted with the linear-trend technique.

Table 4.15 Full Study Item Descriptives

Item	N	Mean	S.D.	Skew	Kurtosis	Missing	Item	N	Mean	S.D.	Skew	Kurtosis	Missing
ES1	228	5.18	1.52	-0.64	-0.22	1 (0.44%)	CR4	228	5.46	1.40	-0.70	-0.28	1 (0.44%)
ES2	227	4.71	1.46	-0.29	-0.76	2 (0.87%)	SP1	229	4.50	1.74	-0.17	-0.95	0 (0.00%)
ES3	228	4.72	1.55	-0.21	-0.99	1 (0.44%)	SP2	229	4.60	1.79	-0.25	-1.01	0 (0.00%)
MD1	228	4.70	1.66	-0.34	-0.78	1 (0.44%)	SP3	229	4.37	1.74	-0.02	-1.15	0 (0.00%)
MD2	228	4.80	1.67	-0.27	-0.95	1 (0.44%)	BE1	228	4.95	1.51	-0.49	-0.36	1 (0.44%)
MD3	228	4.36	1.71	-0.20	-0.93	1 (0.44%)	BE2	229	4.91	1.58	-0.60	-0.36	0 (0.00%)
KS1	228	4.28	1.40	0.09	-0.63	1 (0.44%)	BE3	229	4.90	1.49	-0.44	-0.38	0 (0.00%)
KS2	228	4.22	1.47	0.19	-0.65	1 (0.44%)	AF1	228	4.46	1.65	-0.07	-0.76	1 (0.44%)
KS3	228	4.96	1.53	-0.41	-0.55	1 (0.44%)	AF2	227	4.29	1.68	-0.05	-0.80	2 (0.87%)
SO1	227	4.23	1.50	0.10	-0.70	2 (0.87%)	AF3	227	4.25	1.69	-0.15	-0.74	2 (0.87%)
SO3	227	4.33	1.62	-0.03	-0.89	2 (0.87%)	RI1	229	5.01	1.56	-0.64	-0.16	0 (0.00%)
SO4	228	4.28	1.48	0.10	-0.68	1 (0.44%)	RI2	229	4.79	1.64	-0.49	-0.40	0 (0.00%)
RS1	229	4.30	1.58	-0.01	-0.73	0 (0.00%)	RI3	229	4.64	1.59	-0.30	-0.60	0 (0.00%)
RS2	229	4.27	1.63	0.07	-0.91	0 (0.00%)	RI4	229	4.78	1.62	-0.49	-0.42	0 (0.00%)
RS3	229	4.32	1.67	-0.12	-0.77	0 (0.00%)	ITI1	229	5.22	1.42	-0.53	-0.45	0 (0.00%)
DL1	229	4.81	1.43	-0.22	-0.79	0 (0.00%)	ITI2	228	5.54	1.39	-0.71	-0.13	1 (0.44%)
DL2	229	4.97	1.53	-0.46	-0.70	0 (0.00%)	ITI4	227	5.59	1.40	-0.72	-0.24	2 (0.87%)
DL4	229	5.55	1.47	-0.87	0.19	0 (0.00%)	TS1	229	4.18	1.71	-0.05	-0.72	0 (0.00%)
PF1	229	4.44	1.66	-0.05	-0.91	0 (0.00%)	TS2	229	4.44	1.86	-0.21	-1.11	0 (0.00%)
PF3	229	4.70	1.55	-0.16	-0.67	0 (0.00%)	TS4	229	5.81	1.19	-1.02	0.59	0 (0.00%)
PF4	229	4.28	1.65	-0.01	-0.91	0 (0.00%)	ITIF1	228	4.51	1.49	-0.20	-0.53	1 (0.44%)
CR1	228	5.36	1.48	-0.74	0.03	1 (0.44%)	ITIF2	228	4.21	1.46	0.01	-0.49	1 (0.44%)
CR2	228	5.12	1.54	-0.41	-0.80	1 (0.44%)	ITIF3	228	4.75	1.46	-0.36	-0.34	1 (0.44%)

n = 229

Note: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE**: IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills; **ITIF**: IT Infrastructure Flexibility

Construct Reliability

Table 4.16 provides a summary of the estimated scale property values found for the measurement instrument used in the Full study phase of this research. Cronbach alpha values (Hair et al., 2010; MacKenzie et al., 2011) were calculated for each first-order factor in the measurement instrument. No construct scale was found to have a Cronbach alpha level lower than .75, exceeding the stricter "adequate" threshold noted by Kline (2011, p. 70). Next, Construct Reliability estimates (Bhattacherjee, 2001; Fornell & Larcker, 1981; Hair et al., 2010) were calculated for all first-order factor scales. Bhattacherjee (2001) notes a stricter threshold of .8, and only one factor, Technical Skills (C.R. = .78) was found to have a value lower than this in

the Full study. Finally, unstandardized and standardized factor loadings, Critical Ratios, and Squared Multiple Correlation (SMC) coefficients were calculated for measurement items, as summarized in Table 4.17. MacKenzie et al. (2011) note that SMC values higher than .5 indicate an acceptable indication of variance of an item's values as explained by the latent factor loading upon it. Six items in the measurement instrument fell below this threshold: TS4 (SMC = .28); PF4 (SMC = .39); ITI1 (SMC = .41); DL4 (SMC = .46); SO3 (SMC = .49); and KS1 (SMC = .45). Overall, the results of the construct reliability analysis suggests adequate to good construct reliability, with some items exhibiting problematic values.

Table 4.16 Full Study Scale Properties for First-Order Constructs

Construct	Mean	S.D.	α^1	C.R.[2]	AVE[3]	TS	SO	RS	DL	PF	CR	ES	MD	KS	SP	BE	AF	RI	ITI	ITIF
TS	4.81	0.88	.75	0.78	0.55	**0.74**	0.14	0.29	0.23	0.16	0.12	0.18	0.05	0.17	0.16	0.16	0.14	0.29	0.23	0.22
ES	4.87	0.27	.85	0.85	0.65	0.37	**0.81**	0.31	0.32	0.20	0.21	0.23	0.09	0.15	0.37	0.20	0.09	0.18	0.10	0.12
MD	4.62	0.23	.90	0.90	0.76	0.54	0.56	**0.87**	0.41	0.25	0.32	0.41	0.15	0.27	0.26	0.08	0.17	0.21	0.13	0.10
KS	4.49	0.41	.84	0.84	0.64	0.48	0.57	0.64	**0.80**	0.61	0.56	0.55	0.15	0.51	0.31	0.24	0.27	0.28	0.24	0.23
SO	4.28	0.05	.83	0.83	0.62	0.40	0.44	0.50	0.78	**0.79**	0.48	0.53	0.13	0.46	0.24	0.29	0.23	0.29	0.13	0.24
RS	4.30	0.03	.85	0.86	0.67	0.34	0.46	0.57	0.75	0.70	**0.82**	0.53	0.17	0.44	0.19	0.21	0.32	0.26	0.15	0.20
DL	5.11	0.39	.83	0.84	0.64	0.43	0.48	0.64	0.74	0.73	0.73	**0.80**	0.20	0.64	0.26	0.26	0.31	0.31	0.24	0.16
PF	4.48	0.21	.81	0.84	0.64	0.22**	0.29	0.39	0.38	0.36	0.41	0.45	**0.80**	0.28	0.14	0.14	0.17	0.09	0.11	0.06
CR	5.31	0.17	.88	0.88	0.70	0.42	0.39	0.52	0.71	0.68	0.66	0.80	0.53	**0.84**	0.25	0.21	0.33	0.24	0.21	0.20
SP	4.49	0.11	.94	0.94	0.84	0.40	0.61	0.51	0.56	0.49	0.44	0.51	0.38	0.50	**0.91**	0.32	0.31	0.22	0.23	0.18
BE	4.98	0.03	.94	0.94	0.83	0.40	0.44	0.29	0.49	0.54	0.46	0.51	0.37	0.46	0.57	**0.91**	0.37	0.22	0.15	0.22
RI	4.81	0.15	.90	0.95	0.83	0.37	0.30	0.42	0.52	0.48	0.57	0.55	0.41	0.57	0.55	0.61	**0.91**	0.22	0.23	0.19
AF	4.33	0.11	.95	0.90	0.75	0.54	0.42	0.46	0.53	0.54	0.51	0.56	0.30	0.49	0.47	0.47	0.47	**0.87**	0.22	0.44
ITI	5.45	0.20	.87	0.89	0.73	0.48	0.32	0.36	0.49	0.37	0.39	0.49	0.33	0.45	0.48	0.39	0.48	0.47	**0.86**	0.21
ITIF	4.49	0.27	.87	0.87	0.69	0.47	0.34	0.31	0.48	0.49**	0.44	0.40	0.25	0.44	0.43	0.47	0.44	0.66	0.45	**0.83**

Note: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE**: IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills; **ITIF**: IT Infrastructure Flexibility; **ET**: Environmental Turbulence.

[1] Cronbach's Alpha; [2] Construct Reliability; [3] Average Variance Extracted.

Square-root of AVE values in bold along diagonal. Correlations below diagonal, squared correlations above.

n = 229; **$p \leq .01$, otherwise all corrleations, $p \leq .001$

Table 4.17 Full Study Item Loadings

Item	B [1]	β [2]	Critical Ratio	SMC [3]	Item	B [1]	β [2]	Critical Ratio	SMC [3]
ES3	1.00	0.85	n/a	0.72	CR1	1.07	0.85	15.19	0.73
ES2	0.89	0.80	13.03	0.64	SP1	1.00	0.93	n/a	0.87
ES1	0.88	0.77	11.89	0.59	SP2	1.00	0.91	23.09	0.83
MD3	1.00	0.93	n/a	0.86	SP3	0.96	0.90	22.36	0.81
MD2	0.92	0.87	18.69	0.76	BE1	1.00	0.94	n/a	0.89
MD1	0.85	0.81	17.07	0.66	BE2	1.02	0.92	24.23	0.84
KS3	1.00	0.85	n/a	0.73	BE3	0.91	0.87	21.47	0.76
KS2	0.96	0.85	14.35	0.72	RS1	1.00	0.90	n/a	0.81
KS1	0.72	0.67	10.36	0.45	RS2	1.09	0.93	23.14	0.87
SO4	1.00	0.81	n/a	0.66	RS3	1.02	0.90	21.09	0.81
SO3	0.94	0.70	10.96	0.49	RS4	1.07	0.92	22.82	0.85
SO1	1.05	0.84	13.63	0.71	AF1	1.00	0.92	n/a	0.84
RS3	1.00	0.77	n/a	0.60	AF2	1.02	0.92	20.38	0.84
RS2	1.02	0.80	12.36	0.64	AF3	0.86	0.77	14.23	0.59
RS1	1.06	0.87	13.36	0.76	ITI1	1.00	0.64	n/a	0.41
DL4	1.00	0.68	n/a	0.46	ITI3	1.46	0.95	11.52	0.91
DL2	1.30	0.85	11.17	0.73	ITI4	1.44	0.94	11.57	0.88
DL1	1.22	0.86	11.11	0.73	TS1	1.00	0.84	n/a	0.71
PF4	1.00	0.63	n/a	0.39	TS2	1.06	0.81	12.47	0.66
PF3	1.40	0.94	9.76	0.87	TS4	0.44	0.53	7.24	0.28
PF1	1.28	0.80	9.61	0.64	ITIF3	1.00	0.87	n/a	0.75
CR4	1.00	0.85	n/a	0.72	ITIF2	0.99	0.85	14.32	0.73
CR2	1.05	0.81	14.37	0.66	ITIF1	0.90	0.77	13.10	0.59

n = 229 For all factor loadings, $p \leq .001$

[1]Unstandardized Factor Loadings; [2]Standardized Factor loadings; [3]Squared Multiple Correlation
Note: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE**: IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills; **ITIF**: IT Infrastructure Flexibility

Construct Validity

Construct validity of our theorized factors was assessed through investigation of both convergent and discriminant validity of the factors hypothesized in the Full study. Convergent validity was first investigated. All unstandardized factor loadings, as presented in Table 4.17,

were found to be statistically significant ($p \leq .001$) (Bhattacherjee, 2001; Fornell & Larcker, 1981; Hair et al., 2010; MacKenzie et al., 2011; Sheskin, 2011). Next, except for three items, all estimated standardized factor loadings were larger than .7, with the five items estimated with values larger than the less strict .5 (Hair et al., 2010; MacKenzie et al., 2011): KS1 ($\beta = .67$); DL4 ($\beta = .68$); PF4 ($\beta = .63$); ITI1 ($\beta = .64$); and TS4 ($\beta = .53$); Additional evidence of convergent validity was gathered through assessment of the Average Variance Extracted (AVE) values for the measurement instrument (Fornell & Larcker, 1981; Hair et al., 2010), as listed in Table 4.16. All estimated AVE values were above the .5 threshold noted in the research literature (Hair et al., 2010; MacKenzie et al., 2011; Pavlou, Liang, & Xue, 2006). The results from these assessments suggest adequate convergent validity of our measurement items, with several of these items exhibiting problematic values.

Discriminant validity was investigated through three assessments. First, AVE values for our measurement instrument were compared to the squared values of the intercorrelations for that AVE value's first-order factor and other factors in the instrument (Bhattacherjee, 2001; Gefen et al., 2011; Hair et al., 2010). Only the estimated value of AVE for Deference to Local Expertise (AVE = .64) was found to be equal to or lower than the squared value of a factor intercorrelations, that of Knowledge Sharing ($r^2 = .64$). Next, a chi-square difference test was conducted (Bhattacherjee, 2001; Gerbing & Anderson, 1988; Hair et al., 2010; B.R. Lewis & Byrd, 2003), with results ($\Delta\chi^2 = 3161.8$, $\Delta df = 104$, $p \leq .001$) suggesting evidence of discriminant validity. Finally, discriminant validity in our measurement instrument was tested in a multi-step method as described by Pavlou et al. (2006, p. 122), who note five procedures for testing for common method variance in the measurement instrument. First, a Harmon's Single Factor Test (Gefen et al., 2011; Pavlou et al., 2006; Podsakoff et al., 2003, p. 890) was conducted. Results

suggested an unrotated ten-factor solution for our measurement instrument based on the threshold of eigenvalues greater than 1.0. The ten-factor solution accounted for 73.98% of variance explained in the data, with extracted factors each accounting for 39.23%, 6.01%, 5.63%, 4.96%, 4.11%, 3.40%, 2.99%, 2.83%, 2.42%, and 2.41% respectively. No one factor was found to account for a majority of the variance explained in the observed data, suggesting evidence of a lack of common method variance in the data (Pavlou & El Sawy, 2006; Podsakoff et al., 2003). Next, a partial correlation procedure was carried out on the *structural* model to test for a common latent factor's (CLF) ability to partial out explained variance in the observed data and impact the statistical significance of the hypothesized structural relationships between factors (Podsakoff et al., 2003). Podsakoff et al. (2003) note that the scale score for the largest unrotated factor from the measurement instrument is loaded into the structural model as a control variable, and the statistical significances of the hypothesized structural paths observed for any changes to non-significance (p. 893). For the full study, all unrotated factor loadings were found to be above .3, a level that can serve as a minimum heuristic for evidence a factor structure if sample sizes are larger than 200 (Hair et al., 2010, p. 117). All items were included in the calculation of a factor score for the CLF and when included in the structural model, all structural model paths remained statistically significant, though values reduced for two paths' significance levels (Technology Learning on IT Dynamic Capabilities, $p \leq .01$ from .001, and IT Infrastructure Flexibility on IT Dynamic Capabilities, $p \leq .01$ from .001), suggesting present but not influential common method bias. Third, the correlation matrix for the measurement model was examined for any first-order factor correlations greater than $r = .90$ which would further suggest evidence of common method bias (Pavlou et al., 2006). No inter-factor correlation above $r = .8$ was observed in the data, suggesting a lack of common method bias in the measurement instrument.

Finally, Pavlou et al. (2006) suggest two additional methods for assessing common method bias: the inclusion of an theoretically unrelated marker variable/factor, which was not included in this study due to the already large survey instrument; and the collection of longitudinal data for the study dependent variable, unavailable for the cross-sectional nature of this study. Overall, results from these tests suggest a lack of influential common method bias in our measurement instrument. Further, the above results broadly suggest adequate discriminant validity in our measurement instrument's ability to measure distinct hypothesized factors in our data.

Measurement Model

Similar to the steps noted by Lewis and Byrd (2003) and as performed in the Pilot phase of this study, a step-through methodology was used to assess the fit of the hypothesized measurement model to that of the observed data (Gerbing & Anderson, 1988). Model fit indices (Hair et al., 2010; Kline, 2011; Sheskin, 2011) were estimated for first-order factors as they were allowed to co-vary with those factors hypothesized to group together under a second-order latent variable. Differences in the reliability estimates for the measurement instrument between the pilot and full study phases were expected and found, due to differences in the sample sizes between the study phases, and the effect of this difference on standard errors for each item. First-order factors for Technology Learning, IT Innovation Mindfulness, and IT Dynamic Capabilities were allowed to co-vary with their groupings first, then all factors in the full measurement model were allowed to co-vary, and fit indices estimated at each step. Chi-Squared Goodness-of-Fit, Goodness-of-Fit (GFI), Standardized Root Mean Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), and Bentler Comparative Fit Index (CFI) values were calculated as the fit indices for the step-through approach (Byrne, 2009; Fabrigar & Wegener, 2009; Hair et al., 2010; Kline, 2011; Sheskin, 2011; Ullman, 2007). As opposed to the Pilot study, individual

fit assessment of each first-order factor was not possible, with each factor being just-identified (three items per first-order factor) (Kline, 2011, p. 126) and lacking the degrees-of-freedom to calculate fit indices. Table 4.18 summarizes the values found during model fit assessment. All Chi-Square tests for fit were found to be statistically significant. GFI for IT Dynamic Capabilities (GFI = .86) was found to be below the desired threshold of .9 (Gefen et al., 2011), with other second-order factor groupings estimated with GFI values above. The SRMR value for IT Dynamic Capabilities (SRMR = .11) also failed to meet the less restrictive threshold of .8 (Fabrigar & Wegener, 2009), with other second order factor groupings falling above. No second-order groupings were estimated with a RMSEA value below the desired .5 threshold (Sheskin, 2011), though the 90% RMSEA confidence interval does contain this threshold for Technology Learning and IT Innovation Mindfulness. All second-order groupings were found to have CFI values above .9 (Gefen, Karahanna, & Straub, 2003; Hu & Bentler, 1999; Marsh et al., 2004). In the second-step, the full measurement model was assessed by allowing all first-order factors to co-vary with each other. Results suggest mediocre fit of the full measurement model (χ^2 = 1483.00, df = 884, $p \leq .001$; GFI = .79; SRMR = .08; RMSEA (90% C.I.) = .06 (.050, .059); CFI = .93).

Table 4.18 Full Study Measurement Model Fit Indices

Step	2nd Order	1st Order	χ^2(df)	*p* -value	GFI	SRMR	RMSEA	90% C.I.	CFI
(2)	TL	--	39.29 (24)	.03	.96	.04	.05	(.019, .082)	.99
	IM	--	143.659 (85)	.00	.93	.07	.06	(.039, .070)	.97
	ITDC	--	344.93 (146)	.00	.86	.11	.08	(.067, .088)	.95
(3)	--	*All*	1483.00 (884)	.00	.79	.08	.06	(.050, .059)	.93

n = 229

Note: **TL**: Technology Learning; **IM**: IT Innovation Mindfulness; **ITDC**: IT Dynamic Capabilities

Structural Model

Assessment of the Full study's measurement model found evidence that suggests Construct Reliability, Construct Validity, and adequate fit of the hypothesized factors targeted in the measurement instrument. The final step in our analysis was to assess the statistical significant of the hypothesized relationships between our study's second-order factors. The examination of the fit statistics for the full structural model suggested adequate fit of the model to the study data (χ^2 = 1691.39, df = 971, $p \leq .001$; GFI = .76; SRMR = .09; RMSEA (90% C.I.) = .06 (.053, .062); CFI = .91). A chi-square difference test performed on the fit statistics for the structural model as compared to the measurement model found a statistically significant difference in the fit of the two to the underlying observed data ($\Delta\chi^2$ =208.9, Δdf =87, $p \leq .001$), an expected difference as the structural model is a more simplistic representation of inter-construct relationships (Hair et al., 2010, p. 719). All factor loadings were found to be statistically significant ($p \leq .001$). All hypothesized path coefficients were also found to be statistically significant ($p \leq .001$). In a structural model, the R^2_{smc} of a variable is calculated by squaring the value of the standardized regression weight(s) between that variable and its predictor (Sheskin, 2011, p. 1712). It is considered a measure of the extent to which a variable variance is explained by a predictor (Hair et al., 2010), or in a structural model, the amount of variability in a latent variable explained by the variability of a predictor variable (Sheskin, 2011, p. 1712). For the structural model investigated in the Full study, the R^2_{smc} value for IT Innovation Mindfulness is .883, suggesting that 88.3% of its variance is explained by its predictors. The R^2_{smc} for IT Infrastructure Flexibility was estimated at .273, suggesting 27.3% of its variance is explained by its predictors, and the R^2_{smc} for IT Dynamic Capabilities was estimated at .831, suggesting 83.1% of its variance is explained by Technology Learning and IT Infrastructure Flexibility in the firm. Kline (2011, p. 53) notes that values for R^2_{smc} greater than or equal to .90 for a variable suggests

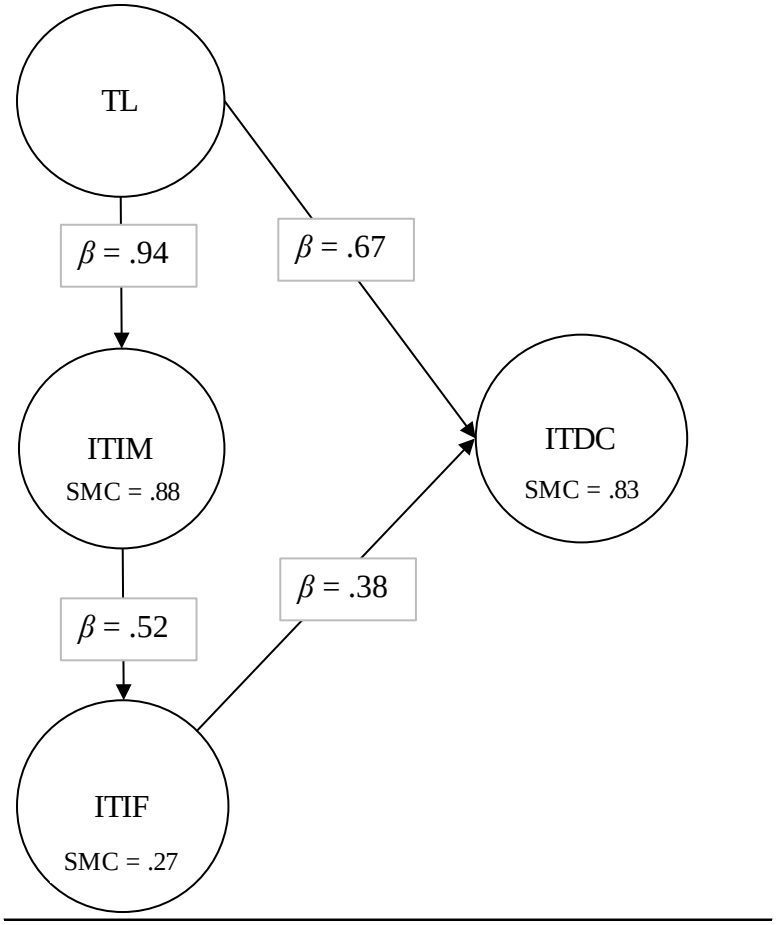
evidence of extreme multivariate collinarity between the variable and its predictor(s). Examination of the correlations between the second-order factors, presented in Table 4.19, reveals high inter-correlations between Technology Learning, IT Innovation Mindfulness, and IT Dynamic capabilities. Though high, Hair (2010, p. 687) notes that during assessment of discriminant validity, models where two separate constructs and those where two constructs' correlations have been set equal to 1 can still produce statistically significant differences in fit between models, even when high inter-construct correlations near the $r^2 = .9$ level are present. Though variance explained between the Full study's second-order factors is unusually high in some cases, assessments of both the measurement and structural model still suggest distinct and path-related constructs, though overlapping at higher factor levels. Figure 4.1 presents a summary of the standardized path coefficients and squared multiple correlation values for the Full study hypothesized model. For parsimony, only second-order factors and hypothesized relationships are shown in Figure 4.1. Standardized factor loadings, squared multiple correlation coefficients, Variance Inflation Factors (VIF), and Tolerance values are shown for the full structural model in Table 4.20.

Table 4.19 Full Study Second-Order Latent Factor Correlations

	TL	ITIM	ITIF	ITDC
TL				
ITIM	0.92			
ITIF	0.51	0.51		
ITDC	0.83	0.83	0.71	

n = 229

Note: For all correlations, $p < .001$



($\chi 2$ = 1691.93, df = 971, p ≤ .001; GFI = .76; SRMR = .09; RMSEA (90% C.I.) = .06 (.053, .062); CFI = .91)

Standardized path coefficients shown

All paths significant at $p \leq .001$

Note: **TL**: Technology Learning; **ITIM**: IT Innovation Mindfulness; **ITIF**: IT Infrastructure Flexibility; **ITDC**: IT Dynamic Capabilities

Figure 4.1 Full Study Structural Model Results – Second-Order Constructs

Table 4.20 Structural Model Results for First and Second Order Factors

Item		1st Order	β	SMC	VIF	Tolerance
ES3	<-	ES	0.85	0.72	3.52	0.28
ES2	<-	ES	0.81	0.66	2.92	0.34
ES1	<-	ES	0.76	0.58	2.38	0.42
MD3	<-	MD	0.94	0.88	8.06	0.12
MD2	<-	MD	0.86	0.74	3.83	0.26
MD1	<-	MD	0.81	0.66	2.96	0.34
KS3	<-	KS	0.85	0.71	3.50	0.29
KS2	<-	KS	0.86	0.74	3.85	0.26
KS1	<-	KS	0.68	0.46	1.85	0.54
SO4	<-	SO	0.82	0.66	2.98	0.34
SO3	<-	SO	0.71	0.50	2.00	0.50
SO1	<-	SO	0.84	0.70	3.37	0.30
RS3	<-	RS	0.78	0.61	2.54	0.39
RS2	<-	RS	0.81	0.65	2.86	0.35
RS1	<-	RS	0.86	0.74	3.89	0.26
DL4	<-	DL	0.68	0.46	1.87	0.54
DL2	<-	DL	0.85	0.72	3.57	0.28
DL1	<-	DL	0.86	0.74	3.77	0.27
PF4	<-	PF	0.62	0.38	1.62	0.62
PF3	<-	PF	0.95	0.90	9.52	0.11
PF1	<-	PF	0.80	0.63	2.73	0.37
CR4	<-	CR	0.85	0.71	3.50	0.29
CR2	<-	CR	0.82	0.67	3.05	0.33
CR1	<-	CR	0.85	0.72	3.57	0.28
SP1	<-	SP	0.93	0.86	6.90	0.15
SP2	<-	SP	0.92	0.85	6.54	0.15
SP3	<-	SP	0.90	0.81	5.13	0.20
BE1	<-	BE	0.95	0.90	9.90	0.10
BE2	<-	BE	0.91	0.83	6.02	0.17
BE3	<-	BE	0.87	0.76	4.12	0.24
RS1	<-	RI	0.90	0.82	5.49	0.18
RS2	<-	RI	0.93	0.86	7.35	0.14
RS3	<-	RI	0.90	0.81	5.18	0.19
RS4	<-	RI	0.92	0.85	6.62	0.15
AF1	<-	AF	0.91	0.84	6.10	0.16
AF2	<-	AF	0.92	0.85	6.45	0.16
AF3	<-	AF	0.76	0.58	2.39	0.42
ITI1	<-	ITI	0.64	0.41	1.70	0.59
ITI3	<-	ITI	0.95	0.90	10.31	0.10
ITI4	<-	ITI	0.94	0.88	8.33	0.12
TS1	<-	TS	0.84	0.71	3.39	0.30
TS2	<-	TS	0.80	0.65	2.82	0.35
TS4	<-	TS	0.55	0.30	1.43	0.70
ITIF3	<-	ITIF	0.87	0.76	4.13	0.24
ITIF2	<-	ITIF	0.84	0.71	3.47	0.29
ITIF1	<-	ITIF	0.77	0.60	2.47	0.41

1st Order		2nd Order	β	SMC	VIF	Tolerance
ES	<-	TL	0.63	0.39	1.65	0.61
MD	<-	TL	0.72	0.52	2.09	0.48
KS	<-	TL	0.90	0.80	5.08	0.20
SO	<-	ITIM	0.83	0.68	3.16	0.32
RS	<-	ITIM	0.82	0.68	3.12	0.32
DL	<-	ITIM	0.90	0.80	5.08	0.20
PF	<-	ITIM	0.51	0.26	1.35	0.74
CR	<-	ITIM	0.84	0.71	3.45	0.29
SP	<-	ITDC	0.72	0.52	2.07	0.48
BE	<-	ITDC	0.69	0.48	1.92	0.52
RI	<-	ITDC	0.71	0.51	2.03	0.49
AF	<-	ITDC	0.74	0.55	2.22	0.45
ITI	<-	ITDC	0.64	0.41	1.69	0.59
TS	<-	ITDC	0.64	0.40	1.68	0.60

n = 229

Note: Standardized Factor Loadings shown; All factor loadings significant ($p \leq .001$)

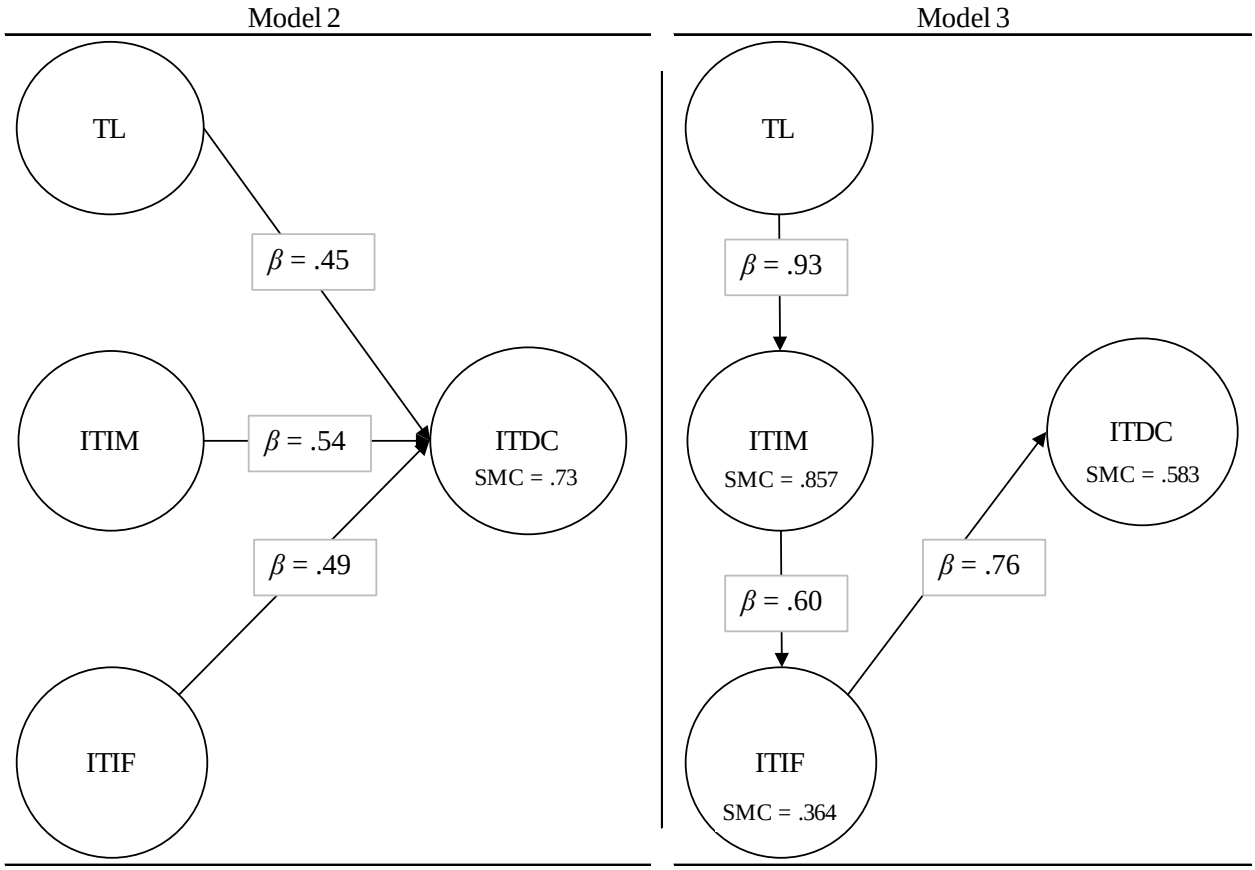
Note: **ES**: Environmental Scanning; **MD**: Member Diversity; **KS**: Knowledge Sharing; **SO**: Sensitivity to Local Operations; **RS**: Reluctance to Simplify; **DL**: Deference to Local Expertise; **PF**: Preoccupation with Failure; **CR**: Commitment to Resilience; **SP**: Strategic IT Planning; **BE**: IT Business Experience; **RI**: IT Relationship Infrastructure; **AF**: IT Application Functionality; **ITI**: IT Integration; **TS**: Technical Skills; **ITIF**: IT Infrastructure Flexibility; **ET**: Environmental Turbulence

Equivalent Models

Testing for possible alternative models was conducted, as the final step in the analysis of the hypothesized model (Gerbing & Anderson, 1988). Kline (2011) notes that equivalent or near-equivalent models should be considered, will have nearly identical fit statistics, but their consideration should be guided by the literature and theory. For the Full study, two alternative models were considered that would run counter to the relationships suggested by the research literature and those hypothesized in the study. These models are presented in Figure 4.2. Fit statistics for these models were calculated and compared to the hypothesized structural model for consideration of equivalency.

Model 1 consists of the hypothesized model for this research study and will be the model against which other potential equivalent models are tested. The calculated fit statistics and the Chi-Square difference test results for these model comparison are listed in Table 4.21. The first equivalent model tested (Model 2) removes the hypothesized relationship between Technology Learning, IT Innovation Mindfulness, and IT Infrastructure Flexibility and presumes a direct effect of all three of these second-order factors on IT Dynamic Capabilities, with no mediation. The results of the Chi-Square difference test, presented in Table 4.21, were statistically significant ($p \leq .001$), suggesting that a decrease in fit of the hypothesized model to the observed data occurred beyond that of random chance. This further suggests that Model 2 does not represent the underlying variance-covariance structure of the observed data in an equivalent fashion to Model 1. Second, a model (Model 3) was tested which allowed IT Innovation Mindfulness and IT Infrastructure Flexibility to fully mediate the relationship between Technology Learning and IT Dynamic Capabilities. The results of the Chi-Square difference test, presented in Table 4.21, show a statistically significant ($p \leq .001$) decrease in model fit between

this potential alternative model, suggesting the Full study baseline model (Model 1) provides a better representation of the variance-covariance structure in the data. Due to the high level of correlation between the second-order constructs of Technology Learning and IT Innovation Mindfulness, a fourth model was tested for equivalence. All first order factors of both constructs were allowed to load on one latent variable, and then this placed in the structural model, and labeled Model 4. The results of this chi-square difference test, presented in Table 4.21, suggest a statistically significant decrease in the model fit between our baseline model, and the TL/ITIM combined latent variable model. Results of the model comparison tests suggest that the baseline Full study model be retained for Hypothesis testing.



($\chi 2 = 1931.93$, df = 972, $p \leq .001$; GFI = .76; SRMR = .21; RMSEA (90% C.I.) = .06 (.053, .062); CFI = .91)

Standardized path coefficients shown
Note: **TL**: Technology Learning; **ITIM**: IT Innovation Mindfulness; **ITIF**: IT Infrastructure Flexibility; **ITDC**: IT Dynamic Capabilities

($\chi 2 = 1793.99$, df = 972, $p \leq .001$; GFI = .76; SRMR = .14; RMSEA (90% C.I.) = .06 (.056, .065); CFI = .91)

Standardized path coefficients shown
Note: **TL**: Technology Learning; **ITIM**: IT Innovation Mindfulness; **ITIF**: IT Infrastructure Flexibility; **ITDC**: IT Dynamic Capabilities

Figure 4.2 Potential Equivalent Study Models

Table 4.21 Chi-Square Difference Tests and Fit Statistics for Potential Equivalent Models

Model	χ^2	df	*p*- value	$\Delta\chi^2$	Δdf	*p*- value	GFI	CFI	SRMR	RMSEA	90% C.I.
1	1691.93	971	.000	--	--	--	.76	.91	.09	.06	(.053, .062)
2	1931.93	972	.000	240.00	1	.00	.74	.89	.21	.07	(.062, .070)
3	1793.99	972	.000	102.06	1	.00	.75	.90	.14	.06	(.056, .065)
4	1700.36	972	.000	8.43	1	.01	.76	.91	.09	.06	(.053, .062)

n = 229

Hypothesis Testing

The hypothesized relationships between constructs in the Full study were assessed using IBM AMOS (v.22) software through covariance-based structural equation modeling (CB-SEM). CB-SEM was preferred for this analysis due to its ability to more effectively test for model fit to the data (Rönkkö & Evermann, 2013). Further, CB-SEM is noted by the research literature as being a more confirmatory statistical method, examining hypothesized relationships using data gathered through measures based more on prior research (Gefen et al., 2011). Results from assessment of the hypothesized structural model suggest statistically significant relationships between the study constructs.

Hypothesis 1 predicts that the level of Technology Learning in the firm will have a positive relationship with the extent of IT Innovation Mindfulness present within the firm. Results from the CB-SEM analysis yielded support to Hypothesis 1 (β = .94, z = 7.17, $p \leq .001$). This result suggests that as Technology Learning routines are increasingly implemented and executed within the firm, their presence will have a positive effect on the mindfulness towards which IT innovations are considered and adopted. Hypothesis 2 predicts that the level of Technology Learning in the firm will have a positive relationship with the firm's IT Dynamic Capabilities. Results from the CB-SEM analysis yielded support to Hypothesis 2 (β = .67, z = 6.44, $p \leq .001$). This result suggests that as Technology Learning routines are increasingly implemented and executed within the organization, their presence will have a positive effect upon the ability of the firm to dynamically reconfigure their IT resources to meet new needs and challenges as presented by the competitive marketplace. Next, Hypothesis 3 predicted that the extent of IT Innovation Mindfulness within a firm would have a positive relationship with the IT Infrastructure Flexibility of the organization. Results from the CB-SEM analysis yielded support

to Hypothesis 3 (β = .52, z = 6.71, $p \leq .001$). This result suggests that as organizations increasingly adopt traits of mindfully considering all aspects of IT innovations and their appropriateness and fit within the firm after adoption, they will build and experience an increasingly flexible IT Infrastructure, one able to adapt as nimble changes are needed by the firm during competitive activities. Finally, Hypothesis 4 predicts that the increased IT Infrastructure Flexibility will have a positive relationship with the IT Dynamic Capabilities of the firm. Results from the CB-SEM analysis yielded support for Hypothesis 4 (β = .38, z = 5.86, $p \leq .001$). This result suggests that the increasing flexibility of firms' IT infrastructures has a positive effect upon the maturity and extent of the internal dynamic IT resource reconfiguration abilities of the firm. Table 4.21 presents a summary of the Hypothesis test results.

Table 4.22 Summary of Full Study Hypothesis Testing

Study Hypothesis	Findings	Result
H1: The level of Technology Learning present in the firm will have a positive relationship with the extent of IT Innovation Mindfulness within the firm.	β = .94, z = 7.17, $p \leq .001$	Supported
H2: The level of Technology Learning present in the firm will have a positive relationship with the firm's IT Dynamic Capabilities	β = .67, z = 6.44, $p \leq .001$	Supported
H3: The extent of IT Innovation Mindfulness within the firm will have a positive relationship with the IT Infrastructure Flexibility of the firm.	β = .52, z = 6.71, $p \leq .001$	Supported
H4: The level of IT Infrastructure Flexibility in the firm will have a positive relationship with the IT Dynamic Capabilities of the firm.	β = .38, z = 5.86, $p \leq .001$	Supported

n = 229

Summary

In Chapter 4, the results of the study data collection methods and analysis of hypothesized constructs was presented. The chapter summarized response rates and participant demographics from both the Pilot and Full phases of this research study. The chapter next

presented the results of statistical analysis of the data collected from the Pilot study, including item descriptive statistics and measurement instrument assessment through construct reliability and validity tests. Discussion of the modifications to the measurement instrument were next presented. Finally, results from the statistical analysis of the data collected in the Full study phase of this research were presented. Item response data descriptive statistics and results from the assessment of the Full study measurement instrument were presented, followed by assessment of the study structural model and testing of the hypothesized relationships presented in Chapter 2.

Chapter 5: Discussion

Overview

This research study was conducted in order to test and assess hypothesized relationships between the theoretical constructs of Technology Learning, IT Innovation Mindfulness, IT Infrastructure Flexibility, and the IT Dynamic Capabilities of the firm. Though examination of these relationships, we sought to clarify the underlying nature of the Absorptive Capacity construct, and note the processes which operationalize this characteristic of the firm. Chapter 4 presented the results found from both the Pilot and Full phases of the study, with analysis results suggesting all study hypotheses were supported. This chapter will discuss the results found from the dissertation. First, potential implications the results have for the research literature are discussed. Next, suggested courses of action for practitioners in business due to the results of the study are discussed. Next, study limitations are presented and potential avenues of future research are proposed. Finally, an overall summary of the study concludes the chapter.

Implications for Research

The broad focus of this dissertation research was to investigate the nature and operationalization of the absorptive capacity construct in the firm by answering the first of its research questions: *What are the underlying dimensions of the Absorptive Capacity construct?* Roberts et al. (2012) have noted the often contradictory nature of the research into absorptive

capacity in the literature, and points out the strong need for further work in this area. The absorptive capacity of the firm has been broadly defined as its ability to use prior learning to impact future learning, activities, and competitive advantage (W. M. Cohen & Levinthal, 1990; Daspit & D'Souza, 2013; Lane et al., 2006). The new learning that takes place is used to alter operational routines underlying competitive activities and to guide the gathering and processing of new knowledge in the future (W. M. Cohen & Levinthal, 1990; Lenox & King, 2004; Lyytinen & Rose, 2006; Teece & Pisano, 1994). This learning by the firm, or knowledge creation, as enhanced by the firm's absorptive capacity, are critical to helping it create and repeat competitive advantage in the market through its ability to innovate effectively (Duggan, 2012; Su et al., 2013). The firm's maturity in absorptive capacity emerges through the in-place information processing structures that facilitate knowledge movement and application in the firm, and these processes are based in the IT of the modern organization (Roberts et al., 2012).

Prior research into the nature and structure of the concept of absorptive capacity in the firm has suggested three (Lane et al., 2006; Roberts et al., 2012) to four (Pavlou & El Sawy, 2011; Zahra & George, 2002) general areas, usually consisting of knowledge *learning*, *transformation/assimilation*, and *exploitation/application/coordinating*. Prior research into the construct has found a linear relationship between these areas as information flows through the firm (Daspit & D'Souza, 2013). This dissertation study aligned its investigation of these three-to-four general areas by investigating the constructs of Technology Learning (bringing in of new knowledge), Innovation Mindfulness (the careful transformation and consideration of knowledge to organizational reality), and IT Infrastructure Flexibility along with IT Dynamic Capabilities (the exploitation and application of the knowledge). The relationship between these constructs was hypothesized to be linear in nature in alignment with prior research. Analysis of the data

gathered through the study produced results that supported all four hypothesized relationships. Study results are in alignment with Daspit and D'Souza's (2013) findings of a linear relationship and Roberts et al.'s (2012) between the three areas.

It is important to note that Pavlou and El Sawy (2011) have viewed these three/four areas of the firm as *dynamic capabilities* of the firm, while here we have viewed them in alignment with other literature as underlying dimensions of the absorptive capacity construct. The results of this study are potentially not at odds with either literature view. The results from the results of this study suggest that the hypothesized constructs do represent those processes consisting of a linear flow of knowledge, from gathering, to assimilation, and finally to application, as are theorized to make up the three areas of the absorptive capacity construct. This ability of the firm to absorb and apply knew knowledge can itself be broadly considered to be a dynamic capability of the firm (Pavlou & El Sawy, 2010, 2011). Our hypothesized construct of IT Dynamic Capabilities are specifically focused on those skillsets and firm traits allowing it to reconfigure the resources that make up its IT infrastructure (Bhatt & Grover, 2005; Byrd et al., 2006). The study results' support of the hypothesized relationship between the firm's IT dynamic capabilities and other absorptive capacity processes strengthen their position as one subset of the firm's overall dynamic capabilities. Further, the study's overall results suggest a hierarchical nature to this relationship: (1) A firm possesses dynamic capabilities which allow it to reconfigure resources and alter operational capabilities to meet new competitive needs (Pavlou & El Sawy, 2011; Teece, 2007; Winter, 2003); (2) One of these dynamic capabilities of the firm is the firm's absorptive capacity, which allows for the effective processing of knew knowledge towards its assimilation and transformation through the application of that knowledge to change internal firm processes through resource reconfiguration (W. M. Cohen & Levinthal, 1990;

Roberts et al., 2012; C. L. Wang & Ahmed, 2004; Zahra & George, 2002); and (3) the presence of this overall absorptive capacity has an impact on IT-focused dynamic resource reconfiguration capabilities (Bhatt & Grover, 2005; Byrd et al., 2006) which make up the final "application" dimension of the construct, supported by results from this study and in alignment with suggestions by Wang and Ahmed (C. L. Wang & Ahmed, 2007).

Overall, the study results support a linear relationship between multiple underlying dimensions of the absorptive capacity construct as conceptualized and investigated in prior research. The processes, traits, and resource reconfiguration skills that this study's results suggested are related in an, at least, initially linear manner, are discussed next along with their hypothesized relationships.

Technology Learning and IT Innovation Mindfulness

The knowledge possessed by the firm will have an impact on its ability to gather and eventually apply new knowledge (W. M. Cohen & Levinthal, 1990; Liang et al., 2007). Fiol and Lyles (1985) note that learning in the organization occurs through processes, and is itself part of a process of improving organizational activities through knowledge. The ability to gather knowledge through extensive search routines, especially those routines sourced in IT, is seen to promote mindfulness in the organization and drive its innovative activities (Valorinta, 2009). The literature has noted the relationship between gathering of new knowledge that takes place within the organization, or *organizational learning*, and the organization's ability to apply that knowledge mindfully (Langer, 1989; Levinthal & Rerup, 2006; Mu & Butler, 2009; Weick & Sutcliffe, 2001).

Hypothesis 1 stated that the level of IT-focused organizational learning in the firm (i.e., *technology learning*) would have a positive relationship with the extent of the traits of IT innovation mindfulness present within the firm. Technology learning was theorized as a second-

order construct consisting of three first-order factors consisting of Environmental Scanning (Lichtenthaler, 2009), firm Member Diversity and internal Knowledge Sharing (Templeton et al., 2002). IT innovation mindfulness is seen as the ability of firms to mindfully and accurately consider the local potential of an IT innovation and the organizational reality (Mu & Butler, 2009). IT innovation mindfulness was also conceptualized as a second-order factor consisting of first order factors Sensitivity to Local Operations, Reluctance to Simplify, Deference to Local Expertise, Preoccupation with Failure, and a Commitment to Resilience, all operationalized with measures from Mu and Butler (2009).

Results from this study found support for Hypothesis 1 (β = .94, z = 7.17, $p \leq .001$). These results suggest that as the level of implemented routines for technology learning within the firm increase, this increase will be positively related to the traits of mindfulness within the firm towards IT innovation adoptions. These findings yield additional evidence towards answering our third research question: *What impact does technology-focused organizational learning have upon IT innovation mindfulness?* Study results suggesting a relationship between these two also lend evidence towards these constructs acting as effective representations of the first two absorptive capacity dimensions of learning and transformation/assimilation (Lane et al., 2006; Pavlou & El Sawy, 2011; Roberts et al., 2012; Zahra & George, 2002). The literature suggests a rise in the ability of firms to learn about, mindfully consider, and adopt new IT innovations as absorptive capacity rises (Roberts et al., 2012; Saraf et al., 2013), a rise facilitated through an increase in technology learning and IT innovation mindfulness, as suggested by this study's results. The empirical support for this link, and placement of the technology learning construct within the learning dimension of absorptive capacity, also answers a need pointed out by Roberts

et al. (2012) to further investigate the relationship between organizational learning and absorptive capacity.

Technology Learning and IT Dynamic Capabilities

The knowledge that a firm gathers through its learning routines, and the learning that takes place, will be added (after transformation, if need be) to the knowledge already present in the firm and applied through changes to firm resources (W. M. Cohen & Levinthal, 1990; Lenox & King, 2004), especially those IT resources of the firm (Pavlou & El Sawy, 2010, 2011). Previous literature has shown this relationship between learning and the reconfiguration of firm resources underlays the core of the absorptive capacity construct (Pavlou & El Sawy, 2011; Roberts et al., 2012; Schwager et al., 2000; C. L. Wang et al., 2008). Wang and Ahmed (2004) note empirical studies that have pointed out various firm processes as being related to dynamic capabilities: The integration of internal and external knowledge; learning in a dynamic fashion (guided by relevance and prior learning); and the creation, absorption, reconfiguration, and integration of knowledge. These processes, related to dynamic capabilities, are related to the *sensing/learning* dimension of absorptive capacity (Roberts et al., 2012), which is itself considered by the literature to be a dynamic capability of the firm (Zahra & George, 2002). These extent of these IT capabilities, made dynamic through their reconfiguration of IT resources and routines (Pavlou & El Sawy, 2006, 2011) has been grounded by Clark et al. (1997) in IT personnel who are skilled and capable of leveraging their technology knowledge for change, a connection echoed by other literature as well (Pavlou & El Sawy, 2006; N. Wang et al., 2012).

Hypothesis 2 predicted that as the extent of technology learning processes within the firm increase, this increase will be positively related to the extent of the firm's IT dynamic capabilities. IT dynamic capabilities was conceptualized as a second-order construct loading upon six first-order factors: Strategic IT Planning and IT Integration (Byrd et al., 2006); and IT

Business Experience, IT Relationship Infrastructure, IT Application Functionality, and Technical Skills (Bhatt & Grover, 2005). Study results suggested support for Hypothesis 2 (β = .67, z = 6.44, $p \leq .001$). This results gives support to the hypothesized flow of information through the firm and through the processes that make up the dimensions of absorptive capacity, and how the gathering and dissemination of new knowledge in the firm directly and positively impacts the ability of the firm to reconfigure its IT resources. This finding that learning processes in the firm are in line with the contention by Wang and Ahmed (C. L. Wang & Ahmed, 2004) that dynamic capabilities are based by the processes in the firm, as well as being embedded in them (through the ability to reconfigure the resources used by those processes). Abraham et al. (2012) highlight the need for processes of constant learning by noting research (Pavlou & El Sawy, 2010; Vera & Crossan, 2005) that warns of the suppressive dangers to innovative and improvisational changes to firm resources that comes from heavy reliance on past information. The findings from this study show a relationship between the learning taking place in the firm and the increased ability to apply that learning through IT-focused dynamic capabilities enhancing the reconfiguration of IT-specific resources. Our study results, and the suggested relationship between learning and IT dynamic capabilities, adds strength this previously suggested link in prior research (Bowman & Ambrosini, 2003; Easterby-Smith & Prieto, 2008).

IT Innovation Mindfulness and IT Infrastructure Flexibility

Mindfulness in organizations refers to those processes and traits that heighten firm sensitivity to the competitive environment, increase their openness to new information, and make them more effective at handling unknown situations in a flexible manner (Langer, 1989; Levinthal & Rerup, 2006). Valorinta (2009) in conducting two case studies to examine mindfulness in IT-intensive organizations notes that little is known about how IT in firms impact mindfulness, stating that increased IT is likely to increase the organization's attentiveness to

(external) events and its competitive activities, increasing mindfulness at the firm level. Mu and Butler (2009) state that IT innovations are difficult to assimilate and implement into the firm due to issues such as difficulty in selecting the appropriate innovation for the firm needs and community hype behind potentially inappropriate IT innovations (Swanson & Ramiller, 2004). Organizations mindfully innovate with IT when they approach the adoption and assimilation choice in a carefully reasoned way based in the firm's specific facts and circumstances (Fiol & O'Connor, 2003; Swanson & Ramiller, 2004). Mu and Butler (2009) further note that effective choice and assimilation of an IT innovation into a firm's IT infrastructure requires a careful (i.e., mindful) consideration of the "local potential of the innovation" (2009, p. 29). Multiple studies have noted the impact that IT innovation adoption has on the IT infrastructure of the firm (C. P. Armstrong & Sambamurthy, 1999; Chau & Tam, 1997; Chau & Tam, 2000; Mu & Butler, 2009; Valorinta, 2009). The types and choices of IT innovations adopted by the firm impact the IT infrastructure's technical aspects by altering the *flexibility* aspects of connectivity, compatibility, and modularity of its various components (Bhatt & Grover, 2005; Byrd, 2001; Duncan, 1995). Investments and acquisitions in IT innovations will then contribute to the differences between firms in their ability to competitively use their IT infrastructure and the capabilities it enables (Tanriverdi, Rai, & Venkatraman, 2010).

Hypothesis 3 predicted that as the extent of the mindfulness in the firm towards IT innovations and their adoptions increases, this increase would be positively related to the flexibility of the firm in diffusing and reconfiguring the parts of its IT infrastructure. The operationalization of a measure for IT infrastructure flexibility was adapted from Bhatt and Grover (2005) and conceptualized as a first-order construct, surveying the perceptions of compatibility, modularity, and scalability of the ITIF on the part of participants. Results from the study (β = .52, z = 6.71, *p*

≤ .001) suggest support for Hypothesis 3. This finding supports the link between the mindfulness towards the adoption between an IT innovation and its successful incorporation into the IT infrastructure, as noted by Mu and Butler (2009), and suggests answers to the fourth research question of this study. Further, the IT innovation adoption will impact those aspects of IT infrastructure flexibility as noted by Duncan (1995) as well as Bhatt and Grover (2005), which affect the ability of the firm to pivot competitively through flexible IT infrastructure use (Tanriverdi et al., 2010). This empirical link between the theoretical constructs in contemporary organizations demonstrates how effective IT innovation choice and assimilation, effective through the means of the IT innovation's appropriateness for the firm specifics and competitive needs (Fiol & O'Connor, 2003; Swanson & Ramiller, 2004), can be eased through the establishment of processes and traits of mindfulness in the organization.

IT Infrastructure Flexibility and IT Dynamic Capabilities

Byrd and Turner (2000) note prior research that sets the IT infrastructure of the firm as the base upon which all the business activities and IT applications are built (Davenport & Linder, 1994; McKay & Brockway, 1989). The IT infrastructure in organizations represents all of the IT resources that are shared and leveraged throughout the firm (Broadbent, Weill, & Neo, 1999) as wells as the capabilities to both use and change those resources (Davenport & Linder, 1994; McKay & Brockway, 1989; Weill, 1993). Firms see a competitive difference in the benefits they derive from their IT capabilities due to differences in their ability to effectively implement IT within the firm (Tanriverdi et al., 2010). Those firms that have flexible IT infrastructures can, in an often rapid manner, reconfigure those resources to enable novel, digitally based, competitive options in the market (Schwager et al., 2000). Flexibility in the IT infrastructure through such aspects as modularity are also seen to increase the effectiveness of firm IT capabilities to reconfigure those resources (Ross, Weill, & Robertson, 2006) that allow the firm to match

changes in the often rapid-changing competitive landscape (Tanriverdi et al., 2010). It is these rapidly changing competitive landscapes that make the IT capabilities of the firm *dynamic,* as they enable rapid reconfiguration of IT resources within the firm to meet fast-changing market needs (Daspit & D'Souza, 2013; Pavlou & El Sawy, 2006, 2010, 2011). Wang et al. (2012) state that the IT capabilities of the firm, defined through similar activities as noted by Bhatt and Grover (2005), are anteceded in relationship by a firm's IT resources (i.e., IT infrastructure), and they are the most influential upon the competitive advantage of the firm.

The fifth and final research question of this study focused on a potential link between IT infrastructure flexibility and the dynamic IT capabilities of the firm. Hypothesis 4 predicts that as the flexibility of the IT infrastructure of the firm increases, this increase will have a positive effect on IT dynamic capabilities of the firm. Results from the analysis of the study data offered support for Hypothesis 4 (β = .38, z = 5.86, $p \leq .001$). Our finding suggests that as the firm builds an increasingly flexible IT infrastructure, guided by the mindful adoption of IT resources that are modular, compatible in terms of data connectivity and interoperability, and scalable, its ability to use the skills, relationships, and IT capability resources present in the company will increase as well. The firm will have both the skills and resources needed to flexibly meet any challenge or need posed by the market through nimble repositioning. The study results are in alignment with the expected relationship between these two constructs noted by Wang et al. (2012). Interestingly, the results of this study and its finding of an antecedent relationship of IT infrastructure flexibility to IT dynamic capabilities runs counter to previous research that found some capabilities as predictors of IT flexibility aspects such as modularity, integration, and functionality (Byrd, 2001; Byrd et al., 2006). It should be noted that these studies based their definitions of the various capabilities, as we do in this research, on Bhatt and Grover's (2005)

study, in which flexibility dimensions were noted as *IT Infrastructure Quality*, which, along with Business Experience and Relationship Infrastructure, were modeled as endogenous constructs predicted by organizational learning. We separate out aspects of IT infrastructure flexibility and posit their influential position between learning and IT dynamic capabilities, with study results offering support for this hypothesized relationship between constructs.

Byrd (2001) notes that theoretical and empirical links between the flexibility of the IT Infrastructure and the competitive advantage of the firm have not yet been established the literature. Wang et al. (2012) state that the IT resources underlying the firm's IT infrastructure impact the firm's IT dynamic capabilities, which are strongly influential upon firm competitive advantage. Though the competitive advantage of the firm was not tested in this study, its findings support this link between resources and capabilities enhancement, offering a theoretical link between the flexibility enabled by the resources of the IT infrastructure and firm competitive advantage. As the firm leverages its unique collection of knowledge (less imitable under the RBV), the resources in the IT infrastructure (more imitable under the RBV), and the IT related skills and structures in the firm necessary to reconfigure the resources guided by the knowledge possessed by the firm, its ability to meet market demands, innovate with products and services and do so faster than its competitors should see an increase.

Implications for Business

In addition to the contributions to the research literature suggested by the study findings, results suggest actionable steps that practitioners can implement to increase the mindfulness of their IT adoptions, the flexibility of their IT infrastructure, and the level of skill in executing IT

dynamic capabilities for the reconfiguration of IT resources. Over all, study findings yield evidence towards the ability of practitioners to operationalize absorptive capacity and increase the ability of their firm to gather and apply new knowledge. Whereas before the literature highlighted absorptive capacity as a more abstract, yet beneficial, concept for the firm, we have described one scenario by which certain firm processes can be seen to be involved in increasing the overall absorptive capacity of the firm.

The linear nature of the absorptive capacity processes starts, initially, with the gathering and dissemination of knowledge throughout the firm. CIO's have previously noted in qualitative research (Cegielski & Rebman, 2003; Cegielski et al., 2005) that organizational learning processes enabling continuous review of emerging information technology, creating local IT-based resources for sharing information, and leaning on internal expert advice are all steps that firms can take to alleviate decision maker cognitive load. These steps align with the study's theoretical first-order factors of Environmental Scanning, Knowledge Sharing, and Member Diversity (which increases the quantity of internal IT experts), respectively. Organizations that purposefully commit resources towards the scanning and gathering of IT related knowledge from the market will be better able to discern fit of potential IT innovations to the company, its local specifics, and its strategic goals. As absorptive capacity's drives new learning through the influence of the learning that has previously occurred, a purposeful policy of hiring a personnel base with IT-diverse backgrounds increases the amount of learning present in the firm, further enabling it to deem newly encountered knowledge relevant (or future relevant) to the firm and its technology needs. A diverse IT personnel base, with resources and routines dedicated to gathering knowledge from the environment, can then ensure benefits of this focused knowledge

search to all corners of the company through the dedication of technical and policy resources for knowledge sharing within the firm.

Importantly, prior IS research has noted that more knowledge does not necessarily mean better decision making. As suggested by the study results, benefits to the IT infrastructure and its flexibility can be achieved through the mindful consideration of the increased knowledge repository of the firm. Decision makers within the firm can be faced with pressures, from both without and within, to adopt a specific IT innovation. In the cases where the choice to adopt from several IT innovations is voluntary, the IT executive in the firm and those involved in the decision making process can use the information gathered through scanning routines to fully consider all the local specifics of the organization. Will the innovation be a good fit for the firm? Is it compatible with our current technology infrastructure, or its potential future needs?

Practitioners can take steps to ensure that firm members have as accurate and "big" a picture of the organization, its operations, its status, and the jobs of its co-workers as possible to increase the ability of decision makers to mindfully consider firm specifics. Further, decision makers can unpack claims surrounding both the IT innovation and the status of the local specifics of the organization by an increased reluctance to simply during the decision making process. Encouragement for personnel to question firm activities, to be skeptical of assumed "facts" until unpacked, and to challenge "old-way" of performing organizational routines all help to decrease reliance on cognitively-simplified organizational realities. With increased diversity of IT personnel, those involved in IT innovation adoption decisions can mindfully defer to firm expertise to help unpack claims surrounding a new IT resource under investigation. Mindfulness of local specifics also enhances the sensitivity to failures, both past and potentially in the future,

and how the innovation under consideration would potentially be impacted by, and possibly exacerbate, failures.

Mindfulness towards the adoption of IT innovations can help to increase the fit between those technologies under consideration, the current IT infrastructure, and the potential future competitive needs of the organization. Building up an IT infrastructure with innovations that are appropriate and that take into careful consideration the possible future needs will help to increase the flexibility of the firms IT resources through enhanced qualities such as modularity, compatibility, and scalability. The increased learning, and more importantly, the focused and relevance-guided learning the firm undertakes through purposeful technology scanning routines will impact the firm's ability to skillfully reconfigure the IT resources that make up its IT infrastructure. This learning through scanning, member diversity, and knowledge sharing will positively impact the IT dynamic capabilities of the firm through an increase in the technical skills of IT personnel, the ability to configure application resources for modularity and reuse, and the ability to ensure compatibility and integration of resources. As knowledge of local firm specifics increase, and as the IT infrastructure becomes increasingly flexible, the knowledge of what *can* be done in terms of IT resource reconfigurations, and *how* to perform those reconfigurations will enhance the strategic planning for IT resources within the firm. The sharing of knowledge and increase in awareness of company operations and strategic goals will increase the business experience of the IT personnel, as IT increasingly coordinates with other areas of the firm. As coordination increases, the relationship between the IT executive team and the firm executive team will improve as well, with trust improving and continued communication and co-accountability between organization management staff improve.

Study Limitations

Several study limitations could potentially influence both the generalizability and the interpretation of the study results. First, the 1.22% response rate limits the generalizability of the results of the study. This suggests that of the target population, our study was only able to gather responses from an under-representative proportion of those IT executives daily engaged in IT innovation adoption decisions. Though the study meets the minimum response of 200 observations for a covariance-based structural equation modeling analysis (Gefen et al., 2011), it falls short of commonly suggested observation-to-parameter ratios (e.g. 10:1 (Kline, 2011, p. 12)) estimating a model with 110 parameters. In addition, a large percentage of our survey respondents self-reported the primary competitive industry of their firm as “Education” (33.48%), potentially adding further bias in the study’s suggestion how learning and innovation activity occurs within the firm.

Next, the design of the study is seen as a limitation to the generalizability and interpretation of the results. Participants were randomly chosen but purposefully included in the respondent population based on job title. This has the potential to introduce bias in the results gathered from the respondents. Additionally, the study instrument consisted of measures of respondent perceptions of the theoretical constructs within the organizations. Secondary data gathered from firms who responded would have increased the validity of interpretation of response data. Finally, the cross-sectional nature of the study may fail to adequately capture the nature of interactions that occur between the processes that make up the absorptive capacity construct, which Roberts et al. (2012) notes can feature a feedback learning loop.

Finally, the presence of multicollinearity in our response data may inflate the standard error of our parameter estimates and reduce their interpretability (J. Cohen, Cohen, West, &

Aiken, 2003). Grewal, Cote, and Baumgartner (2004) note that the true impact of multicollinearity on an SEM analysis is not well known, and is debated in both the statistical and management/marketing literatures. As R^2_{smc} , composite reliability, and sample sizes increase, along with confirmation of discriminant validity in the measurement model, the effect of multicollinarity on parameter estimates, and thus the risk of committing a Type-II error, decreases. (Grewal et al., 2004). We found high values for these values, in addition to the results suggesting discriminant validity in the measurement model. Finally, multicollinearity influences individual parameter estimates, but not the overall level of variance explained in the model, limiting its presence's impact values of R^2_{smc} or model fit statistics (Burnham & Anderson, 2002; J. Cohen et al., 2003), potentially limiting its impact on the results of the assessment of the study structural model.

Future Research

As noted by Roberts et al. (2012), research conducted by Todorova and Durisin (2007) suggests a looping nature to the absorptive capacity construct. As the firm learns and applies that learning, it will then potentially learn from the application of previously gathered knowledge and adjust the learning and application routines that underlay its absorptive capacity, i.e., double-loop learning (Argyris & Schön, 1999; Hall, Paradice, & Courtney, 2003). To succinctly study the impact that technology learning and IT innovation mindfulness processes have upon the firms IT infrastructure and its capabilities for dynamic IT resource reconfiguration, a longitudinal study would be preferred. This type of long-term study would allow for the investigation of specific

changes that occur in the absorptive capacity processes from end-to-end, and to fully understand the impact IT has upon these, and vice versa.

Prior research has noted the difficulty and simultaneous importance of researching theoretical constructs such as dynamic capabilities and its related areas (C. Helfat & Peteraf, 2009; Teece, 2007). In conducting Harmon's Single-Factor test (Gefen et al., 2011; Podsakoff et al., 2003) on this study's measurement instrument, a factor solution (nine) different from that of the number of theorized first-order constructs (14) emerged. Also, moderate correlations exist between our first-constructs as found in the Full study's CFA analysis. Taken together, these results suggest that future research should continue efforts to refine and adapt the measurement instrument used in this study to attempt a broad measure of the absorptive capacity construct. Though some measurement instrument development has occurred for the theoretical constructs used in this study, further work is needed to determine the proper and distinct factor-structure of our constructs and to minimize the overlap between measurement items and first-order factors, an overlap noted by research such as Roberts et al. (2012).

Finally, an additional data gathered through a limited number of case studies or secondary data collections from firms and their IT adoption decision making staff could improve future research efforts in both areas described above. Mixed-methods research, the combination of both quantitative and qualitative methods, has seen a growth in IS research in recent decades (Mingers, 2001, 2003). Though we leverage the operationalization of several constructs previously investigated and used in the research literature to a certain extent, the weaknesses in the study design and results as described above limited the interpretability and generalizability of such a large and encompassing theoretical model. In addition, from the review of the relevant literature, this is the first study to attempt an investigation of these constructs in a unified model.

With this understanding, we propose that future studies gather data on this model from multiple sources through multiple methods in ensuring triangulation of the constructs investigated in this study and delineating their nature (Webb, Campbell, Schwartz, & Sechrest, 1966). Clarification of the nature of the relationships among our theorized constructs through multi-method future mixed studies will help to bolster study findings and reduce any claims of non-interpretability due to study weaknesses (Salehi & Golafshani, 2010). Newer qualitative-quantitative mixed techniques such as Qualitative Comparative Analysis (QCA) using configurational comparative methods (Rihoux & Ragin, 2009) could potentially generate information on IT infrastructure configurations that, while differing from firm to firm, yield equifinal outcomes of high levels of mindfulness, flexibility, and IT dynamic capability extent.

Conclusion

At a broad level, we investigated the processes that underlay the theoretical concept known as the Absorptive Capacity of the firm. This concept, defined as the ability of the firm to use prior learning to guide both near learning and application of the knowledge, has received mixed attention in the information systems literature. Even less research attention has been focused on the identification of those processes and/or traits of the firm that can be implemented and enhanced to improve the absorptive capacity capability of the firm. After a review of the related literature, we formulated five research questions in order to better define the nature and reality of absorptive capacity in the firm and the processes that underlay it. Organizational, IT-related processes of Technology Learning, IT Innovation Mindfulness, and IT Infrastructure Flexibility / IT Dynamic Capabilities were found to align with the literature-defined absorptive

capacity structures of Learning, Transformation/Assimilation, and Application, respectively. Hypothesized relationships between these constructs were formed, and a measurement instrument developed from adapted scales drawn from previous research.

The study was conducted in three phases: (1) a small Face/Content validity check phase where researchers with industry experience in the areas of information technology and management reviewed the initial measurement instrument, with changes recommended and made; (2) a Pilot study where the measurement instrument was administered and linked through an IRB-approved recruitment email to a random sample of 5,000 professionals, including Chief Executive Officers, IT professionals, and small business owners, with additional IT professionals recruited directly. Data from 109 responses were used to refine the measurement instrument; and (3), a Full study was conducted with 18,833 IT executives recruited to participate in the study. 229 responses were evaluated using covariance-based structural equation modeling (CB-SEM), and results of the analysis suggested support for all four hypothesized construct relationships.

The study findings contribute to the research literature through investigation of the absorptive capacity construct as a whole, as well as a focus on those processes founds through the study results to underlay this firm capability, as well as the relationships between them. Practical implications for the firm are many, as study results suggest numerous actionable steps that the practitioner can take to improve the overall absorptive capacity of the firm through process implementation in many areas.

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Appendix A: Participant List Queries

(1) COMPUSTAT database:

```
%let wrds=wrds.wharton.upenn.edu 4016;
options comamid=TCP remote=WRDS;
signon username=_prompt_;
rsubmit;

libname sastemp '/sastemp1';

proc sql;
create table work.iqdata as
select firstName, lastName, emailAddress, wrds_professional.companyname,
wrds_professional.title from ispeople, ciq.wrds_professional where ispeople.yearBorn > 1960
AND currentProFlag = 1 AND ispeople.emailAddress is not missing;
quit;

proc export data = work.iqdata outfile='/sastemp1/ciqperson.csv';
run;

*proc print data=work.iqdata (obs=10);
* run a procedure to print everything in output file, 10 obs;
*run;

endrsubmit;
```

(2) Microsoft Access Criteria Field for SELECT query from above extracted professionals table

```
Like '*information*' Or Like '*technology*' Or Like '*cto*' Or Like '*Chief Technology
Officer*' Or Like '*cio*' Or Like '*Chief Information Officer*' Or Like '*Vice President of
Information Technology*' Or Like '*Vice President of IT*' Or Like '*VP of IT*' Or Like
'*data*' Or Like '*innovation*' Or Like '*digital*' Or Like '*visionary*' Or Like
'*knowledge*' Or Like '*information technology*' Or Like '*computer*' Or Like
'*computing*' Or Like '*CEO*' Or Like '*chief executive officer*' Or Like '*owner*'
```

Appendix B: Pilot and Full Study Measurement Instrument Comparisons

Construct:	Dimension:	Item (Pilot Study)	Item (Full Study)
Technology Learning	Environmental Scanning	We scan the competitive environment for new technologies very frequently	
		We thoroughly observe all technological trends	
		We monitor external sources of information on new technology in detail	
		We thoroughly collect information on new technologies used in our industry[1]	
	Member Diversity	My company maintains a wide mix of technology skills through its hired pool of employees.	
		The company hires personnel who are highly knowledgeable about technology.	
		The company acquires subunits (such as smaller companies, spin-offs, or start-ups) to gain technical knowledge[2]	My company improves its technology knowledge through purposeful hiring of employees with diverse technology experience.
	Knowledge Sharing	When employees need specific information, they know exactly where in the organization they can find it.	
		Employees are fully aware of how the company can benefit from their knowledge.	
		Employees feel completely free to share information (e.g., numbers, plans, and ideas) with other company employees.[2]	Employees in our company feel encouraged to share information (e.g., ideas, news, and plans) with fellow employees.
		When employees need expertise different from their own, they know exactly where to find it.[1]	

Construct:	Dimension:	Item (Pilot Study)	Item (Full Study)
IT Innovation Mindfulness	Sensitivity to Local Operations	Staff here are very familiar with company operations beyond their immediate jobs.	
		Employees in our company frequently discuss company-wide operational issues with each other.[1]	
		Our management team fully understands what employees do from day to day.	
		Our staff are fully aware of the nature of each other's jobs.	
	Reluctance to Simplify	Personnel in our company are strongly encouraged to question the way things are done in regards to a new technology.	
		Personnel in our company are very willing to change the 'status quo' in regards to a new technology.	
		Our company greatly appreciates skepticism on the part of its personnel in regards to a new technology's claimed benefits.	
		Personnel in our company feel very free to prolong their analysis of a new technology's problem.[1]	
	Deference to Local Expertise	Personnel in our company have great respect for each other's expertise. Personnel in our company are asked to contribute their expertise to problems very frequently.	
		Internal personnel with expertise are asked to help solve company problems very frequently.[1]	
		Our company seeks out the expertise of internal personnel in resolving problems first before seeking outside help.[2]	Personnel in our company are consulted regarding problems first before outside help is sought.
	Preoccupation with Failure	We take mistakes, even small ones, very seriously.	

Construct:	Dimension:	Item (Pilot Study)	Item (Full Study)
		Close calls are very frequently seen as mistakes to be learned from.[1]	
		We very strongly recognize failures as impactful on individual departments and the company as a whole.	
		Personnel in our company very frequently collaborate in examining failures and sub-optimal performances	
	Commitment to Resilience	Personnel in our company can always rely on each other in case of problems.	
		Personnel in our company never give up on solving problems.	
		Management in our company are very concerned with developing the skills and knowledge of our personnel.[1]	
		Personnel in our company feel very free to ask others for help in solving any problem that arises.	
IT Dynamic Capabilities	Strategic IT Planning	Our company has extensively developed criteria for implementing ongoing changes in its Information Technology (IT) architecture.	
		Our company has extensively implemented a plan for a company-wide Information Technology (IT) architecture that reflects strategic goals.	
		Our company has a extensively developed planning process for its Information Technology (IT) architecture.	
		Our company has extensively developed a business continuity / disaster recovery plan based upon its Information Technology (IT).[1]	

Construct:	Dimension:	Item (Pilot Study)	Item (Full Study)
	IT Business Experience	Information Technology (IT) personnel in our company are very knowledgeable about the company's Business Strategy.	
		Information Technology (IT) personnel in our company are very knowledgeable about the company's Strategic Priorities	
		Information Technology (IT) personnel in our company are very knowledgeable about the company's Business Policies	
		Information Technology (IT) personnel in our company are very knowledgeable about how to initiate change within the company.[1]	
	IT Relationship Infrastructure	Our Information Technology (IT) staff and our company's Management staff trust each other in setting Business and IT Strategy.	
		Our Information Technology (IT) staff and our company's Management staff consult each other in setting Business and IT Strategy.	
		Our Information Technology (IT) staff and our company's Management staff are accountable to each other in setting Business and IT Strategy.	
		Our Information Technology (IT) staff and our company's Management staff have great respect for each other in setting Business and IT Strategy.	
	IT Application Functionality	The applications in our company are designed to be extensively reusable.	

Construct:	Dimension:	Item (Pilot Study)	Item (Full Study)
		Reusable software modules are extensively used in new systems development.	
		Information Technology personnel use object-oriented technologies to minimize new application development time very frequently.[2]	Information Technology personnel use object-oriented technologies to minimize new application development time.
		Legacy systems within our company do not restrict the development of new, reusable applications.[1]	
	IT Integration	Our company has a high level of Information Technology (IT) integration.	
		Our company has a high level of Communications Technology integration.[1]	
		Our company has extensively implemented connectivity between its distributed facilities (regional, national, or international technology resources).	
		Our company has a high level of Data Communications between its central and distributed facilities (regional, national, or international technology resources).	
	Technical Skills	Our IT personnel are very skilled in multiple programming languages	
		Our IT personnel are very skilled in developing web-based applications	
		Our IT personnel are very skilled with Business Intelligence technologies (e.g., big data, data mining, data warehousing, etc.).[2]	Our IT personnel are very skilled with the technology used within our company.
		Our IT personnel are very skilled in network management and maintenance.[1]	

Construct:	Dimension:	Item (Pilot Study)	Item (Full Study)
	IT Infrastructure Flexibility	Our Information Technology systems are extensively compatible with each other.	
		Our Information Technology systems are extensively modular	
		Our Information Technology systems are extensively scalable	
		Our Information Technology systems are extensively transparent	
		Our Information Technology systems can extensively handle multiple applications.[1]	
		Our Information Technology systems extensively use common industry IT standards.[1]	
	Environmental Turbulence	Products or services become obsolete very quickly in our industry The technology-related products and services in our industry change very quickly.[1]	
		We cannot predict what our competitors are going to do next.[1]	
		We cannot predict when our product and services demands from customers will change.[1]	
	Job Title		What is your Job Title / Position Title at your company?
	Employee Count	Employee Count: Please indicate the number of employees in your company:	
	Gross Revenue	Gross Revenue: Please indicate the gross revenue for your company in the last fiscal year:	
		(0-$500,000; $500,000 - $1 Million; $1 Million - $10 Million; $10 Million - $20 Million; $20 Million - $50 Million; $50 Million - $100 Million; $100 Million - $500 Million; $500 Million +)	

Construct:	Dimension:	Item (Pilot Study)	Item (Full Study)
	IT Officer Reporting	IT Officer Reporting: To whom does the top Information Technology officer in your company report? (CEO, P, VP, COO, CFO, Other _____)	
	Firm's Primary Industry	Industry: Please select your company's primary industry: (Agriculture, Banking, Business Services, Communications, Construction, Education, Finance, Government, Health Services, Insurance, Investment, Legal, Manufacturing, Mining, Real Estate, Retail, Technology, Transportation, Utilities, Wholesale, [Other: _____]	

[1] Item was dropped from instrument for Full Study

[2] Item was reworded to more closely match its construct's definition

Appendix C: Pilot and Full Study Initial Recruitment Email

Hello!

I am a doctoral candidate in the Department of Aviation and Supply Chain Management in Auburn University's College of Business. I would like to invite you to participate in my research study, which is being conducted to investigate the effect that learning about technology has on Information Technology innovation adoption, IT skills, and IT infrastructure flexibility in the firm. You are invited to participate in this study if you are currently employed in an IT or Management-related position within an organization.

As a participant, you will be asked to complete a short survey with questions about how your company learns about technology and makes decisions regarding its adoption. Your total time commitment to complete the task and survey will be approximately 10 – 15 minutes. There are no risks associated with participation in this study and your responses will remain anonymous. You may withdraw from the study at any time.

If you would like to participate in this study, you may click on the survey link below

[URL link to survey]

Or you may copy and paste the following URL into your browser:

Also, you may allow another person to take this survey as well by forwarding them this link: https://auburn.qualtrics.com/SE/?SID=SV_effgrRNVGXd0YMR

If you have any questions whatsoever, please contact me at 1-334-844-6537 or jde0009@auburn.edu, or you may contact my faculty advisor, Dr. Terry Byrd, at 1-334-844-6543 or byrdter@auburn.edu.

Thank you so much for your consideration and time!

Jeremy D. Ezell
Doctoral Candidate
Department of Aviation and Supply Chain Management
Auburn University
Phone: 1-334-844-6537
Email: jde0009@auburn.edu

Follow the link to opt out of future emails.
Click here to unsubscribe

Appendix D: Pilot Study Follow-up Recruitment Email

We need your help!

I am a doctoral candidate in the Department of Aviation and Supply Chain Management in Auburn University's College of Business. Prior to today you received a link to a research study, and I would again like to invite you to participate in this critical research which is being conducted to investigate the effect of technology scanning/learning on Information Technology innovation adoption, IT skills, and IT infrastructure flexibility in the firm. You are invited to participate in this study if you are currently employed in an IT related position in industry.

As a participant, you will be asked to complete a short survey with questions about how your company learns about technology and makes decisions regarding its adoption. Your total time commitment to complete the task and survey will be approximately 10 – 15 minutes. There are no risks associated with participation in this study and your responses will remain anonymous. You may withdraw from the study at any time.

If you would like to participate in this study, you may click on the survey link below

[URL link to experimental treatment]

Or you may copy and paste the following URL into your browser:

If you have any questions whatsoever, please contact me, Jeremy Ezell, at 1-334-844-6537 or jde0009@auburn.edu, or you may contact my faculty sponsor, Dr. Terry Byrd, at 1-334-844-6543 or byrdter@auburn.edu.

Thank you so much for your consideration.

Jeremy D. Ezell
Doctoral Candidate
Department of Aviation and Supply Chain Management
Auburn University
Phone: 1-334-844-6537
Email: jde0009@auburn.edu

Follow the link to opt out of future emails.
Click here to unsubscribe

Appendix E: Final Full Study Follow-up Recruitment Email

We need your help!

I am a Ph.D. candidate in the Department of Aviation and Supply Chain Management in Auburn University's College of Business. Prior to today you received a link to a research study, and I would again like to invite you to participate in this critical research which is being conducted to investigate the effect of technology scanning/learning on Information Technology innovation adoption, IT skills, and IT infrastructure flexibility in the firm. You are invited to participate in this study if you are currently employed in an IT related position in industry.

As a participant, you will be asked to complete a short survey with questions about how your company learns about technology and makes decisions regarding its adoption. Your total time commitment to complete the task and survey will be approximately 10 – 15 minutes. There are no risks associated with participation in this study and **your responses will remain anonymous**. You may withdraw from the study at any time.

You may request a **Summary Report** of this study's findings by contacting me directly and requesting one.

If you would like to participate in this study, you may click on the survey link below. The IRB-Approved Information Letter for this study can be found on the first page of the survey:
https://auburn.qualtrics.com/SE/?SID=SV_3gUVfzMPoffBUwZ

If you have any questions whatsoever, please contact me at 1-334-844-6537 or jde0009@auburn.edu, or you may also contact my faculty advisor, Dr. Terry Byrd, at 1-334-844-6543 or byrdter@auburn.edu.

Thank you for your consideration and very valuable time!

Jeremy D. Ezell
Doctoral Candidate – Information Systems
Department of Aviation and Supply Chain Management
Auburn University
Phone: 1-334-844-6537
Email: jde0009@auburn.edu

Click this link to opt out of future emails:
[Qualtrics opt-out auto-generated link]

Appendix F: Pilot Study Survey Instrument

Thank you for taking the time to participate in our survey!

Please click the "Next Page" button below to begin.
Your total time commitment to finish the survey is estimated to be **10-15 minutes *or less*!**

If you wish, you may review the Information Letter for this study here (Opens in new window/tab).

Your participation is voluntary and all data collected will remain **completely anonymous**.

Jeremy D. Ezell - jde0009@auburn.edu
Terry A. Byrd - byrdter@auburn.edu
Raymond J. Harbert College of Business
Auburn University

AUBURN UNIVERSITY
RAYMOND J. HARBERT COLLEGE OF BUSINESS

Survey Completion
0% 100%

Next Page -->

Survey Powered By Qualtrics

The statements below assess the extent to which your company monitors technology in the market.

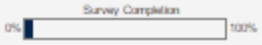
	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
We scan the competitive environment for new technologies very frequently.	○	○	○	○	○	○	○
We thoroughly observe all technological trends.	○	○	○	○	○	○	○
We monitor external sources of information on new technology in great detail.	○	○	○	○	○	○	○
We thoroughly collect information on new technologies used in our industry.	○	○	○	○	○	○	○

The statements below assess the extent to which your company hires employees with diverse technology skill sets.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
My company maintains a wide mix of technology skills through its hired pool of employees.	○	○	○	○	○	○	○
The company hires personnel who are highly knowledgeable about technology.	○	○	○	○	○	○	○
The company acquires subunits (such as smaller companies, spin-offs, or start-ups) to gain technical knowledge.	○	○	○	○	○	○	○

The statements below assess the extent to which your company shares information and knowledge internally.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
When employees need specific information, they know exactly where in the organization they can find it.	○	○	○	○	○	○	○
Employees are fully aware of how the company can benefit from their knowledge.	○	○	○	○	○	○	○
Employees feel completely free to share information (e.g., numbers, plans, and ideas) with other company employees.	○	○	○	○	○	○	○
When employees need expertise different from their own, they know exactly where to find it.	○	○	○	○	○	○	○



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The statements below assess the extent to which your company is sensitive to internal operations and activities.

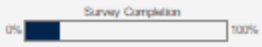
	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Staff here are very familiar with company operations beyond their immediate jobs.	○	○	○	○	○	○	○
Employees in our company frequently discuss company-wide operational issues with each other.	○	○	○	○	○	○	○
Our management team fully understands what employees do from day to day.	○	○	○	○	○	○	○
Our staff are fully aware of the nature of each others jobs.	○	○	○	○	○	○	○

The statements below assess the extent to which your company refuses to take technology information and claims at "face value."

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Personnel in our company are strongly encouraged to question the way things are done in regards to new technology.	○	○	○	○	○	○	○
Personnel in our company are very willing to challenge the 'status quo' in regards to new technology.	○	○	○	○	○	○	○
Our company greatly appreciates skepticism on the part of its personnel in regards to new technology's claimed benefits.	○	○	○	○	○	○	○
Personnel in our company feel very free to prolong their analysis of a new technology's benefit towards a problem.	○	○	○	○	○	○	○

The statements below assess the extent to which your company defers to its internal employee technology experts.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Personnel in our company have great respect for each others' technology expertise.	○	○	○	○	○	○	○
Personnel in our company are asked to contribute their technology expertise to problems very frequently.	○	○	○	○	○	○	○
Internal personnel with technology expertise are asked to help solve company problems very frequently.	○	○	○	○	○	○	○
Our company seeks out the technology expertise of internal personnel in resolving problems first before seeking outside help.	○	○	○	○	○	○	○



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The statements below assess the extent to which your company is sensitive to errors and sub-optimal performance.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
We take mistakes, even small ones, very seriously.	○	○	○	○	○	○	○
Close calls are very frequently seen as mistakes to be learned from.	○	○	○	○	○	○	○
We very strongly recognize failures as being impactful on individual departments and the company as a whole.	○	○	○	○	○	○	○
Personnel in our company very frequently collaborate in examining failures and sub-optimal performances.	○	○	○	○	○	○	○

The statements below assess the extent to which your company is committed to resiliency against future errors.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Personnel in our company can always rely on each other in case of problems.	○	○	○	○	○	○	○
Personnel in our company never give up on solving problems.	○	○	○	○	○	○	○
Management in our company are very concerned with developing the skills and knowledge of our personnel.	○	○	○	○	○	○	○
Personnel in our company feel very free to ask others for help in solving any problem that arises.	○	○	○	○	○	○	○

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The statements below assess the extent to which your company engages in strategic Information Technology (IT) planning.

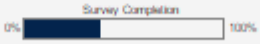
	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Our company has extensively developed plans for implementing ongoing changes in its Information Technology (IT).	○	○	○	○	○	○	○
Our company has extensively implemented a plan for a company-wide Information Technology (IT) that reflects strategic goals.	○	○	○	○	○	○	○
Our company has a extensively developed planning process for its Information Technology (IT).	○	○	○	○	○	○	○
Our company has extensively developed a business continuity / disaster recovery plan based upon its Information Technology (IT).	○	○	○	○	○	○	○

The statements below assess the extent to which your company's Information Technology (IT) personnel have business experience and knowledge of the firm.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Information Technology (IT) personnel in our company are very knowledgeable about the company's Business Strategy.	○	○	○	○	○	○	○
Information Technology (IT) personnel in our company are very knowledgeable about the company's Strategic Priorities.	○	○	○	○	○	○	○
Information Technology (IT) personnel in our company are very knowledgeable about the company's Business Policies.	○	○	○	○	○	○	○
Information Technology (IT) personnel in our company are very knowledgeable about how to initiate change within the company.	○	○	○	○	○	○	○

The statements below assess the extent to which your company's Information Technology (IT) personnel and management staff communicate and coordinate.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Our Information Technology (IT) staff and our company's Management staff trust each other in setting Business and IT Strategy.	○	○	○	○	○	○	○
Our Information Technology (IT) staff and our company's Management staff consult each other in setting Business and IT Strategy.	○	○	○	○	○	○	○
Our Information Technology (IT) staff and our company's Management staff are accountable to each other in setting Business and IT Strategy.	○	○	○	○	○	○	○
Our Information Technology (IT) staff and our company's Management staff have great respect for each other in setting Business and IT Strategy.	○	○	○	○	○	○	○



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The statements below assess the functionality and nature of your company's Information Technology (IT) applications.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
The applications in our company are designed to be extensively reusable.	○	○	○	○	○	○	○
Reusable software modules are extensively used in new systems development.	○	○	○	○	○	○	○
Information Technology personnel use object-oriented technologies to minimize new application development time very frequently.	○	○	○	○	○	○	○
Legacy systems within our company do not restrict the development of new, reusable applications	○	○	○	○	○	○	○

The statements below assess the integrated nature of your company's technology.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Our company has a high level of Information Technology (IT) integration.	○	○	○	○	○	○	○
Our company has a high level of Communications Technology integration.	○	○	○	○	○	○	○
Our company has extensively implemented connectivity between its distributed facilities (regional, national, or international technology resources).	○	○	○	○	○	○	○
Our company has a high level of Data Communications between its central and distributed facilities (regional, national, or international technology resources).	○	○	○	○	○	○	○

The statements below assess the technical skills and capabilities of your company's Information Technology (IT) personnel.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Our IT personnel are very skilled in multiple programming languages.	○	○	○	○	○	○	○
Our IT personnel are very skilled in developing web-based applications.	○	○	○	○	○	○	○
Our IT personnel are very skilled with Business Intelligence technologies (e.g., big data, data mining, data warehousing, etc.).	○	○	○	○	○	○	○
Our IT personnel are very skilled in network management and maintenance.	○	○	○	○	○	○	○

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The statements below assess the overall flexibility of your company's Information Technology (IT) infrastructure.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Our Information Technology (IT) systems are extensively compatible with each other.	○	○	○	○	○	○	○
Our Information Technology (IT) systems are extensively modular.	○	○	○	○	○	○	○
Our Information Technology (IT) systems are extensively scalable.	○	○	○	○	○	○	○
Our Information Technology (IT) systems can extensively handle multiple applications.	○	○	○	○	○	○	○
Our Information Technology (IT) systems extensively use common industry IT standards.	○	○	○	○	○	○	○

The statements below assess the extent of turbulence and change in your company's competitive environment.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Products or services become obsolete very quickly in our industry.	○	○	○	○	○	○	○
The technology-related products and services in our industry change very quickly.	○	○	○	○	○	○	○
We cannot predict what our competitors are going to do next.	○	○	○	○	○	○	○
We cannot predict when our product and services demands from customers will change.	○	○	○	○	○	○	○

Please estimate the number of employees total in your company:

▼

Please estimate the Gross Revenue of your company in the last fiscal year:

▼

To whom in your company does the top Information Technology officer report to?

▼

If you answered "Other" to the above reporting question, please enter the position title here:

Please select the primary industry in which your company operates/competes:

▼

If you answered "Other" on the previous Industry question, please enter your company's primary competitive industry here:

Survey Completion

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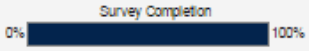
Thank you for completing our survey! Your anonymous responses have been recorded.

If you would like a Summary Report of the results from this survey, please click here to email the Primary Investigator and request a copy.



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Appendix G: Information Letter and Full Study Survey Instrument

AUBURN UNIVERSITY

Thank You! Please review the below IRB Approved Information Letter at your convenience and click the "Next Page" button at the bottom if you wish to participate in the study.

Jeremy Ezell (jde0009@auburn.edu), Auburn University

www.auburn.edu

The Auburn University Institutional Review Board has approved this document for use from 9/28/14 to 9/27/15 Protocol # 14-310 EP 1409

AUBURN UNIVERSITY

RAYMOND J. HARBERT
COLLEGE OF BUSINESS
DEPARTMENT OF AVIATION & SUPPLY CHAIN MANAGEMENT

INFORMATION LETTER

"Impact of Technology Learning and Mindfulness on the IT Dynamic Capabilities of the Firm."

You are invited to participate in a research study to investigate the effect of technology scanning/learning on Information Technology innovation adoption, IT skills, and IT infrastructure flexibility in the firm. This study is being conducted by Jeremy Ezell, doctoral candidate, under the direction of Dr. Terry A. Byrd, Professor of Information Systems the Department of Aviation and Supply Chain Management in the Auburn University College of Business. You were selected as a possible participant in this study because you are currently employed in an IT-related position and you are of 19 years of age or older.

What will be involved if you participate? Your participation in this study is completely voluntary. If you decide to participate in this study, you will be briefed on a technology purchasing scenario and asked to make a recommendation among purchasing choices. We ask that you complete the study at home, at your convenience. Your total time commitment will be approximately 10 – 15 minutes.

Are there any risks or discomforts? There are no risks or discomfort associated with participation in the study. Keep in mind that you can withdraw from this study at any time.

Are there any benefits to yourself or others? There are no personal benefits associated with participation in this study.

Will you receive compensation for participating? There is no compensation for participating in the study.

Are there any costs? There are no anticipated costs associated with participation in this study.

If you change your mind about participating, you may withdraw from this study at any time. Your participation is completely voluntary.

403 Lowder Hall
Auburn, AL 36849-5247

Telephone:
(334) 844-4908

Fax:
(334) 844-4927

All data collected as part of this study will be completely anonymous. We will protect your privacy and the data you provide by not collecting any personally identifiable information from you. The data collected in this study may be used in a publication in an academic journal and/or presentation at a professional conference.

If you have any questions about this study, please contact Jeremy Ezell at 334-844-6537 or jde0009@auburn.edu, or contact Dr. Terry Byrd at 334-844-6543 or byrdter@auburn.edu.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone at (334)844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION ABOVE, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, PLEASE CLICK ON THE LINK BELOW.
YOU MAY PRINT A COPY OF THIS LETTER TO KEEP

Jeremy D. Ezell Jeremy D. Ezell

Investigator **Date** **Printed Name**

Terry A. Byrd Terry A. Byrd

Co-Investigator or Faculty Advisor **Date** **Printed Name**

The Auburn University Institutional Review Board has approved this document for use from September 28, 2014 to September 27, 2015. Protocol #14-310 EP 1409.

LINK TO SURVEY

Next Page -->

Survey Completion
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The statements below assess the extent to which your company monitors technology in the market.

Please rate your level of agreement with each of the following:

	Strongly Disagree			Agree			Strongly Agree
We scan the competitive environment for new technologies very frequently.	○	○	○	○	○	○	○
We thoroughly observe all technological trends.	○	○	○	○	○	○	○
We monitor external sources of information on new technology in great detail.	○	○	○	○	○	○	○

The statements below assess the extent to which your company hires employees with diverse technology skill sets.

Please rate your level of agreement with each of the following:

	Strongly Disagree			Agree			Strongly Agree
My company maintains a wide mix of technology skills through its hired pool of employees.	○	○	○	○	○	○	○
The company hires personnel who are highly knowledgeable about technology.	○	○	○	○	○	○	○
My company improves its technology knowledge through purposeful hiring of employees with diverse technology experience.	○	○	○	○	○	○	○

The statements below assess the extent to which your company shares information and knowledge internally.

Please rate your level of agreement with each of the following:

	Strongly Disagree			Agree			Strongly Agree
When employees need specific information, they know exactly where in the organization they can find it.	○	○	○	○	○	○	○
Employees are fully aware of how the company can benefit from their knowledge.	○	○	○	○	○	○	○
Employees in our company feel encouraged to share information (e.g., ideas, news, and plans) with fellow employees.	○	○	○	○	○	○	○

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Survey Completion

0% 100%

The statements below assess the extent to which your company is sensitive to internal operations and activities.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Staff here are very familiar with company operations beyond their immediate jobs.	○	○	○	○	○	○	○
Our management team fully understands what employees do from day to day.	○	○	○	○	○	○	○
Our staff are fully aware of the nature of each others jobs.	○	○	○	○	○	○	○

The statements below assess the extent to which your company refuses to take technology information and claims at "face value."

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Personnel in our company are strongly encouraged to question the way things are done in regards to new technology.	○	○	○	○	○	○	○
Personnel in our company are very willing to challenge the 'status quo' in regards to new technology.	○	○	○	○	○	○	○
Our company greatly appreciates skepticism on the part of its personnel in regards to new technology's claimed benefits.	○	○	○	○	○	○	○

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Survey Completion
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The statements below assess the extent to which your company defers to its internal employee technology experts.

Please rate your level of agreement with each of the following:

	Strongly Disagree			Agree			Strongly Agree
Personnel in our company have great respect for each others' technology expertise.	○	○	○	○	○	○	○
Personnel in our company are asked to contribute their technology expertise to problems very frequently.	○	○	○	○	○	○	○
Personnel in our company are consulted regarding problems first before outside help is sought.	○	○	○	○	○	○	○

The statements below assess the extent to which your company is sensitive to errors and sub-optimal performance.

Please rate your level of agreement with each of the following:

	Strongly Disagree			Agree			Strongly Agree
We take mistakes, even small ones, very seriously.	○	○	○	○	○	○	○
We very strongly recognize failures as being impactful on individual departments and the company as a whole.	○	○	○	○	○	○	○
Personnel in our company very frequently collaborate in examining failures and sub-optimal performances.	○	○	○	○	○	○	○

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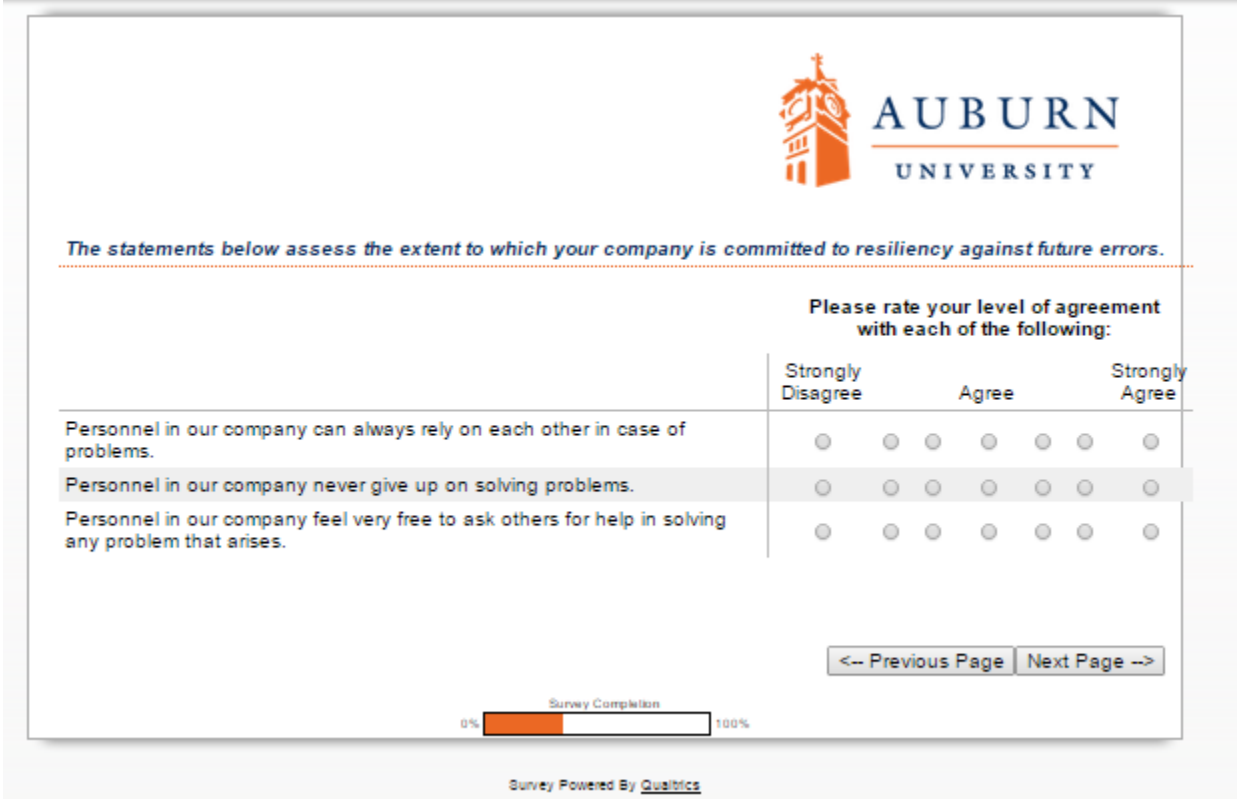
AUBURN
UNIVERSITY
The statements below assess the extent to which your company is committed to resiliency against future errors.
Please rate your level of agreement with each of the following:
Strongly Disagree
Agree
Strongly Agree
Personnel in our company can always rely on each other in case of problems.
Personnel in our company never give up on solving problems.
Personnel in our company feel very free to ask others for help in solving any problem that arises.
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The statements below assess the extent to which your company engages in strategic Information Technology (IT) planning.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Our company has extensively developed plans for implementing ongoing changes in its Information Technology (IT).	○	○	○	○	○	○	○
Our company has extensively implemented a plan for a company-wide Information Technology (IT) that reflects strategic goals.	○	○	○	○	○	○	○
Our company has an extensively developed planning process for its Information Technology (IT).	○	○	○	○	○	○	○

The statements below assess the extent to which your company's Information Technology (IT) personnel have business experience and knowledge of the firm.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Information Technology (IT) personnel in our company are very knowledgeable about the company's Business Strategy.	○	○	○	○	○	○	○
Information Technology (IT) personnel in our company are very knowledgeable about the company's Strategic Priorities.	○	○	○	○	○	○	○
Information Technology (IT) personnel in our company are very knowledgeable about the company's Business Policies.	○	○	○	○	○	○	○

The statements below assess the functionality and nature of your company's Information Technology (IT) applications.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
The applications in our company are designed to be extensively reusable.	○	○	○	○	○	○	○
Reusable software modules are extensively used in new systems development.	○	○	○	○	○	○	○
Information Technology personnel use object-oriented technologies to minimize new application development time very frequently.	○	○	○	○	○	○	○

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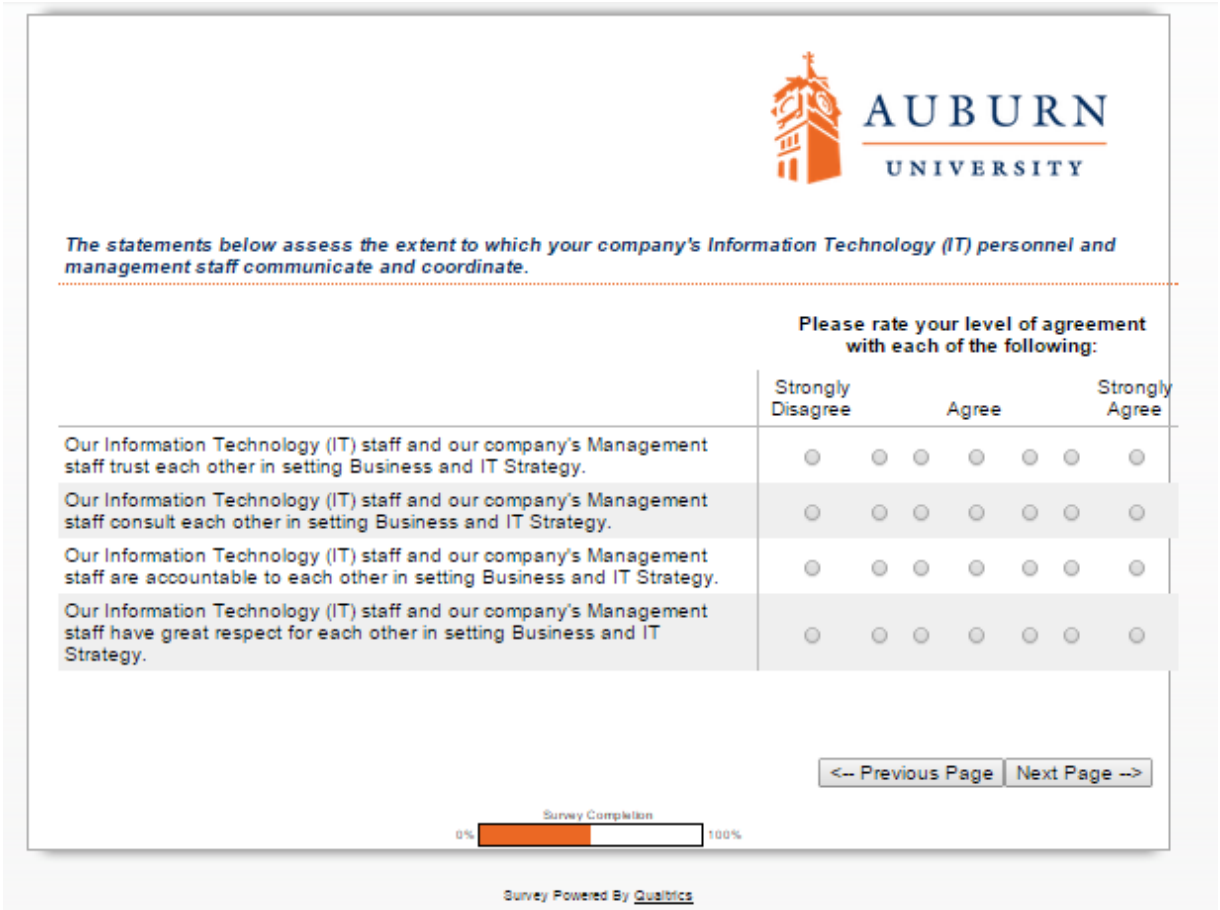
AUBURN
UNIVERSITY
The statements below assess the extent to which your company's Information Technology (IT) personnel and management staff communicate and coordinate.
Please rate your level of agreement with each of the following:
Strongly Disagree
Agree
Strongly Agree
Our Information Technology (IT) staff and our company's Management staff trust each other in setting Business and IT Strategy.
Our Information Technology (IT) staff and our company's Management staff consult each other in setting Business and IT Strategy.
Our Information Technology (IT) staff and our company's Management staff are accountable to each other in setting Business and IT Strategy.
Our Information Technology (IT) staff and our company's Management staff have great respect for each other in setting Business and IT Strategy.
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The statements below assess the integrated nature of your company's technology.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Our company has a high level of Information Technology (IT) integration.	○	○	○	○	○	○	○
Our company has extensively implemented connectivity between its distributed facilities (regional, national, or international technology resources).	○	○	○	○	○	○	○
Our company has a high level of Data Communications between its central and distributed facilities (regional, national, or international technology resources).	○	○	○	○	○	○	○

The statements below assess the technical skills and capabilities of your company's Information Technology (IT) personnel.

	Please rate your level of agreement with each of the following:						
	Strongly Disagree			Agree			Strongly Agree
Our IT personnel are very skilled in multiple programming languages.	○	○	○	○	○	○	○
Our IT personnel are very skilled in developing web-based applications.	○	○	○	○	○	○	○
Our IT personnel are very skilled with the technology used within our company	○	○	○	○	○	○	○

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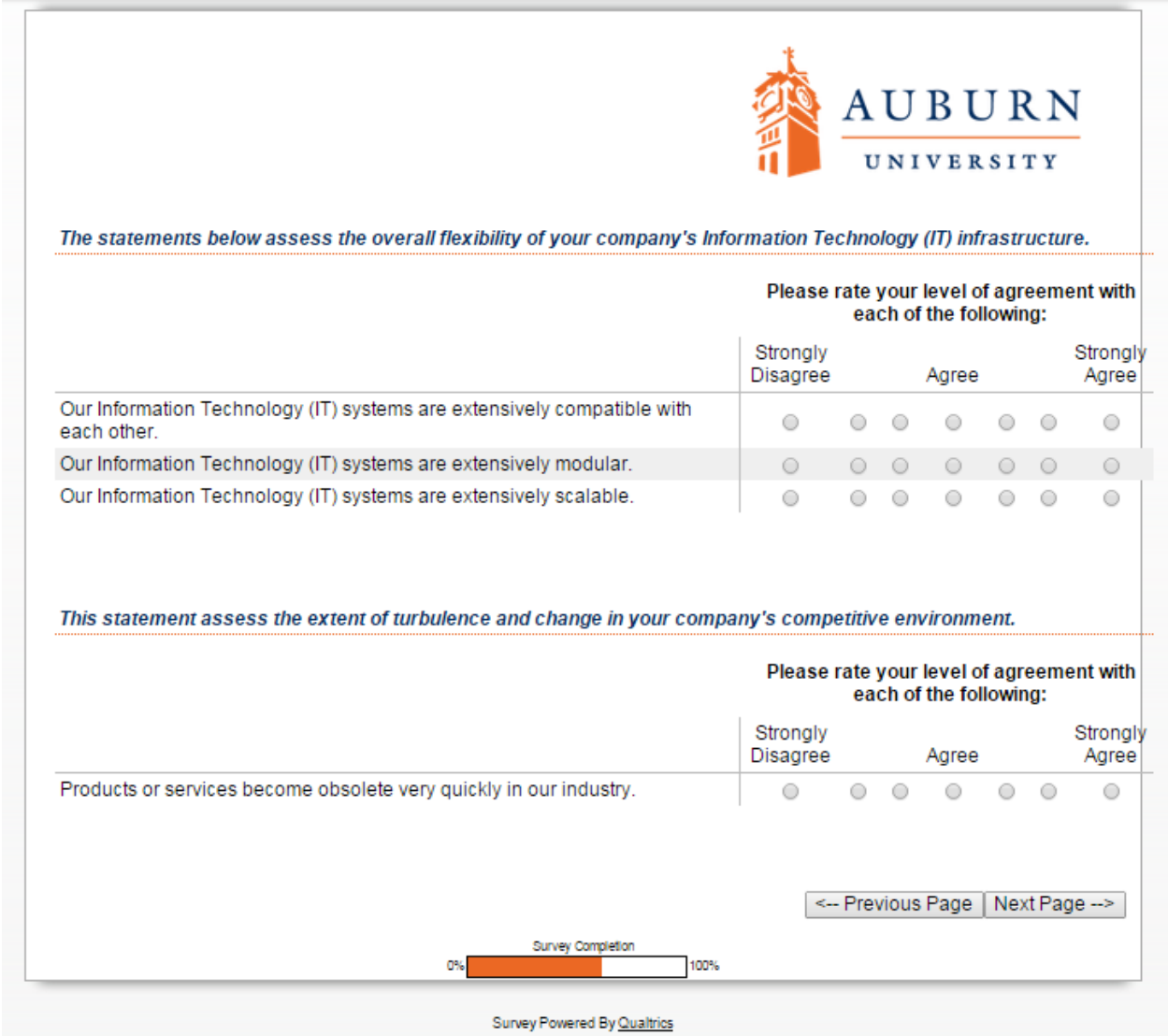
AUBURN
UNIVERSITY
The statements below assess the overall flexibility of your company's Information Technology (IT) infrastructure.
Please rate your level of agreement with each of the following:
Strongly Disagree
Agree
Strongly Agree
Our Information Technology (IT) systems are extensively compatible with each other.
Our Information Technology (IT) systems are extensively modular.
Our Information Technology (IT) systems are extensively scalable.
This statement assess the extent of turbulence and change in your company's competitive environment.
Please rate your level of agreement with each of the following:
Strongly Disagree
Agree
Strongly Agree
Products or services become obsolete very quickly in our industry.
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Demographic Information:

What is your Job Title / Position Title at your company?

Please estimate the number of employees total in your company:

Please estimate the Gross Revenue of your company in the last fiscal year:

To whom in your company does the top Information Technology officer report to?

If you answered "Other" to the above reporting question, please enter the position title here:

Please select the primary industry in which your company operates/competes:

If you answered "Other" on the previous Industry question, please enter your company's primary competitive industry here:

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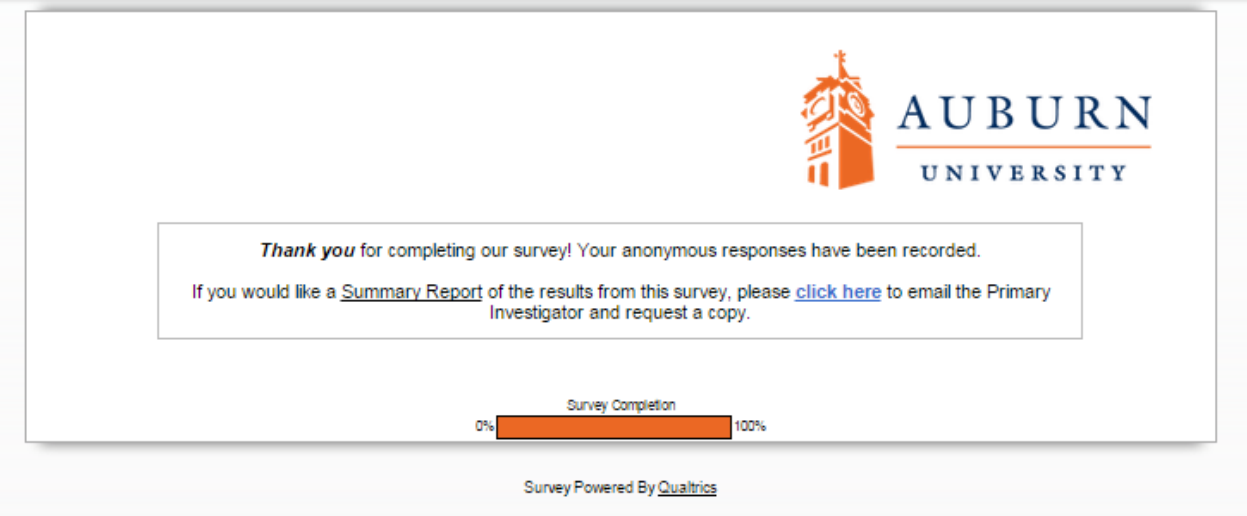
AUBURN
UNIVERSITY
Thank you for completing our survey! Your anonymous responses have been recorded.
If you would like a Summary Report of the results from this survey, please click here to email the Primary Investigator and request a copy.
Survey Completion
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Appendix H: Study IRB Approval Notification

Jeremy Ezell

From:	IRB Administration <irbadmin@auburn.edu>
Sent:	Thursday, October 09, 2014 10:09 AM
To:	Jeremy Ezell
Cc:	Joe Hanna; Terry Byrd
Subject:	Approval, Protocol # 14-310 EP 1409
Attachments:	Investigators Responsibilities rev 1-2011.docx

Use IRBsubmit@auburn.edu for protocol-related submissions and IRBadmin@auburn.edu for questions and information.
The IRB only accepts forms posted at https://cws.auburn.edu/vpr/compliance/humansubjects/?Forms and submitted electronically.

Dear Mr. Ezell,

Your protocol entitled " Impact of Technology Learning and Mindfulness on the IT Dynamic Capabilities of the Firm " has received approval as "Expedited" under federal regulation 45 CFR 46.110(7).

Official notice:
This e-mail serves as official notice that your protocol has been approved. A formal approval letter will not be sent unless you notify us that you need one. By accepting this approval, you also accept your responsibilities associated with this approval. Details of your responsibilities are attached. Please print and retain.

Electronic Information letter:
You may begin your study using the information letter to which you have already added the IRB approval information. Please add a date beside your printed name. *Please send us the actual electronic letter with a **live link** for our files.*

Expiration:
Your protocol **will expire on September 27, 2015**. Put that date on your calendar now. About three weeks before that time you will need to submit a final report or renewal request.

If you have any questions, please let us know.

Best wishes for success with your research!
Susan

IRB / Office of Research Compliance
115 Ramsay Hall (basement)
Auburn University, AL 36849
(334) 844-5966
irbadmin@auburn.edu *(for general queries)*
irbsubmit@auburn.edu *(for protocol submissions)*
844-5966

Appendix I: Respondent Reported Top IT Officer's Direct Supervisor - Full Study

Reported Position	Frequency
"Agency Director"	1
"Assistant Director for Adminitration"	1
"Board of County Commissioners"	1
"Board of Directors"	1
"CFO and Academic VP"	1
"Chairman"	1
"Chief Academic Officer"	2
"Chief Administrative Officer"	1
"Chief Adminstrative Officer"	1
"Chief Financial Officer & Executive Steering Committee"	1
"Chief Operations Officer AND Chief Financial Officer"	1
"County Administrator"	1
"County Board"	1
"County Board Chairman"	1
"County Commissioners - 3 of them"	1
"CTO"	1
"Dean"	1
"Deputy City Manager"	1
"Director"	1
"Director of Strategic Initiatives and Institutional Effectiveness"	1
"Executive Vice Chanellor"	1
"Executive VP and Provost+"	1
"Finance Director"	1
"GM"	1
"God"	1
"He is the CEO, does not report to anybody!"	1
"President & Secretary Treasurer"	1
"Provost"	4
"Superintendent"	2
"Superintendent (Highest Title in the School District)"	1
"Superintendent Of Schools"	1
"Vice President for Academic Affairs"	1
"Vice President of Academic Affairs"	1
Used Survey Instrument Reporting Category	191
Total	229

Appendix J: Primary Competitive Industry as Reported by Full Study Respondents

Respondent Reported Industry	Frequency
"Aerospace Defense"	1
"Airport / Aviation"	1
"Also retail, mortgage and insurance"	1
"asp provider - social work applications"	1
"Biotechnology/Pharmaceutical"	1
"Broadcast TV and Radio"	1
"Construction equipment sales, service and rental"	1
"Construction, Shipbuilding, Cement & Manufacturing"	1
"Consulting"	1
"Digital Content"	1
"Digital Marketing"	1
"Direct Selling"	1
"Engineering / Construction and Supply Chain"	1
"Entertainment/Sports"	1
"Environmental Testing, Asbestos, Micro, food, raddio(	1
"Higher Education"	1
"Hospitality"	4
"non-profit agency providing services to children"	1
"Political Research"	1
"Religous Organization/Church"	1
"Venture Capital & New Business Creation"	1
Used Survey Instrument Reporting Category	205
Total	229

Appendix K: Full Study Respondent Reported Job Titles

Position Description	Frequency	Percent
"CIO"	35	15.28%
"Chief Information Officer"	17	7.42%
"CTO"	11	4.80%
"Director of IT"	10	4.37%
"IT Director"	9	3.93%
"IT Manager"	6	2.62%
"Director"	5	2.18%
"Director of Information Technology"	5	2.18%
"Chief Technology Officer"	2	0.87%
"Director of Information Systems"	2	0.87%
"Director, IT"	2	0.87%
"Information Systems Manager"	2	0.87%
"IT Administrator"	2	0.87%
"Vice President"	2	0.87%
"Adjunct professor/consultant (retired CIO & Director-IT Services)"	1	0.44%
"Assoc VP"	1	0.44%
"Associate Chief Information Officer"	1	0.44%
"Associate CIO"	1	0.44%
"Associate Vice President / Chief Information Officer"	1	0.44%
"Associate Vice President, Technology Solution Services (CIO)"	1	0.44%
"Branch Manager, Planning & IT"	1	0.44%
"CEO"	1	0.44%
"Cheif Informaion Officer"	1	0.44%
"Chief Information Office"	1	0.44%
"Chief Information Officer and Vice President"	1	0.44%
"cio"	1	0.44%
"CIO & Principal Consultant"	1	0.44%
"CIO and SVP"	1	0.44%
"CIO/VP"	1	0.44%
"Co-founder"	1	0.44%
"Country IT manager"	1	0.44%
"County Administrator"	1	0.44%
"CTDO Chief Technical and Development Officer"	1	0.44%
"Curriculum Technology Specialist"	1	0.44%
"Dean"	1	0.44%
"Dean CIS"	1	0.44%
"Deputy CIO"	1	0.44%
"Deputy CIO and CTO"	1	0.44%
"Directir,IT"	1	0.44%
"Director Information Systems and Telecommunications"	1	0.44%
"Director Information Technology"	1	0.44%
"Director IT"	1	0.44%

Position Description	Frequency	Percent
"Director of Clinical Operations"	1	0.44%
"Director of Information Services Infrastructure"	1	0.44%
"Director of Information Technology Services"	1	0.44%
"director of it"	1	0.44%
"Director of Technology Services"	1	0.44%
"Director Technology"	1	0.44%
"Director, Engineering Services"	1	0.44%
"Director, Information Technology"	1	0.44%
"Director, IT Infrastructure Services"	1	0.44%
"EVP & CIO"	1	0.44%
"EVP Operations"	1	0.44%
"Executive Director Finance and Information Systems"	1	0.44%
"Executive Manager Of Information Technology"	1	0.44%
"Executive V.P. of Systems/Supply Chain"	1	0.44%
"Executive Vice President CIO"	1	0.44%
"Generl Manager, IT"	1	0.44%
"Global Channel Manager"	1	0.44%
"Global IT Director"	1	0.44%
"Group CIO"	1	0.44%
"I. S. Manager"	1	0.44%
"Information Systems & Technology Manager"	1	0.44%
"Information Systems Director"	1	0.44%
"Information Technology Administrator"	1	0.44%
"Information Technology Director"	1	0.44%
"Instructional Designer (former Director of IT)"	1	0.44%
"IS/IT Regional Manager, Americas"	1	0.44%
"IT director"	1	0.44%
"It Manager"	1	0.44%
"IT Support Manager"	1	0.44%
"Managing Director"	1	0.44%
"MIS Coordinator"	1	0.44%
"Network Administrato"	1	0.44%
"Network Administrator"	1	0.44%
"pres"	1	0.44%
"Principal"	1	0.44%
"Principal Leader Program Management"	1	0.44%
"Professor and director"	1	0.44%
"project manager"	1	0.44%
"Senior Director"	1	0.44%
"Senior Director, Application Development"	1	0.44%
"Senior General Manager - Special Projects"	1	0.44%
"Senior Manager of Technology Operations"	1	0.44%
"Senior Network Administrator"	1	0.44%

Position Description	Frequency	Percent
"Senior Program Director Science, Technology, Engineering and Mathematics (STEM)"	1	0.44%
"Senior Vice President"	1	0.44%
"Senior Vice President and Chief Information Officer"	1	0.44%
"Senior VP of IT"	1	0.44%
"Software development"	1	0.44%
"Sr. vice president"	1	0.44%
"State CIO"	1	0.44%
"SVP & CIO"	1	0.44%
"SVP Global Operations"	1	0.44%
"SVP-CIO"	1	0.44%
"SVP/CIO"	1	0.44%
"Technology director"	1	0.44%
"Technology Service Supervisor"	1	0.44%
"ti director"	1	0.44%
"Treasurer/CIO"	1	0.44%
"Unit Manager - Enterprise Architecture"	1	0.44%
"Vice President - Information Systems"	1	0.44%
"Vice President an Chief Information Officer"	1	0.44%
"Vice President and Chief Information Officer"	1	0.44%
"Vice President and CIO"	1	0.44%
"Vice President CIO"	1	0.44%
"Vice President for Library and Information Serivces"	1	0.44%
"Vice President for Operations and CIO"	1	0.44%
"Vice President for Technology"	1	0.44%
"Vice President Information Technology"	1	0.44%
"Vice President of Information Technology"	1	0.44%
"Vice President, Information management"	1	0.44%
"VP"	1	0.44%
"VP for technology"	1	0.44%
"VP & CIO"	1	0.44%
"VP Application Development"	1	0.44%
"VP Coordination"	1	0.44%
"VP for Information Technology"	1	0.44%
"VP for Libraries and Information Technology"	1	0.44%
"VP Info Systems"	1	0.44%
"VP IT and CIO"	1	0.44%
"VP MIS"	1	0.44%
"VP of Administration & IT"	1	0.44%
"VP of IT"	1	0.44%
"Vp of Technology (higherst ranking Technology officer (no CTO or CIO)"	1	0.44%
"VP Technology & Development"	1	0.44%
"VP, IT"	1	0.44%

Position Description	Frequency	Percent
"VP,CIO"	1	0.44%
"VP/CIO"	1	0.44%
Did Not Report a Job Title	4	1.75%
Total	229	